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United States Nuclear Regulatory Commission

Protecting People and the Environment

NUREG-1938

Draft Environmental Impact Statement for the Proposed GE-Hitachi Global Laser Enrichment LLC Facility in Wilmington, North Carolina

Draft Report for Comment

Office of Federal and State Materials and
Environmental Management Programs

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Environmental Management Programs

COMMENTS ON DRAFT REPORT

Any interested party may submit comments on this report for consideration by the NRC staff. Comments may be accompanied by additional relevant information or supporting data. Please specify the report number NUREG-1938, draft, in your comments, and send them by August 9, 2010 to the following address:

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Division of Administrative Services
U.S. Nuclear Regulatory Commission
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Electronic comments may be submitted to the NRC by e-mail at GLE.EIS@nrc.gov.

For any questions about the material in this report, please contact:

Jennifer Davis
TWFN T8 F-5
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001
Phone: 301-415-3835
E-mail: Jennifer.Davis@nrc.gov

ABSTRACT

On January 30, 2009, General Electric (GE)-Hitachi Global Laser Enrichment LLC (GLE) submitted an environmental report to the U.S. Nuclear Regulatory Commission (NRC) for a license to construct, operate, and decommission the GLE Global Laser Enrichment Facility. The proposed GLE Facility would be located in the North-Central Sector of the existing GE property near Wilmington, North Carolina. The proposed GLE Facility, if licensed, would enrich uranium for use in commercial nuclear fuel for power reactors. Feed material would be comprised of non-enriched uranium hexafluoride (UF_6). GLE would employ a laser-based enrichment process to enrich uranium to up to eight percent uranium-235 by weight, with an initial planned maximum target production of six million separative work units (SWUs) per year. GLE expects to begin preconstruction activities in 2011. If the license is approved, GLE would expect to begin facility construction in 2012, and continue some construction activities through 2017. GLE anticipates commencing initial production in 2013 and reaching peak production in 2017. Prior to license expiration in 2052, GLE would seek to renew its license to continue operating the facility, or plan for the decontamination and decommissioning of the facility per the applicable licensing conditions and NRC regulations. The proposed GLE Facility would be licensed in accordance with the provisions of the *Atomic Energy Act*. Specifically, an NRC license under Title 10, “Energy,” of the *U.S. Code of Federal Regulations* (10 CFR) Parts 30, 40, and 70 would be required to authorize GLE to possess and use special nuclear material, source material, and byproduct material at the proposed GLE site.

This draft Environmental Impact Statement (EIS) was prepared in compliance with the *National Environmental Policy Act* and the NRC regulations for implementing the Act (10 CFR Part 51). This draft EIS evaluates the potential environmental impacts of the proposed action and reasonable alternatives. This draft EIS also describes the environment potentially affected by GLE’s proposal, presents and compares the potential environmental impacts resulting from the proposed action and alternatives, and describes GLE’s environmental monitoring program and mitigation measures.

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EXECUTIVE SUMMARY

BACKGROUND

Pursuant to Title 10 of the *U.S. Code of Federal Regulations* (10 CFR) Parts 30, 40, and 70, the U.S. Nuclear Regulatory Commission (NRC) is considering whether to issue a license that would allow General Electric (GE)-Hitachi Global Laser Enrichment LLC (GLE) to possess and use special nuclear material, source material, and byproduct material at a proposed laser-based uranium enrichment facility near Wilmington, North Carolina. The scope of activities to be conducted under the license would include the construction, operation, and decommissioning of the proposed GLE Facility. GLE submitted its Environmental Report (GLE, 2008) to the NRC on January 30, 2009, and the license application was submitted on June 26, 2009. To support its licensing decision on the proposed GLE Facility, the NRC's implementing regulations in 10 CFR Part 51 for the *National Environmental Policy Act* (NEPA) require the preparation of an Environmental Impact Statement (EIS). The development of this draft EIS is based on the NRC staff's review of information provided by GLE, the NRC staff's independent analyses, and consultation with other Federal agencies, American Indian tribes and organizations, State agencies, and local agencies.

The enriched uranium produced at the proposed GLE Facility would be used to manufacture nuclear fuel for commercial nuclear power reactors. Enrichment is the process of increasing the concentration of the naturally occurring and fissionable uranium-235 isotope. Uranium ore usually contains approximately 0.72 percent uranium-235 by weight. To be useful in nuclear power plants as fuel for electricity generation, uranium must be enriched to approximately 3–5 percent uranium-235 by weight.

THE PROPOSED ACTION

The proposed action considered in this draft EIS is for GLE to construct, operate, and decommission a laser-based uranium enrichment facility, the proposed GLE Facility, at a site near Wilmington, North Carolina. If the NRC would issue a license to GLE, the license would authorize GLE to possess and use special nuclear material, source material, and byproduct material at the proposed GLE Facility for a period of 40 years. If the license is granted, the proposed GLE Facility would be located in the North-Central Sector of the existing GE property near Wilmington, North Carolina.

The proposed GLE Facility would employ a laser-based enrichment process to enrich uranium to up to 8 percent uranium-235 by weight (although nuclear power reactors normally require three to five percent uranium-235 by weight), with an initial planned maximum target production of 6 million separative work units (SWUs) per year. GLE expects to begin preconstruction activities in 2011. If the license is approved, GLE would expect to begin facility construction in 2012, and continue construction activities though 2017. GLE anticipates commencing initial production in 2013 and reaching peak production in 2017. Prior to license expiration in 2052, GLE would decide to either seek to renew its license to continue operating the facility, or plan for the decontamination and decommissioning of the facility per the applicable licensing conditions and NRC regulations.

PURPOSE OF AND NEED FOR THE PROPOSED ACTION

The purpose of the proposed action is for GLE to construct and operate a facility to enrich uranium up to 8 percent uranium-235 by weight, with a production capacity of 6 million SWU per year, using laser-based technology at the proposed GLE Facility near Wilmington, North Carolina. This facility would provide an additional domestic source of low-enriched uranium to be used in commercial nuclear power plants.

Nuclear power currently supplies approximately 20 percent of the nation's electricity. The United States Enrichment Corporation (USEC) is currently the sole U.S. supplier of low-enriched uranium for nuclear fuel in the United States. However, the National Enrichment Facility (NEF) near Eunice, New Mexico and the American Centrifuge Plant (ACP) in Piketon, Ohio, both currently under construction, would also be expected to provide enrichment services in the future. USEC has one operating enrichment plant near Paducah, Kentucky, which supplies approximately 10–15 percent of the current U.S. demand for low-enriched uranium. USEC also imports downblended (diluted) weapons-grade uranium from Russia to supply an additional 38 percent of the U.S. demand. The remaining 47–52 percent is imported from foreign suppliers. The current dependence on a single U.S. supplier and foreign sources for low-enriched uranium imposes reliability risks for the nuclear fuel supply to U.S. nuclear power plants. The production of enriched uranium at the proposed GLE Facility would be equivalent to about 40 percent of the current and projected demand (16 million SWU) for enrichment services within the United States.

ALTERNATIVES

The NRC staff considered a reasonable range of alternatives, including the no-action alternative, in this draft EIS. Two of the alternatives, the proposed action and the no-action alternative, were analyzed in detail. Under the no-action alternative, the proposed GLE Facility would not be constructed, operated, and decommissioned. Enrichment services would continue to be performed by existing domestic and foreign uranium enrichment suppliers. However, the NEF and ACP, and potentially another enrichment facility that is currently under NRC review (AREVA's proposed Eagle Rock Enrichment Facility [EREF]), would also be expected to provide enrichment services in the future.

GLE considered 22 sites throughout the United States, evaluating them based on various technical, safety, economic, and environmental criteria. GLE concluded that the site considered in the proposed action met all of the criteria and none of the other candidate sites were obviously superior to the preferred site near Wilmington, North Carolina. The NRC staff has reviewed the GLE site selection process and determined that it is rational and objective, and that its results are reasonable. Therefore, no other site was analyzed further in this draft EIS.

The NRC staff examined three alternatives to satisfy domestic enrichment needs, including (1) reactivation of the Portsmouth Gaseous Diffusion Plant near Piketon, Ohio, (2) downblending of high-enriched uranium, and (3) purchase of low-enriched uranium from foreign sources. These alternatives were eliminated from further consideration based on reliability, excessive energy consumption, national energy policy objectives, and national energy security concerns.

The NRC staff also evaluated several alternative technologies to the laser-based enrichment process, including electromagnetic isotope separation, liquid thermal diffusion, gaseous diffusion, atomic vapor laser isotope separation, molecular laser isotope separation, and gas centrifuge. All of these technologies, except gas centrifuge, were eliminated from further consideration based on the technologies' maturity and economic viability. The environmental impacts of gas centrifuge technology were qualitatively evaluated, relative to those of the proposed laser-based technology. Although gas centrifuge is a technologically and economically viable alternative, it is not obviously superior to the laser-based technology that GLE has chosen to pursue for the proposed action.

The NRC staff also evaluated alternative conversion and disposition methods for depleted uranium hexafluoride (UF_6), including (1) beneficial use of depleted UF_6 and (2) conversion at facilities other than the new facilities that the U.S. Department of Energy (DOE) is constructing at Portsmouth, Ohio, and Paducah, Kentucky. For the purposes of this analysis, because the current available inventory of depleted uranium exceeds the current and projected future demand for the material, the depleted UF_6 generated by the proposed GLE Facility was considered a waste product, and disposition alternatives involving its use as a resource were not further evaluated. Existing fuel fabrication facilities have not expressed an interest in performing depleted UF_6 conversion services, and the cost for the services would be difficult to estimate. Therefore, this alternative was eliminated from further consideration. However, International Isotopes, Inc., submitted a license application to the NRC on December 31, 2009, to construct and operate a depleted UF_6 conversion facility near Hobbs, New Mexico. On February 23, 2010, the NRC staff accepted the license application. NRC staff has initiated a formal safety and environmental review.

NRC EXEMPTION TO CONDUCT CERTAIN PRECONSTRUCTION ACTIVITIES

The NRC has approved an exemption request from GLE to conduct certain preconstruction activities prior to NRC's decision to issue a license for the construction and operation of the proposed GLE Facility. The exemption covers the following activities and facilities:

- Clearing of 47 hectares (117 acres) for the proposed GLE Facility;
- Site grading and erosion control;
- Installing a stormwater retention system;
- Constructing main access roadways and guardhouse(s);
- Installing utilities (electricity, potable water, process water, water for fire suppression, sanitary sewer, and natural gas);
- Constructing parking lots and minor roadways; and
- Constructing administrative building(s).

The NRC granted the exemption on May 8, 2009. This exemption authorizes GLE to conduct the stated activities, provided that none of the facilities or activities subject to the exemption would be components of GLE's Physical Security Plan or its Standard Practice Procedures Plan for the Protection of Classified Matter, or otherwise be subject to NRC review or approval. These activities are assumed to occur prior to NRC's decision to grant a license to GLE, and therefore, are assumed to occur under both the proposed action and no-action alternatives.

POTENTIAL ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

This draft EIS evaluates the potential environmental impacts of the proposed action, which are summarized below. The anticipated environmental impacts from the proposed action are SMALL or SMALL to MODERATE.

The NRC defines three significance levels for rating impacts on a resource:

- *Small impact*: Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

- *Moderate impact*: Environmental effects are sufficient to alter noticeably, but not destabilize, important attributes of the resource.

- *Large impact*: Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

Land Use

<u>Small Impact.</u> The project area is owned by GE, contains mostly mixed pine forest, and is bordered by existing GE facilities, the Northeast Cape Fear River, and residential development. The project area is zoned for heavy industrial use, and an enrichment facility is consistent with current zoning. Construction will alter the current land use of undeveloped forest but is not expected to affect surrounding land use.

Operation of a uranium enrichment facility will affect land use and could affect nearby residential developments. However, operation of such a facility is consistent with existing industrial developments at the Wilmington Site.

Historical and Cultural Resources

<u>Small to Moderate Impact.</u> The study area comprises 106 hectares (263 acres). Construction would take place on ground previously disturbed by preconstruction. No construction activities are expected to occur in the portion of the Wilmington Site where historic and cultural resources are known to exist.

Facility operation has the potential to affect historic and cultural resources. Operational impacts depend largely on procedures employed to protect historic and archaeological resources. Resources could be affected if expansion of the facility is deemed necessary and occurs in areas that contain these resources. No facility activities are expected that would affect Middle Woodland archaeological site 31NH801. However, the North Carolina State Historic Preservation Office (SHPO) has requested that GLE develop procedures to protect site 31NH801. These procedures have not been finalized and consultation between GLE and the

North Carolina SHPO is ongoing. Impact levels could be reduced if a plan for the site is developed and implemented.

Visual and Scenic Resources

Small Impact. The project area has low scenic quality and the environment in the project area is not unique for the area. The proposed facility site is adjacent to other industrial developments and will not alter a pristine environment. Likewise, the project area is not in a location that is sensitive to visual intrusions. There is limited expectation that the area would be kept in a wilderness condition.

Construction activities would be concentrated on the Wilmington Site. The greatest visual impacts would result from increased truck and worker traffic, but these impacts would be temporary. The main project area is surrounded by a vegetation barrier, so construction activities would be largely screened. Construction cranes would be visible from greater distances, but this impact would be temporary.

During operation, the two most visible (i.e., tallest) features of the proposed facility would be the water tower and a portion of the operations building referred to as the operations building tower. The operations building tower will have front and side profiles of 37 meters (120 feet) by 200 meters (660 feet), and could reach up to 49 meters (160 feet) above grade. The proposed water tower is the same height as the existing Wilmington Site water tower, the top of which is visible from south of Interstate 140 (I-140). Although the operations building tower could be 10 meters (30 feet) taller than the existing water tower, it would be visible primarily from Castle Hayne Road and the residential subdivision to the northeast because it would be further from I-140 than the existing water tower. The intrusion of the water tower, facility, and operations building tower would not represent a major alteration of the existing visual environment. Portions of the proposed facility may be visible from I-140, and the planting of additional vegetation may minimize visual impacts.

Air Quality

Small to Moderate Impact. Potential air quality impacts would be the highest during preconstruction activities (which are not a part of the proposed action) and the initial two years of construction. Air emissions of criteria pollutants, volatile organic compounds (VOCs), greenhouse gases, and hazardous air pollutants (HAPs) would include primarily fugitive dust emissions and engine exhaust emissions. Potential impacts of sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and carbon monoxide (CO) emissions on ambient air quality would be SMALL (well below applicable standards), and construction activities would have SMALL impacts on ambient air quality for all criteria pollutants. Lead emissions are expected to be negligible and potential carbon dioxide (CO_2) emissions would be SMALL.

Total 24-hour concentrations of particulate matter equal to or smaller than 10 micrometers (PM_{10}) and particulate matter equal to or smaller than 2.5 micrometers ($PM_{2.5}$), mostly resulting from fugitive dust emissions, are predicted to exceed the standards during the preconstruction and construction phases. In addition, high PM_{10} and $PM_{2.5}$ concentrations could result from fugitive dust emissions from vehicle traffic on the unpaved access road during preconstruction activities. Since preconstruction and construction activities would last about nine months and two years, respectively, the potential air quality impacts during the preconstruction phase are expected to be MODERATE but temporary in nature. To minimize the impacts on air quality from fugitive dust, aggressive dust control measures would be implemented during the preconstruction and construction phases. While the impacts of fugitive dust emissions are expected to be MODERATE, these impacts would be temporary and appropriately mitigated.

Because the proposed facility will not employ any continuous combustion activities during operation, criteria pollutant and HAP emission rates are expected to be SMALL. Uranium-related and/or hydrogen fluoride (HF) stack emissions would be minimal. Fugitive air emissions from diesel fuel handling would be very low. Vehicles using onsite roads would contribute emissions, but these would decrease with time. Fugitive dust emissions during operation would be minimal, as most working areas and roads would be paved. Ozone precursor emissions would be relatively small, so the potential impacts on regional ozone would be SMALL.

Geology and Soils

Small Impact. Approximately 91 hectares (226 acres) of land would be disturbed under the proposed action, including the proposed facility site, support structures, and road construction. Construction vehicles and equipment could potentially leak fuel, oil, or grease to site soils. Soil-related aspects of construction would include soil excavation, soil storage and removal, and stormwater management. Construction would not impact site geologic resources because the site lacks significant geologic resources.

Soil disturbance during operations would occur at a reduced level, as some construction projects would be completed, while others are ongoing. Restoration and seeding would limit erosion due to stormwater. Roads, parking lots, and roofs would create impervious surfaces and increase runoff, increasing the erosion potential. Large storm events could create erosion along drainages or at culverts, requiring maintenance or drainage system improvement. Vehicles and equipment used in unpaved areas could potentially leak fuel, oil, or grease to site soils. Groundwater pumping is expected to have a minimal effect on groundwater levels, and the associated degree of subsidence is expected to be negligible. Other geologic hazards to the site are not anticipated.

Surface Water Resources

Small Impact. Excavations during construction would lead to possible short-term soil erosion with impacts on surface water quality. The proposed access road would have a new stream crossing and possibly change a jurisdictional channel, which could lead to erosion and increased sediment load. Construction vehicles and equipment pose the possibility of leaks or spills of fuels, oil, or grease, which could run off and impact nearby surface water. However, it is unlikely that a minor spill would reach the Northeast Cape Fear River or Prince George Creek. Infiltration into site soil would likely eliminate runoff.

Process wastewater effluent would be discharged at an existing outfall during operation, increasing the site's process wastewater volume by about 7 percent. Liquid radioactive waste would be pretreated to reduce uranium to acceptable levels before transfer to the existing wastewater treatment facility. Treatment would produce an effluent similar to current process wastewaters. Treated sanitary wastewater effluent would be reused in site cooling towers.

No consumption of surface water use would take place during operation. Stormwater runoff would collect in a State-permitted detention basin before discharge and would be regulated by a National Pollutant Discharge Elimination System (NPDES) permit. Stormwater runoff from the UF_6 cylinder storage pads would collect in a lined retention pond. If monitoring demonstrates a lack of radioactivity, pond effluent would be discharged to the stormwater detention basin and ultimately, to the effluent channel. Any increase in turbidity and sediment loading to streams as a result of construction would subside during operation. Oil, grease, metals, and other automotive-related contaminants would be present in limited quantities due to general traffic. The use of herbicides in landscaped areas would be similar to their use elsewhere at the Wilmington Site.

Groundwater Resources

Small Impact. Construction equipment poses the potential for leaks of fuel, oil, and grease to soil and groundwater; implementation of best management practices (BMPs) would reduce these impacts. The use of portable toilets during construction would eliminate sanitary system impacts on groundwater. Potable and nonpotable construction water requirements would be met by transport of offsite water by tanker truck.

During operation, the stormwater collected from the UF_6 cylinder storage pad is expected to have no more than trace amounts of radiological contaminants, and the liner is expected to limit infiltration to groundwater. Discharge at site outfalls would be from process and sanitary wastewater. Some portion of these effluents may potentially infiltrate the Peedee sand aquifer. However, treatment and monitoring are expected to result in no significant contaminant concentrations in the effluent channel. The proposed facility will obtain additional groundwater for potable purposes from the Wilmington Site's existing production wells. Water level data show these wells to be cross-gradient of the overall Wilmington Site, and they do not result in significant drawdown. Groundwater will also be needed as a source of process water. A small amount of increased drawdown is expected, without significant effect on flow directions, water quality, or availability for offsite users. Diesel tanks at the facility would have appropriate leak detection equipment. A groundwater monitoring plan would be developed after the facility is constructed.

Ecological Resources

Small to Moderate Impact. Construction activities that could impact ecological resources at the Wilmington Site include constructing the UF_6 storage pads, constructing the operations building, and adding a fence around the proposed facility. Most construction activities would occur in areas that would have already been disturbed by preconstruction activities. Impacts on vegetation would occur primarily from vegetation clearing, habitat fragmentation, alteration of topography, changes in drainage patterns, and soil compaction. Remaining potential impacts on vegetation include decline or mortality of trees near the construction boundary, effects related to hydrologic changes, deposition of dust and other particulate matter, introduction of invasive plant species, and accidental releases of hazardous materials (e.g., fuel spills).

Wetlands could be impacted by alteration of surface water runoff patterns, soil compaction, or groundwater flow. No wetlands would be directly impacted by construction of the proposed facility, but three jurisdictional wetlands and one isolated wetland occur within the corridor for the revised entrance and roadway. It is probable that the isolated wetland would be directly impacted, resulting in a wetland loss. However, impacts on, or loss of, this wetland would not be significant, given the apparent low value of the wetland under State rating guidelines. Indirect impacts on wetlands could occur from increased stormwater runoff, decreased groundwater recharge, disconnected hydrologic conductivity, or changes in groundwater or surface water flow patterns. Impacts from increased or decreased runoff are expected to be negligible.

Except for the probable impact on wetlands, no environmentally sensitive areas would be directly impacted by construction. Only minor, localized indirect impacts on environmentally sensitive areas may occur from erosion and sedimentation or from changes in drainage patterns.

Impacts on wildlife from construction would include habitat disturbance, wildlife disturbance, and injury or mortality of wildlife. Habitats within the footprint disturbed by construction would be reduced or altered, and construction activities would result in habitat fragmentation. Construction would cause a loss of habitat, which could result in a long-term reduction in wildlife abundance and richness. Although habitats adjacent to the proposed facility site would mostly remain unaffected, wildlife might make less use of these areas due to disturbance (indirect habitat loss). Habitat disturbance, including roads, could facilitate the spread and introduction of invasive plant species. Wildlife habitat could be adversely affected if invasive vegetation became established in the disturbed areas and adjacent offsite habitats. If exposure of wildlife to fugitive dust was of sufficient magnitude and duration, the effects could be similar to those on humans. A more probable effect would be the dusting of plants, which could make forage less palatable. Construction activities could cause wildlife disturbance, including interference with behavioral activities. Wildlife could respond in various ways, including attraction, habituation, and avoidance. Principal sources of noise would include vehicle traffic and operation of machinery. Regular or periodic noise could cause adjacent areas to be less attractive to wildlife and result in a long-term reduction in use. Construction activities could result in the direct injury or death of certain wildlife species. Wildlife could also be exposed to accidental fuel spills or releases of other hazardous materials.

No aquatic habitats are located within the footprint of the areas that will be cleared for the proposed facility, and no significant adverse impacts on aquatic biota are expected from construction activities.

No impacts would be expected on any Federally listed threatened, endangered, or other special status species from construction activities. Similarly, no impacts would be expected on any State-listed species.

During operation, impacts on vegetation would include moving, hand-cutting, and chemical control of vegetation around the proposed facility, support facilities, utility corridors, and access road. No effects on vegetation would be expected from the cooling tower or air emissions, wastewaters, and solid wastes generated during operation. It is unlikely that radionuclide releases would have adverse effects on ecological resources. Facility operation would not encroach upon or have any other adverse effect on wetlands. Impervious surfaces generally result in increased runoff and reduced infiltration, but routing drainage to the stormwater detention and retention basins would minimize the potential for wetland water-level fluctuations. No environmentally sensitive areas would be impacted by operations. Potential impacts on wildlife from operations would include ongoing habitat disturbance (i.e., reduction, alteration, and fragmentation of habitat), and wildlife injury or mortality.

No natural water bodies occur within the immediate area of the proposed facility. During operations, aquatic habitats and biota could be affected by continued erosion and sedimentation and exposure to contaminants. Increased liquid effluent discharges could increase turbidity and sedimentation until the stream channel adjusts. Wastewater would be treated to meet NPDES permit requirements, so aquatic biota would not be adversely impacted. The potential exists for toxic materials (e.g., fuel, lubricants, and herbicides) to be accidentally introduced into aquatic habitats, but an uncontained spill would probably affect only a limited area, and lubricants and fuel would not be expected to enter wetlands or waterways (due to soil infiltration and the distance from the main work area to drainages). Only trace levels of radiological contamination would be released to surface waters during operation, so adverse radiological impacts on aquatic biota would not be expected.

No adverse impacts on threatened, endangered, or other special status species would be expected from facility operations due to the lack of suitable habitats within the immediate project area.

Noise

<u>Small to Moderate Impact.</u> During construction, vehicular traffic around the proposed facility and along nearby traffic routes would generate intermittent noise, but the noise contribution from these sources would be limited to the immediate vicinity of the traffic routes and would be minor in comparison with the contribution from continuous sources used during construction. Noise levels from planned construction activities would be comparable to those from other construction sites of similar size. The dominant noise source for most construction equipment is the diesel engine without sufficient muffling. Major construction activities would include building erection and electrical and mechanical installation, and some activities would occur inside the structures. Typically, heavy equipment with lower noise levels than used during road construction would be employed. Traffic accessing the site would increase but would largely consist of smaller passenger vehicles, vans, and pickup trucks. Potential noise impacts on the nearest subdivision would be moderate but temporary in nature when road construction (which is a preconstruction activity and therefore not a part of the proposed action) occurs in the proximity of the site boundary. Potential noise impacts during subsequent additional preconstruction activities would be SMALL.

During facility operation, noise sources would be primarily enclosed within buildings. Various outbuildings are planned with exterior equipment, such as pumps, heat pumps, transformers, and cooling towers. Other noise sources would include vehicular traffic on the proposed access road, as well as hauling vehicles around the proposed facility. Noise levels at the fenceline receptor closest to the Wooden Shoe residential subdivision are estimated to be below the day and night equivalent sound level for the local noise ordinance and the U.S. Environmental Protection Agency (EPA) noise guideline.

Transportation

Small to Moderate Impact. Construction involves the movement of personnel and equipment to and from the site, the delivery of materials and supplies, and the removal of construction debris and waste. The number and type of truck shipments will vary over the course of construction. Construction activities are estimated to add an average of approximately 35 trucks per day, with a small impact on local traffic. Prior to start-up, an average increase of up to 815 daily trips by construction personnel is anticipated, with the heaviest traffic occurring in the immediate vicinity of the site entrance. Impacts on the local site vicinity could be SMALL to MODERATE; regional impacts are expected to be SMALL. Impacts would be reduced if shift changes did not coincide with local peak road usage times.

Facility operations would overlap with the construction period for five years, during which time vehicular traffic from commuting operations personnel will add to increased local traffic from construction workers and shipments. The remaining years of operation will involve vehicular traffic from operations personnel, occasional visitors, incoming truck shipments for materials and supplies, and outgoing shipments of product materials and wastes. An average of approximately six additional heavy haul truck shipments per day to and from the Wilmington Site would occur during operations. The average number of workers (construction and operations personnel) on a daily basis during start-up and construction completion is anticipated to be 743, with about 350 permanent operations personnel employed over the remainder of the operational period. The average number of additional daily vehicle trips from facility activities will increase by about 1560 at the Wilmington Site during joint construction and operations activities. Once construction is complete, the average number of daily trips associated with operations personnel is estimated to be approximately 740. The range of additional daily vehicle trips from facility activities (740 to 1560) would have a MODERATE impact on the local road network. The impact on regional traffic flow is expected to be SMALL.

Operations of the proposed facility will require the shipment (by truck) of various radioactive materials to and from the facility, with multiple origins or destinations. Vehicle-related risks result from moving from one location to another (independent of cargo characteristics), while cargo-related risk refers to that attributable to the cargo being shipped. In the case of the uranium, cargo-related risks include exposure to ionizing radiation during normal transportation and accident conditions, as well as chemical hazards during accident conditions. Less than one latent cancer fatality is anticipated for the public and transportation crews from all shipments on an annual basis. No latent fatalities from vehicle emissions are anticipated on an annual basis, so impacts on the public from vehicle emissions would be SMALL.

Annual transportation accident impacts from the proposed action are anticipated to be SMALL. Chemical impacts would be negligible, as past analyses of depleted UF_6 shipments have shown the estimates of irreversible adverse effects to be approximately 1 to 3 orders of magnitude lower than the estimates of public latent cancer fatalities from radiological accident exposure. No fatalities are expected from accidents (direct physical trauma) on an annual basis.

Public and Occupational Health

Small Impact. Impacts on occupational safety from construction would be SMALL. Occupational exposures during construction would be minor and minimized using work practices and personal protective equipment. Impacts on air quality during construction would be SMALL. Construction activities are not expected to cause any exceedances of ambient air quality criteria, with the possible exception of short-term criteria for particulate matter from fugitive dust.

Radiological impacts during construction would be accrued primarily to construction workers. Offsite exposures would not be expected. Construction activities would not generate radiological contamination but could disturb areas previously contaminated by past and current operations at the Wilmington site. Construction workers could also be exposed to emissions from the proposed facility during the overlap of construction and early operation. The maximum possible dose would be a small fraction of background radiation exposure and less than the 10 CFR 20.1301(a)(1) limit of 1 millisievert per year. Impacts on construction workers from radiological exposure would be SMALL. Dose to the offsite public would be significantly less, as they have no potential for measurable exposure from existing site contamination. Impacts on the offsite public from construction would be SMALL.

A total of 450 total recordable incidents, 247 lost workday incidents, and less than one fatal injury are projected for 38 years of facility operation. Impacts on occupational health and safety during facility operation would be SMALL.

The greatest potential for occupational exposure in the main process building would be from connecting and disconnecting UF_6 cylinders. Airborne concentrations of HF and uranyl fluoride inside facilities are expected to be insignificant, and workers would use ventilation equipment to minimize exposures. Concentrations near the release point could be as high as 10 percent of the Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit and would be limited by ventilation equipment. Impacts associated with routine occupational exposures to HF and UF_6 in the workplace would be SMALL. Large volumes of UF_6 would be present as feed and product material, but there would be no routine exposures to solid or liquid UF_6. Exposure to industrial chemicals would be limited by minimizing airborne releases and use of protective equipment. Non-radiological impacts on workers from operations would be SMALL.

Lasers would normally be operated within enclosures, equipped with interlocks to prevent inadvertent worker exposure. With laser protections in place, impacts of lasers on worker health would be SMALL.

Public health impacts associated with non-radiological liquid effluent releases would be SMALL. Potential long-term, low-level HF and uranium exposure to the public would be the primary offsite chemical exposures of concern. However, public health impacts from such exposures would be SMALL. Only minor quantities of UF_6 or HF would escape the facility ventilation system, and the quantity of HF passing through the emissions control devices would be below levels established in the facility air permit and protective of public health. The estimated HF and uranium concentrations at onsite exposure locations are orders of magnitude below safe levels established by OSHA. UF_6 and HF levels at the site boundary and the location of the nearest resident would be lower than onsite levels. HF concentrations at all exposure locations are far below the most stringent state or Federal ambient air quality standards for the general public. No criteria air pollutants would be produced by the enrichment process.

Facility operation could result in radiation exposure to the public via uranium releases or direct external radiation exposure. UF_6 gas released in the main process building would pass through a ventilation system to minimize external release. Liquid effluents would be treated and sampled to limit releases. Direct exposure to the public could occur from onsite uranium and transportation both onsite and offsite. Direct radiation and skyshine from airborne releases would be undetectable at offsite areas. The main process building would release small amounts of airborne uranium during operation, but impacts on members of the public from air emissions would be SMALL. The NRC public release limits for uranium in air and liquid effluents (i.e., 10 CFR Part 20 Appendix B limits) would be met.

Radioactive materials at the proposed facility would present the possibility for onsite members of the public to receive a direct radiation dose. Only depleted uranium would be continuously present in sufficient quantity to represent a potential source of direct radiation dose. Measurements from existing sources at the Wilmington Site were used to estimate the public dose from direct radiation. Site dosimetry indicated no readings above background at the site boundary. Because of cylinder shielding and the distance to receptors, stored cylinders are expected to have only a minor effect on the exposure rate at the site boundary. Therefore, the impact from direct exposure to the public is expected to be SMALL.

The proposed GLE Facility would generate process and sanitary liquid effluent streams. Liquid radioactive wastewater would be collected and sampled before routing to a liquid effluent treatment system. Treated effluent would be discharged to the existing final process lagoon facility, and cooling tower blowdown would be sent directly to the final process lagoon facility. Water from the lagoon facility would be discharged through a permitted outfall to the site effluent channel. Sanitary wastewater would be treated in the existing sanitary wastewater treatment facility, and treated effluent would replace cooling tower blowdown. Stormwater runoff would drain into a stormwater wet detention basin before being discharged. A separate holding pond would collect stormwater runoff from the UF_6 storage pads, where the runoff would be monitored before discharge to the wet detention basin. Discharges from all liquid effluent streams would be released into the Wilmington Site effluent channel and flow to the Northeast Cape Fear River through Unnamed Tributary #1.

There are no public water intakes on the Northeast Cape Fear River downstream of the discharge point, so the only exposure pathways of concern are fish ingestion and those relating to recreational water use. The maximum dose that a member of the public could receive from liquid effluent releases would occur just south of the Wilmington Site boundary. Calculated doses to a maximally exposed individual (MEI) and the surrounding population from liquid effluent releases are well below the 10 CFR 20.1301(a)(1) limit of 1 millisievert per year. Impacts on members of the public from liquid effluent releases from the proposed GLE Facility would be SMALL.

Impacts of normal operations on public health and occupational exposure would be SMALL.

Waste Management

Small Impact. Solid nonhazardous wastes generated during construction would be similar to wastes from other industrial construction sites and transported offsite to an approved local landfill. Construction activities would generate less than two percent of the waste that the New

Hanover County Landfill receives annually from all other sources. Small quantities of organic solvent-based residuals could be used and may require management as hazardous waste. Hazardous wastes from construction would be packaged and shipped offsite to licensed facilities. Impacts from construction-generated hazardous and nonhazardous waste would be SMALL.

Facility operations would result in the generation of wastewaters that would be treated onsite before discharge and solid wastes that would be treated (onsite or offsite) and shipped for disposal offsite. Sanitary wastewater would be collected by a sewer system connected to the existing Wilmington Site sanitary wastewater treatment facility, increasing the load on the existing system by about one-third. Treated sanitary wastewater effluent could be used as makeup water in onsite cooling towers. Should discharges to surface waters be necessary, the existing NPDES discharge permit would be adequate to cover the additional effluent volume. Impacts from sanitary wastewater would be SMALL. Cooling tower blowdown would be sent to the Wilmington Site's final process lagoons, and impacts from cooling tower blowdown would be SMALL. Radioactive process wastewater from facility operations would be collected and treated to remove uranium, other metals, and fluoride. The treated effluent would be discharged to the process wastewater aeration basin and final process lagoon facility. Impacts from process wastewater would be SMALL. Impacts from radiological exposure to depleted UF_6 in the cylinder storage pad would be SMALL, and impacts from the conversion of depleted UF_6 generated by the proposed GLE Facility would be SMALL.

Socioeconomics

Small Impact. Socioeconomic impacts are calculated for the region in which the majority workers at the proposed GLE Facility are expected to live and spend their wages and salaries. This region of influence (ROI) covers three counties in North Carolina – Brunswick County, New Hanover County, and Pender County. These three counties cover an area that extends up to approximately 80 kilometers (50 miles) from the site. Construction activities in the peak year (2012) would create 680 direct jobs at the facility site and an additional 3131 indirect jobs in the ROI. In 2012, construction would produce $139.8 million in income in the ROI, $1.7 million in direct State income taxes, and $1.2 million in direct State sales taxes. In-migration of workers and their families from outside the ROI would be likely. Although in-migration may potentially impact local housing markets, the relatively small number of in-migrants (between 299 and 598 persons) and the availability of temporary accommodations would limit the impact on the number of vacant rental housing units. In-migration would affect local–community educational and medical services employment to maintain existing levels of service. Approximately one additional police officer and one additional firefighter would be required in the peak construction year. Between 84 and 169 additional school-age children would be expected in the ROI in 2012, requiring approximately one additional teacher to maintain existing student-teacher ratios.

Facility start-up activities would create 200 direct jobs and an additional 218 indirect jobs in the ROI. In 2013, start-up would produce $28.0 million in income in the ROI, $1.3 million in direct State income taxes, and $0.92 million in direct State sales taxes. In-migration of workers and their families from outside the ROI would be likely. Although in-migration may potentially impact local housing markets, the relatively small number of in-migrants (92 to 120) and the availability of temporary accommodations would limit the impact of start-up on the number of vacant rental housing units. In-migration would affect local–community educational and medical services employment to maintain existing levels of service. Less than one additional police officer and less than one additional firefighter would be required in the start-up year. Between 26 and 40 additional school-age children would be expected in the ROI in 2013, requiring one additional teacher to maintain existing student-teacher ratios.

Facility operations in 2017 would create 350 direct jobs and an additional 382 indirect jobs in the ROI. In 2017, operations would produce $51.5 million in income in the ROI, $2.3 million in direct State income taxes, and $1.7 million in direct State sales taxes. Corporate income taxes would also be collected by the State during the operating period, totaling $49.2 million annually. In-migration of workers and their families from outside the ROI would be likely. Although in-migration may potentially impact local housing markets, the relatively small number of in-migrants (161 to 210) and the availability of temporary accommodations would limit the impact of facility operation on the number of vacant owner-occupied housing units. In-migration would affect local-community educational and medical services employment to maintain existing levels of service. Less than one additional police officer and less than one additional firefighter would be required in the peak operations year. Between 46 and 70 additional school-age children would be expected in the ROI in 2017, meaning less than one additional teacher would be required to maintain existing student-teacher ratios.

Environmental Justice

Small Impact. Although the NRC staff has concluded that potential impacts could be SMALL to MODERATE in a number of resource areas during construction and operation of the proposed facility, the impacts on each resource area would not appear to be disproportionately high and adverse for minority or low-income populations.

The majority of environmental impacts associated with construction and operation of the proposed facility are SMALL to MODERATE and would generally be mitigated. Any remaining environmental impacts would affect primarily residents in the immediate vicinity. The neighborhood immediately surrounding the proposed facility site includes a mix of minority and nonminority residents, as well as a mix of low-income and more affluent residents. Because impacts on the general population are generally SMALL to MODERATE, and because the greatest impact is expected to occur in the immediate vicinity (and in an area with a mix of ethnicities and income levels), the various phases of facility development would not be expected to result in disproportionately high or adverse impacts on low-income or minority residents, and would not, therefore, produce any environmental justice concerns.

Even when environmental impacts are anticipated to be SMALL, the behaviors of some population groups, such as higher participation in outdoor recreation, home gardening, or subsistence fishing, may lead to disproportionate exposure. One Census block group with a high percentage of low-income and minority residents is located downstream of the proposed facility on the Northeast Cape Fear River. If radioactive contaminants were released, these residents could face increased risk of exposure. However, air and liquid releases of total uranium and UF_6 are projected to be extremely low, and indirect exposure through fish consumption would be even lower.

Accidents

Small Impact. The consequence of a criticality accident would be high for a worker in close proximity (less than 15 feet). Worker health consequences are Low to Intermediate from four scenarios involving the release of UF_6. Worker health consequences are Low to High from four scenarios involving HF exposure. Worker health consequences are Low to Intermediate from four scenarios involving uranium chemical exposure. Radiological consequences to a maximally exposed individual at the Controlled Area Boundary are Low for the criticality accident, Low for all four UF_6 release scenarios, Low to High for the four HF exposure scenarios, and Low to Intermediate for the four scenarios involving uranium chemical exposure. Risk to the offsite public in the direction of highest exposure is estimated to be less than one lifetime cancer fatality for all accident scenarios. Plant design, passive and active engineered controls, and administrative controls would reduce the likelihood of accidents. Therefore, impacts from accidents are expected to be SMALL.

POTENTIAL ENVIRONMENTAL IMPACTS OF THE NO-ACTION ALTERNATIVE

This draft EIS also considers the potential environmental impacts of the no-action alternative, which are summarized below. As described in Chapter 4, the anticipated environmental impacts from the no-action alternative are SMALL. It is assumed that preconstruction activities take place under the no-action alternative.

Should the nation's need for enriched uranium continue to increase and necessitate the construction and operation of another domestic enrichment facility at an alternate location, impacts could occur for each resource area and could range from SMALL to LARGE. The nature and scale of these impacts could be similar to those of the proposed action, but would depend on several facility- and site-specific factors. Consequently, these impacts would be addressed by the NRC at that time.

Should uranium enrichment activities not be undertaken at alternative locations or through expansion of planned and existing enrichment facilities, the national enrichment capacity would be diminished. This could lead to curtailment of planned new or expanded nuclear power plants, necessitating the generation of electricity to meet current and future demands through the application of other energy technologies featuring a different set of impacts.

Land Use

Small Impact. Under the no-action alternative, other uses of the land would not be precluded.

Historical and Cultural Resources

Small Impact. Under the no-action alternative, additional land disturbance at the Wilmington Site may or may not occur, depending on future plans for the project site. Procedures to address unexpected discoveries that could occur during normal operations are currently in place.

Visual and Scenic Resources

Small Impact. Under the no-action alternative, additional ground-disturbing activities (clearing) may or may not occur. Should the site not be developed, the vegetation screen that surrounds the proposed facility site would be intact and no additional visual disturbance at the Wilmington Site would be introduced.

Air Quality

Small Impact. Under the no-action alternative, existing air emission sources at the Wilmington Site would continue to operate. Point source emissions from current operations are negligible compared to the annual total emissions in New Hanover County.

Geology and Soils

Small Impact. Under the no-action alternative, additional ground-disturbing activities may or may not occur, depending on future plans for the project site.

Surface Water Resources

Small Impact. Under the no-action alternative, no changes to surface water quality would be expected.

Groundwater Resources

Small Impact. Under the no-action alternative, additional water use may or may not occur, depending on future plans for the project site. Groundwater quality would not be reduced at the proposed facility site, but would gradually improve. No adverse changes in groundwater quality would be expected.

Ecological Resources

Small Impact. Most impacts on ecological resources would occur prior to the no-action alternative (i.e., during preconstruction). Under the no-action alternative, impacts on wetlands, environmentally sensitive areas, and aquatic biota would be SMALL. Impacts on Federally threatened and endangered species would be SMALL, and impacts on the Federal species of concern or State-listed species that occur within New Hanover County would be SMALL (i.e., no adverse impacts on these species would result from the no-action alternative).

Noise

Small Impact. Noise associated with construction would not occur and additional noise from operations at the existing Wilmington Site would not likely change, depending on future plans for the project site.

Transportation

Small Impact. Under the no-action alternative, increased construction and operations traffic would not occur and there would not likely be any additional local transportation impacts at the Wilmington Site, depending on future plans for the project site. There would be no additional traffic entering and leaving the Wilmington Site, and additional national impacts from the transportation of radioactive materials to and from the Wilmington Site would not occur in the short term.

Public and Occupational Health

Small Impact. Under the no-action alternative, impacts on construction workers would not occur. Exposure to the public outside the Wilmington Site boundary would remain unchanged, depending on future plans for the project site.

Waste Management

Small Impact. Under the no-action alternative, there may or may not be any additional waste management impacts at the Wilmington Site, depending on future plans for the project site. There would be no additional waste generated at the Wilmington Site beyond that generated by existing activities.

Socioeconomics

Small Impact. Under the no-action alternative, any positive or adverse consequences of the proposed action would not occur. Population and employment in the ROI would be expected to grow in accordance with current projections. Activities completed prior to the no-action alternative (i.e., preconstruction activities) would not expected to have a noticeable effect on these trends or on county services, and the no-action alternative would not directly result in changes to current county services or growth projections.

Environmental Justice

Small Impact. The no-action alternative would not be expected to cause any significant and adverse impacts.

Accidents

Small Impact. Under the no-action alternative, potential accidents and accident consequences from construction and operation of the proposed GLE Facility would not occur.

COSTS AND BENEFITS OF THE PROPOSED ACTION

While there are national energy security and fiscal benefits associated with the proposed action, and local socioeconomic benefits in the ROI in which the proposed GLE Facility would be located, there are also direct costs associated with the construction and operation phases of the proposed action, as well as impacts associated with the proposed action on various resource areas. However, these impacts are estimated to be small in magnitude and small in comparison to the local and national benefits of the proposed action. In addition, many of the impacts on environmental resources associated with the proposed action relate to preconstruction activities at the proposed site, and would also occur under the no-action alternative. The principal socioeconomic impact or benefit of the proposed GLE Facility would be an increase in employment and income in the ROI. Although the majority of the costs, and most of the socioeconomic impacts, of the various phases of GLE Facility development would occur in the ROI, there would be economic, fiscal, and, in particular, energy security benefits, which would occur at both the local and national levels.

Employment created in the ROI in the peak construction year (2012) is estimated at 3811 direct and indirect jobs, and State income tax revenues would be $1.7 million per year during construction. During the GLE operations phase (2017 to 2051), 732 direct and indirect jobs would be created. During this period, the State would benefit from $2.3 million in income taxes and $49.2 million annually in property taxes. Although it can be assumed that some portion of State sales and income taxes paid would be returned to the ROI under revenue-sharing arrangements between each county and State government, the exact amount that would be received by each county cannot be determined. Although there are economic and fiscal benefits associated with the proposed action in the ROI, these beneficial impacts are expected to be SMALL.

The direct costs associated with the proposed action may be categorized by the following life-cycle stages: construction, facility operation, depleted uranium disposal, and decommissioning. In addition to the costs of the proposed action, costs would be incurred for preconstruction activities under both the proposed action and no-action alternatives. In addition to monetary costs, the proposed action would result in impacts on various resource areas, which are summarized above. For all resource areas, the impact of the proposed action is estimated to be SMALL or SMALL to MODERATE.

The proposed action would result in the annual production, in peak years, of six million SWU of enriched uranium, which would augment the supply of enriched uranium and, along with other planned new enrichment facilities, would meet the national energy security need for increased domestic supplies of enriched uranium. Thus, the proposed action would generate national and regional benefits and costs. The national benefit would be an increase in domestic supplies of enriched uranium that would assist the national energy security need. The regional benefits would be increased employment, economic activity, and tax revenues in the ROI. Costs associated with the proposed project are, for the most part, limited to the resource areas in the ROI.

COMPARISON OF ALTERNATIVES

Under the no-action alternative, the proposed GLE Facility would not be constructed, operated, and decommissioned near Wilmington, North Carolina. However, preconstruction activities, such as land clearing, grading, and construction of support structures, would occur on the proposed site even under the no-action alternative. The Paducah Gaseous Diffusion Plant in Paducah, Kentucky, and the downblending of highly enriched uranium under the "Megatons to Megawatts" program would remain the sole sources of domestically generated low-enriched uranium for U.S. commercial nuclear power plants. The NEF and ACP would also be expected to provide enrichment services in the future. The license application for an additional proposed enrichment facility (the EREF) is also currently under review by the NRC. Foreign enrichment sources would be expected to continue to supply more than 85-90 percent of U.S. nuclear power plants' demand until new domestic enrichment facilities are constructed and operated.

The no-action alternative would have SMALL local impacts on current land use, historic and cultural resources, visual and scenic resources, air quality, geology and soils, water resources, ecological resources, socioeconomics, environmental justice, noise, transportation, public and occupational health, and waste management. The costs and benefits of constructing and operating the proposed GLE Facility would not occur. Additional domestic enrichment facilities could be constructed in the future with impacts expected to be SMALL to LARGE, depending on the site-specific conditions.

In comparison to the no-action alternative, the proposed action would also have SMALL impacts on land use, visual and scenic resources, geology and soils, water resources, socioeconomics, environmental justice, noise, public and occupational health, and waste management. The proposed action would have SMALL to MODERATE impacts on historical and cultural resources, air quality, ecological resources, and transportation. The proposed action would have positive impacts in the ROI on employment, income, State tax revenues, and Federal income tax revenues. Impacts from the most serious accidents that might occur are expected to be SMALL.

CUMULATIVE IMPACTS

This draft EIS also considers cumulative impacts that could result from the proposed action when added to other past, present, and reasonably foreseeable future actions (Federal, non-Federal, or private). Identified activities include planned facilities and new processes at the Wilmington Site, as well as offsite industrial development. Impacts from preconstruction activities for the proposed GLE Facility are addressed as cumulative impacts in this draft EIS, as these actions are not part of the proposed action. In general, the anticipated cumulative impacts from the proposed action are SMALL or SMALL to MODERATE. With the exception of socioeconomic impacts (i.e., local job creation), cumulative impacts associated with the no-action alternative would generally be less than those for the proposed action.

SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Preconstruction activities and the proposed action would result in unavoidable adverse impacts on the environment. These impacts would generally be small, and would, in most cases, be mitigated. The disturbed area would be cleared of vegetation and would lead to the displacement of some local wildlife populations. There would be temporary impacts from the construction of new facilities, including increased fugitive dust, increased potential for soil erosion and stormwater pollution, and increased vehicle traffic and emissions. Water consumption from onsite wells during the proposed action would be relatively small and the risk for significant adverse impacts on neighboring residential wells or public supply wells is expected to be small. During operations, workers and members of the public could be exposed to radiation and chemicals.

This draft EIS defines short-term uses as generally affecting the present quality of life for the public (i.e., the 40-year license period for the proposed GLE Facility); and long-term productivity as affecting the quality of life for future generations on the basis of environmental sustainability. The proposed action would necessitate short-term commitments of resources and would permanently commit certain other resources (such as energy and water). The short-term use of resources would result in potential long-term socioeconomic benefits to the local area and the region.

Workers, the public, and the environment would be exposed to increased amounts of hazardous and radioactive materials over the short term from operations of the proposed GLE Facility. Construction and operation would require a long-term commitment of terrestrial resources, such as land, water, and energy. Short-term impacts would be minimized by the application of appropriate mitigation measures. Upon the closure of the proposed GLE Facility, GLE would decontaminate and decommission the buildings and equipment and restore them for unrestricted use. Continued employment, expenditures, and tax revenues generated during the proposed action would directly benefit the local, regional, and State economies.

Irreversible commitment of resources refers to resources that are destroyed and cannot be restored, whereas an irretrievable commitment of resources refers to material resources that once used cannot be recycled or restored for other uses by practical means. The proposed action would include the commitment of land, water, energy, raw materials, and other natural and human-generated resources. Following decommissioning, the land occupied by the proposed facility would likely remain industrial beyond license termination. Water required during preconstruction and the proposed action would be obtained from existing wells at the Wilmington Site and would be replenished through natural mechanisms. Wastewaters would be treated to meet applicable standards and released to local receiving surface waters. Energy used in the form of electricity, natural gas, and diesel fuel would be supplied through existing systems in the Wilmington area. The specific types of construction materials and the quantities of energy and materials used cannot be determined until final facility design is completed, but it is not expected that these quantities would strain the availability of these resources.

Even though the land used to construct the proposed GLE Facility would be returned to other productive uses after the facility is decommissioned, there would be some irreversible commitment of land at offsite locations used to dispose of solid wastes generated by the facility. In addition, wastes generated during the conversion of depleted UF_6 produced by the facility and the depleted uranium oxide conversion product from the conversion of depleted UF_6 would be disposed at an offsite location. Land used for disposal of these materials would represent an irreversible commitment of land. No solid wastes or depleted uranium oxide conversion product originating from the proposed GLE Facility would be disposed of at the Wilmington Site. When the facility is decommissioned, some building materials would be recycled and reused. Other materials would be disposed of in a licensed and approved offsite location, and the amount of land used to dispose of these materials would be an irretrievable land resource.

During operation of the proposed GLE Facility, natural UF_6 would be used as feed material, requiring the mining of uranium and several other operational steps in the uranium fuel cycle. This use of uranium would be an irretrievable resource commitment.

ACRONYMS AND ABBREVIATIONS

AADT	annual average daily traffic
AAL	Acceptable Ambient Level
ACHP	Advisory Council on Historic Preservation
ACP	American Centrifuge Plant
ADAMS	Agencywide Documents Access and Management System
ADT	average daily vehicle trips
AE/SCO	Aircraft Engines/Services Components Operation
AEA	*Atomic Energy Act*
AEGL	Acute Exposure Guideline Level
AES	AREVA Enrichment Services, LLC
ALARA	As Low As Reasonably Achievable
AMA	American Medical Association
ANSI	American National Standards Institute
AQRV	air quality-related value
ASA	Acoustical Society of America
ATC II	Advanced Technology Center
ATSDR	Agency for Toxic Substances and Disease Registry
AVLIS	atomic vapor laser isotope separation

BLM	U.S. Bureau of Land Management
BLS	Bureau of Labor Statistics
BMP	best management practice
BOD	biochemical oxygen demand

C	Celsius
CAA	*Clean Air Act*
CAB	Controlled Area Boundary
CAL/EPA	California Office of Environmental Health Hazard Assessment
CAMA	Coastal Area Management Act
CaOH	lime
CAS	Chemical Abstracts Service
CAST	Horticultural Crops Research Station (Castle Hayne, NC)
CBA	cost-benefit analysis
cDCE	cis-1,2 dichloroethylene
CDC	Centers for Disease Control and Prevention
CaF_2	calcium fluoride
CEDE	committed effective dose equivalent
CEQ	Council on Environmental Quality
CFC	chlorofluorocarbon
CFR	U.S. *Code of Federal Regulations*
CH_4	methane
Ci	Curie
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
CPC	Center for Plant Conservation

ACRONYMS AND ABBREVIATIONS (Cont.)

CSC	Coastal Services Center
CWA	*Clean Water Act*
D&D	decontamination and decommissioning
dB	decibel
dBA	A-weighted decibel
DCE	dichloroethylene
DCF	dose conversion factor
DCP	dry conversion process
DDE	deep dose equivalent
DFP	decommissioning funding plan
DMT	Dundalk Marine Terminal
DNA	deoxyribonucleic acid
DNFSB	Defense Nuclear Facilities Safety Board
DNL	day-night average noise level
DOE	U.S. Department of Energy
DOI	U.S. Department of Interior
DOL	U.S. Department of Labor
DOT	U.S. Department of Transportation
DU	depleted uranium
DUF_4	depleted uranium tetrafluoride
DUF_6	depleted uranium hexafluoride
EA	environmental assessment
EAC	Early Action Compact
EF	Enhanced Fujita
EHS	Environmental, Health, and Safety
EIA	Energy Information Administration
EIS	environmental impact statement
EMF	electromagnetic field
EPA	U.S. Environmental Protection Agency
ER	Environmental Report
EREF	Eagle Rock Enrichment Facility
ESA	*Endangered Species Act*
ESI	Environmental Services, Inc.
F	Fahrenheit; Fujita
FAA	Federal Aviation Administration
FCO	Fuel Components Operation
FBI	Federal Bureau of Investigation
FEMA	Federal Emergency Management Agency
FLM	Federal Land Manager
FMO/FMOX	Fuel Manufacturing Operation
FPLTF	Final Process Lagoon Treatment Facility
FR	*Federal Register*
ft	foot/feet

ACRONYMS AND ABBREVIATIONS (Cont.)

FTE	full-time equivalent
FWS	U.S. Fish and Wildlife Service
GDP	Gaseous Diffusion Plant
GE	General Electric
GEH	General Electric-Hitachi
GHG	greenhouse gas
GLE	GE-Hitachi Global Laser Enrichment LLC
GNEP	Global Nuclear Energy Partnership
GNF-A	Global Nuclear Fuels-Americas
gpd	gallons per day
GWh	gigawatt-hour
GWP	global warming potential
H_2O	water vapor
HAP	hazardous air pollutant
HDDV	heavy-duty diesel vehicle
HEGA	high-efficiency gas absorption
HEPA	high-efficiency particulate air
HEU	highly enriched uranium
HF	hydrogen fluoride or hydrofluoric acid
HFC	hydrofluorocarbon
HFC-23	trifluoromethane
HMTA	*Hazardous Materials Transportation Act*
HNO_3	nitric acid
HVAC	heating, ventilation, and air conditioning
HUD	U.S. Department of Housing and Urban Development
Hz	hertz
I	Interstate
ICRP	International Commission of Radiological Protection
IDLH	Immediately Dangerous to Life and Health
IMPLAN	Impact Analysis for Planning
in.	inch(es)
IROF	item relied upon for safety
ISA	integrated safety analysis
ITE	Institute of Transportation Engineers
kHz	kilohertz
km	kilometer
LCF	latent cancer fatality
LDGV	light-duty gasoline vehicle
L_{dn}	day-night maximum average sound level
L_{eq}	equivalent sound level
$L_{eq(24)}$	24-hour equivalent sound level

ACRONYMS AND ABBREVIATIONS (Cont.)

LES	Louisiana Energy Services, LLC
LEU	low-enriched uranium
LLRW	low-level radioactive waste
lpd	liters per day
LSA	low specific activity
m	meter
MDC	minimum detectable concentration
MEI	maximally exposed individual
mg	milligram
mg/m^3	milligrams per cubic meter
MLIS	molecular laser isotope separation
MMt	million metric tons
MNA	monitored natural attenuation
MOX	mixed oxide fuel
mph	miles per hour
mrem	millirem
m/s	meters per second
MSA	Metropolitan Statistical Area
MSL	mean sea level
mSv	millisievert
MSW	municipal solid waste
MT/yr	metric tons per year
MWe	megawatt electric
MWh	megawatt-hour
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NaOH	sodium hydroxide
NC	North Carolina
NCAC	*North Carolina Administrative Code*
NCDAQ	North Carolina Division of Air Quality
NCDC	National Climatic Data Center
NCDENR	North Carolina Department of Environment and Natural Resources
NCDEHNR	North Carolina Department of Health, Environment, and Natural Resources
NCDMF	North Carolina Division of Marine Fisheries
NCDOT	North Carolina Department of Transportation
NCDWQ	North Carolina Division of Water Quality
NCES	National Center for Education Statistics
NCGS	*North Carolina General Statutes*
NCNHP	North Carolina Natural Heritage Program
NCOSBM	North Carolina Office of State Budget and Management
NCRP	National Council on Radiation Protection and Measurements
NCWRC	North Carolina Wildlife Resources Commission
NEF	National Enrichment Facility
NELAC	National Environmental Laboratory Accreditation Conference

ACRONYMS AND ABBREVIATIONS (Cont.)

NEMA	National Electric Manufacturers Association
NEPA	*National Environmental Policy Act*
NERC	North American Reliability Corporation
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NHC	National Hurricane Center
NHPA	National Institute for Occupational Safety
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standards and Technology
NLCD92	National Land Cover Data 1992 archives
NMFS	National Marine Fisheries Service
NMSS	Office of Nuclear Materials Safety and Safeguards
NMTOC	nonmethane total organic compound
NMVOC	nonmethane volatile organic compound
NO_2	nitrogen dioxide
NO_x	nitrogen oxide, oxide of nitrogen
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NOV	Notice of Violation
NPCR	National Program of Cancer Registries
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NRCS	U.S. Natural Resources Conservation Service
NRHP	*National Register of Historic Places*
NSSL	National Severe Storms Laboratory
NWS	National Weather Service
O_3	ozone
OSHA	Occupational Safety and Health Administration
OSTV	onsite transfer vehicle
PAH	polycyclic aromatic hydrocarbon
Pb	lead
PFC	perfluorocarbon
PM	particulate matter
$PM_{2.5}$	particulate matter equal to or smaller than 2.5 micrometers in diameter
PM_{10}	particulate matter equal to or smaller than 10 micrometers in diameter
PMT	Portsmouth Marine Terminal
ppm	parts per million
PSD	Prevention of Significant Deterioration
PWR	pressurized water reactor
RAI	Request for Additional Information
RCRA	*Resource Conservation and Recovery Act*
rem	roentgen equivalent man
RLETS	Radiological Liquid Waste Treatment System
ROI	region of influence

ACRONYMS AND ABBREVIATIONS (Cont.)

ROW	right-of-way
RPS	North Carolina Radiation Protection Section
RSL	Regional Screening Level
RTI	Research Triangle Institute
RVP	Reid vapor pressure
SAAQS	State Ambient Air Quality Standards
SAM	Social Accounting Matrix
SCONC	State Climate Office of North Carolina
SER	Safety Evaluation Report
SF_6	sulfur hexafluoride
SHPO	State Historic Preservation Office(r)
SILEX	separation of isotopes by laser excitation
SNF	spent nuclear fuel
SO_2	sulfur dioxide
SO_x	sulfur oxide
SPCC	Spill Prevention Control and Countermeasure
SUV	sport-utility vehicle
Sv	Sievert
SVOC	semivolatile organic compound
SWU	separative work unit
TAP	toxic air pollutant
TCE	tricholorethylene
TEDE	total effective dose equivalent
Tg	teragram
TLD	thermoluminescent dosimeter
TSDF	treatment, storage, and disposal facility
TSP	total suspended particulates
TSS	total suspended solids
TWA	time-weighted average
U_3O_8	triuranium octaoxide
UO_2	uranium dioxide
UO_2F_2	uranyl fluoride
UF_6	uranium hexafluoride
UNFCCC	United Nations Framework Convention on Climate Change
USACE	U.S. Army Corps of Engineers
U.S.C.	*United States Code*
USCB	U.S. Census Bureau
USDA	U.S. Department of Agriculture
USEC	U.S. Enrichment Corporation
USGCRP	United States Global Change Research Program
USGS	U.S. Geological Survey
UV	ultraviolet

ACRONYMS AND ABBREVIATIONS (Cont.)

VC	vinyl chloride
VMT	vehicle miles traveled
VOC	volatile organic compound
VRM	visual resource management
WFSC	Wilmington Field Services Center
WMA	Wildlife Management Area
WSA	Wilderness Study Area
WWTF	Wastewater Treatment Facility
μm	micrometer

1 INTRODUCTION

1.1 Background

The U.S. Nuclear Regulatory Commission (NRC) prepared this draft Environmental Impact Statement (EIS) in response to an application submitted by General Electric-Hitachi Global Laser Enrichment LLC (GLE), for a license that would allow the construction, operation, and decommissioning of a laser-based uranium enrichment facility near Wilmington, North Carolina (Figures 1-1 and 1-2). The proposed facility is called the Global Laser Enrichment (GLE) Facility.

The NRC's Office of Federal and State Materials and Environmental Management Programs prepared this draft EIS as required by Title 10, "Energy," Part 51, of the U.S. *Code of Federal Regulations* (10 CFR Part 51). In particular, 10 CFR 51.20 (b)(10) states that issuance of a license for a uranium enrichment facility requires the NRC to prepare an EIS or a supplement to an EIS. NRC's regulations under 10 CFR Part 51 implement the requirements of the *National Environmental Policy Act of 1969*, as amended (Public Law 91-190). The Act requires Federal agencies to assess the potential impacts of their actions affecting the quality of the human environment.

1.2 The Proposed Action

The proposed action is for GLE to construct, operate, and decommission a laser-based uranium enrichment facility near Wilmington, North Carolina. If the NRC issues a license to GLE under the provisions of the *Atomic Energy Act*, the license would authorize GLE to possess and use special nuclear material, source material, and by-product material at the proposed GLE Facility for a period of 40 years, in accordance with the NRC's regulations in 10 CFR Parts 70, 40, and 30, respectively. The scope of activities to be conducted under the license would include the construction, operation, and decommissioning of the proposed GLE Facility.

GLE has proposed to build the GLE Facility on existing General Electric Company (GE) property near Wilmington, North Carolina. Two of GE's principal manufacturing operations – the Global Nuclear Fuel-Americas (GNF-A) Fuel Manufacturing Operation (FMO) facility and the GE Aircraft Engines/Services Components Operation (AE/SCO) facility – are already located at the Wilmington Site. The proposed GLE Facility would be a new facility constructed in the North-Central Sector of the site. Some of the existing infrastructure at the site, such as the waste treatment facilities, would also be used by the proposed facility.

Preconstruction and construction of the proposed GLE Facility would take place from 2011 to 2017, with commencement of facility operations in 2013.[1] A four-year start-up period would run concurrently with construction activities, with the facility expected to reach full production capacity in 2017. Decommissioning or potential license renewal activities would begin in advance of scheduled license expiration (anticipated to be 2052).

[1] As described in Section 1.4.1, certain activities, referred to as "preconstruction" activities in this document, are explicitly excluded from the definition of construction in 10 CFR 51.4. Preconstruction activities are not considered a part of the proposed action.

Figure 1-1 Location of the Proposed GLE Facility (GLE, 2008a)

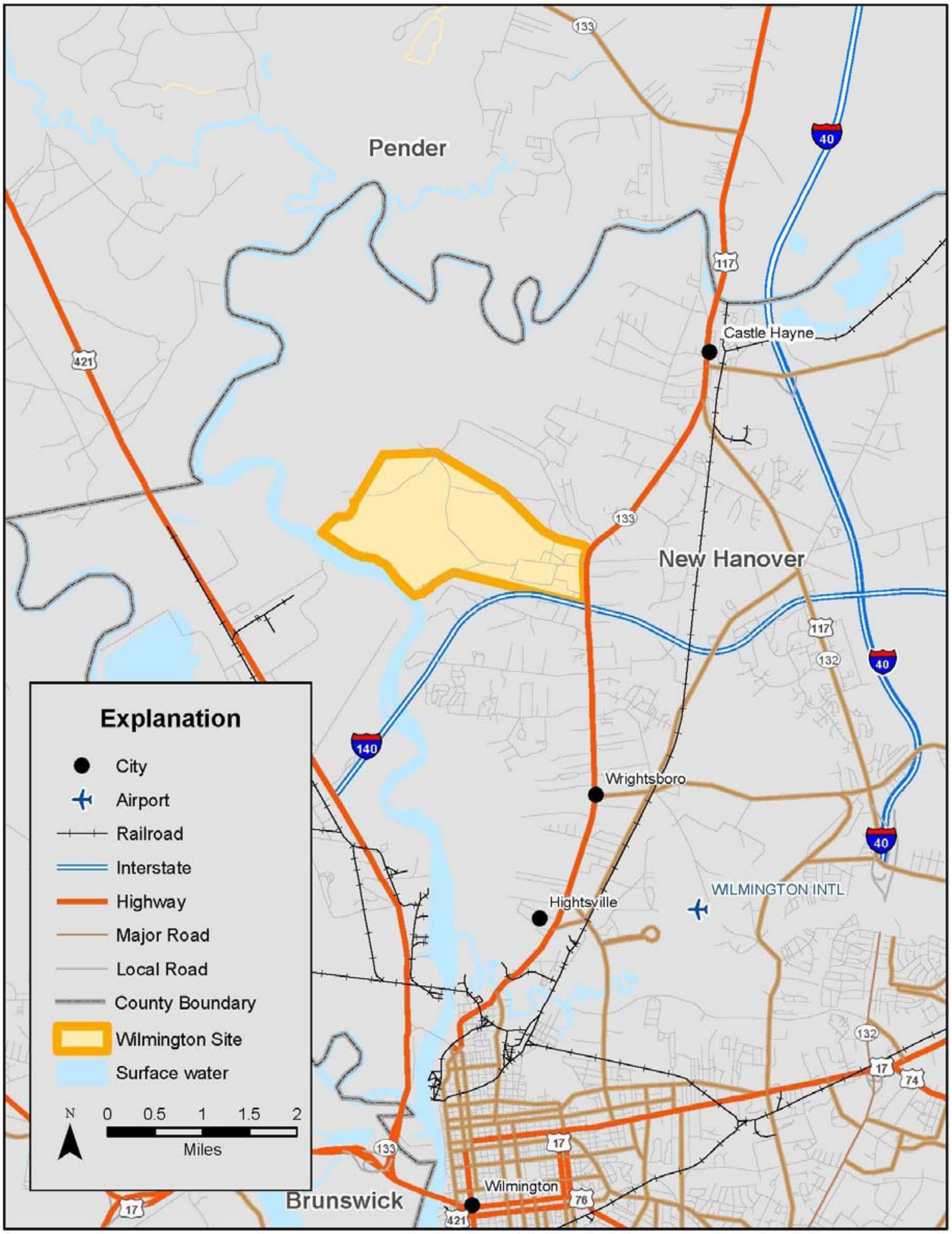


Figure 1-2 Wilmington Site and Vicinity (GLE, 2008a)

GLE intends that the proposed GLE Facility help fulfill needs for domestic enriched uranium capacity for nuclear electrical generation requirements and contribute to national energy security, as well as contribute to deployment of advanced uranium enrichment technologies (GLE, 2008a). This purpose and need are discussed in greater detail in Section 1.3.

Natural uranium ore usually contains approximately 0.72 weight percent uranium-235, and this percentage is significantly less than the 3 to 5 weight percent uranium-235 required by the nuclear power plants currently employed or proposed in the United States and in most other countries as fuel for electricity generation. Therefore, uranium must be enriched in one of the steps of the nuclear fuel cycle (Figure 1-3) before it can be used in most commercial nuclear power plants. Enrichment is the process of increasing the percentage of the naturally occurring and fissile uranium-235 isotope and decreasing the percentage of uranium-238.

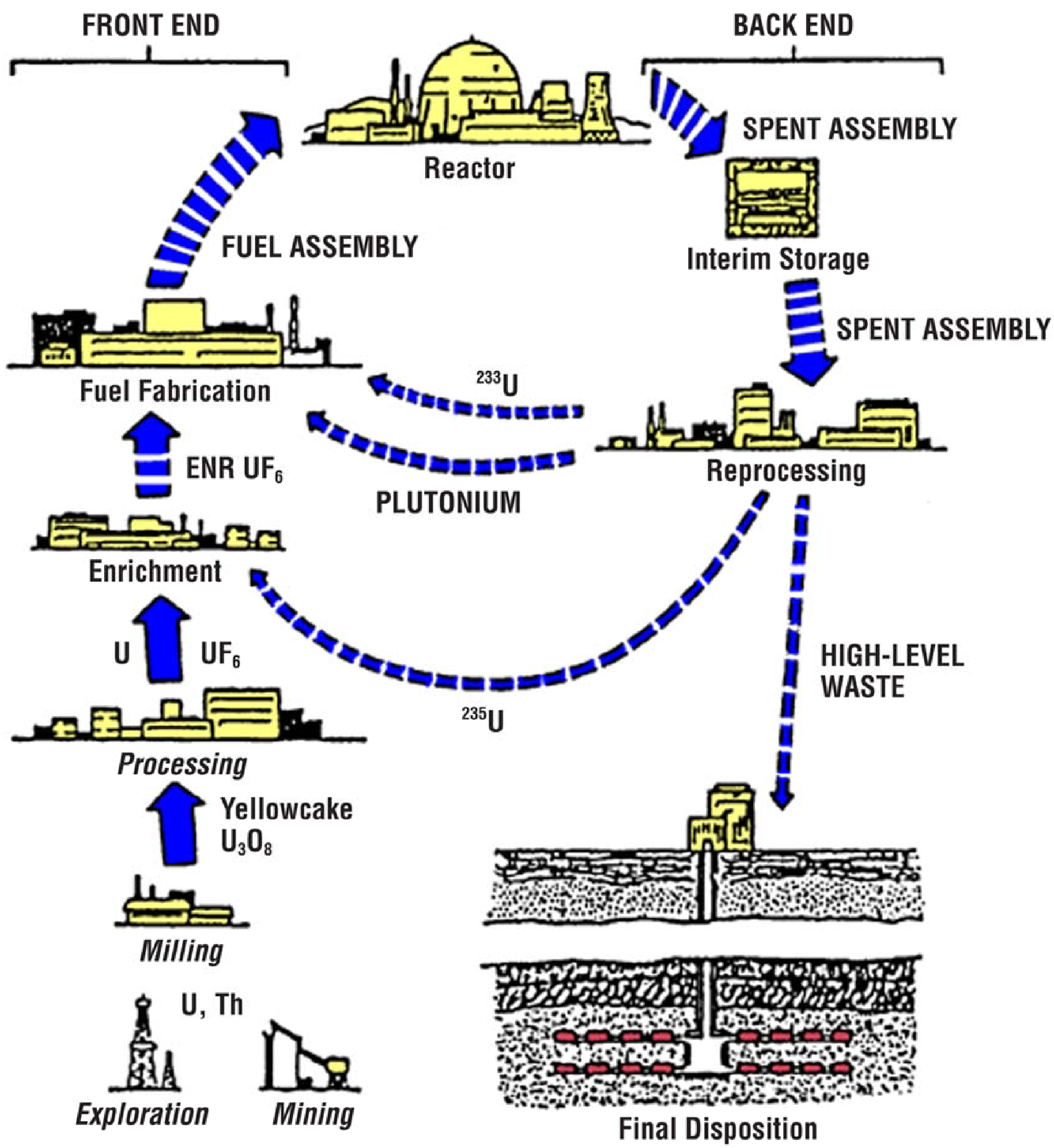
Through its license application, GLE is seeking NRC authorization to produce enriched uranium up to eight percent by weight of uranium-235. Although there is currently no demand for enrichment greater than five percent (enrichment would normally be three to five percent to meet the needs of nuclear power plants), GLE believes that there is potential for future demand to change (GLE, 2009j). Enriched uranium from the proposed GLE Facility would be used in commercial nuclear power plants and is called low-enriched uranium (LEU). Uranium used in military reactors and nuclear weapons has a much greater percentage of uranium-235 by weight and is called high-enriched uranium (HEU).

GLE has requested a license for a production capacity of 6 million separative work units (SWUs)[2] per year. An SWU represents the level of effort or energy required to raise the concentration of uranium-235 to a specified level.

1.3 Purpose and Need for the Proposed Action

As discussed in Section 1.2, the proposed action is for GLE to construct and operate a commercial facility to enrich uranium up to eight percent by weight of uranium-235, with an initial planned maximum target annual production capacity of six million SWUs. The proposed facility would use the GLE laser-based technology and would be constructed on the existing GE property near Wilmington, North Carolina. The proposed action is intended to satisfy the need for an additional economical domestic source of enriched uranium.

[2] A separative work unit (SWU) is a unit of measurement used in the nuclear industry, pertaining to the process of enriching uranium for use as fuel for nuclear power plants. It describes the effort needed to separate uranium-235 and uranium-238 atoms in natural uranium to create a final product that is richer in uranium-235 atoms. Given 100 kilograms (220 pounds) of natural uranium, it takes about 60 SWU to produce 10 kilograms (22 pounds) of uranium enriched to 4.5 percent uranium-235. It takes on the order of 100,000 SWU of enriched uranium to fuel a typical 1000-megawatt commercial nuclear reactor for a year (USEC, 2001).



Note: Reprocessing of high-level waste is currently not done in the United States. Neither a reprocessing facility nor a Federal waste repository is currently approved (licensed) in the United States, and spent fuel is in interim storage.

Figure 1-3 Nuclear Fuel Cycle (NRC, 2008)

In this draft EIS, the need for the proposed GLE Facility is organized by:

- the need for enriched uranium to fulfill electricity generation requirements

- the need for domestic supplies of enriched uranium for national energy security

The purpose of the proposed action is to fulfill these needs. The following sections discuss these needs and how each is addressed by the proposed action.

1.3.1 Need for Enriched Uranium to Fulfill Electricity Requirements

Enriched uranium from the proposed GLE Facility would be used in U.S. commercial nuclear power plants. Nuclear power plants currently supply approximately 20 percent of the nation's electricity requirements (EIA, 2009a). As future demand for electricity increases, the need for enriched uranium to fuel nuclear power plants is also expected to increase (EIA, 2009a).

In the *Annual Energy Outlook* for 2009, for the case based on established policies and current trends (the reference case), the Energy Information Administration (EIA) estimates that nuclear capacity in the United States will increase from 100,500 megawatts in 2007 to 112,600 megawatts by 2030, including 3,400 megawatts of expansion at existing plants, 13,100 megawatts of new capacity, and 4,400 megawatts of retirement (EIA, 2009a). Nuclear generation in the United States is estimated to increase from 806 billion kilowatt hours in 2007 to between 822 and 1,170 billion kilowatt hours in 2030, depending on the low- or high-growth scenarios. From 2007 to 2009, the NRC received 18 applications to build 28 new nuclear power plants. More applications are expected in coming years. The EIA forecasts of nuclear generating capacity, combined with applications from the industry for construction and operation of new plants, suggest a continuing, if not increasing, demand for enriched uranium. The EIA forecast shows that the annual demand for enrichment services may vary between 12.9 million and 15.7 million SWUs from 2006 through 2025 (EIA, 2003).

> ***How Much Is a Megawatt?***
>
> *One megawatt roughly provides enough electricity for the demand of 400 to 900 homes. The actual number is based on the season, time of day, region of the country, power plant capacity factors, and other factors.*
>
> *Source: Bellemare, 2003.*

The demand for enriched uranium in the United States is currently being fulfilled by three main categories of supply:

- *Domestic production of enriched uranium provides about 10–15 percent of U.S. demand* (EIA, 2008; EIA, 2009b). The only uranium enrichment facility currently operating in the United States is the Paducah Gaseous Diffusion Plant, run by USEC's subsidiary, the United States Enrichment Corporation. One other enrichment facility presently exists in the United States, the Portsmouth Gaseous Diffusion Plant; it ceased production in May 2001, however, and will no longer produce enriched uranium since the plant has been placed in cold shutdown (a condition whereby the plant is undergoing preparation for decommissioning and decontamination) (DOE, 2010a).

- *The Megatons-to-Megawatts Program provides about 38 percent of U.S. demand* (EIA, 2009b). Under this program, the United States Enrichment Corporation implements the 1993 government-to-government agreement between the United States and Russia that calls for Russia to convert 500 metric tons (550 tons) of HEU from dismantled nuclear warheads into LEU (DOE, 2010b). This is equivalent to about 20,000 nuclear warheads. The United States Enrichment Corporation purchases the enriched portion of the "downblended" 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. All program activities in the United States now take place at the Paducah plant (NRC, 2006). This program is scheduled to expire in 2013.

- *Other foreign sources provide about 47–52 percent of U.S. demand*. Other countries that produce and export enriched uranium to the United States include France, Germany, the Netherlands, and the United Kingdom (EIA, 2009b).

The current U.S. demand for enriched uranium is approximately 13–14 million SWUs per year (EIA, 2008; EIA, 2009b). As noted, recent forecasts indicate that this demand could reach 15 million to 16 million SWUs by 2025, depending on the rate of nuclear generation growth in the United States (EIA, 2008). Between 2005 and 2009, the United States Enrichment Corporation supplied between 10 and 13 million SWUs annually to the global market (USEC, 2010). Of this supply, 5.5 million SWUs annually came from downblending under the Megatons-to-Megawatts Program (USEC, 2010), which depends on deliveries from Russia. The remaining 4.5–7.5 million SWUs were produced domestically at the Paducah Gaseous Diffusion plant. Theoretically, all of Paducah's enrichment capacity could be sold to the U.S. market, and the overall foreign dependence could be reduced to 5.5–9.5 million SWUs of the 13–14 million SWU total annual demand (42–68 percent of the U.S. demand).

It is anticipated that gaseous diffusion enrichment operations in the United States will cease to exist in the near future because of the higher cost of aging facilities (DOE, 2007). The Megatons-to-Megawatts Program is scheduled to expire in 2013 (DOE, 2010b). As noted above, these two sources meet about half (48–53 percent) of the current U.S. demand for LEU.

To help fill the anticipated supply deficit, other potential future domestic sources of supply have emerged in recent years. The National Enrichment Facility (NEF) and American Centrifuge Plant (ACP) have already received construction and operating licenses from the NRC after NRC consideration of the environmental impacts of those projects (NRC, 2005; 2006), and AREVA applied for a license in 2008 (AES, 2008). If licensed and constructed, all three of these facilities would (or plan to) employ gaseous centrifuge technology. Louisiana Energy Services, LLC (LES) recently announced a potential plan to expand the annual capacity of the NEF from 3 million to 5.9 million SWUs in response to customer expressions of the need for additional enrichment services (Urenco, 2008). Such an expansion requires NRC review and approval. With the initial target capacity of 6 million SWUs per year for the proposed GLE Facility, and if all of the proposed facilities were constructed and operated at their rated capacities, enrichment capacity in the United States would exceed the projected annual demand (approximately 16 million SWUs) by about 6 million SWUs (assuming NEF is authorized to operate at 5.9 million SWUs and the Paducah Gaseous Diffusion Plant is shut down). However, given the uncertainties in future development and potential expansion of the proposed projects, this projected level of extra capacity would provide needed assurance that enriched uranium would be reliably available when needed for domestic nuclear power production. These three facilities and the proposed facility are summarized in Table 1-1.

Table 1-1 Licensed and Proposed Domestic Sources of Uranium Enrichment

Facility	Location	Owner	Production Capacity (million SWUs/year)	Current Status
National Enrichment Facility (NEF)	Lea County, New Mexico	Louisiana Energy Services, LLC (LES)	3.0[a]	Licensed June 23, 2006; under construction
American Centrifuge Plant (ACP)	Piketon, Ohio	USEC, Inc.	3.8	Licensed April 13, 2007; under construction
Eagle Rock Enrichment Facility (EREF)	Bonneville County, Idaho	AREVA Enrichment Services, LLC (AES)	6.6	Application submitted December 30, 2008; under review
Global Laser Enrichment Facility (GLE)	Wilmington, North Carolina	General Electric-Hitachi Global Laser Enrichment, LLC	6.0	Application submitted June 26, 2009; under review

[a] The NRC expects to receive a request to increase licensed NEF production to 5.9 million SWUs.

1.3.2 Need for Domestic Supplies of Enriched Uranium for National Energy Security

All domestic production of enriched uranium currently originates from a single gaseous diffusion plant at Paducah, Kentucky. This situation creates a reliability risk in U.S. domestic enrichment capacity. Any disruption in the supply of enriched uranium for domestic commercial nuclear reactors could have a detrimental impact on national energy security because nuclear reactors supply approximately 20 percent of the nation's electricity requirements. The proposed GLE Facility could play an important role in assuring the nation's ability to maintain a reliable and economical domestic source of enriched uranium.

In a letter to NRC regarding general policy issues raised by the LES license application, DOE stated that uranium enrichment is a critical step in the production of nuclear fuel and noted the decline in domestic enrichment capacity (DOE, 2002). In its 2002 letter, DOE also referenced comments made by the U.S. Department of State indicating that "Maintaining a reliable and economical U.S. uranium enrichment industry is an important U.S. energy security objective" (DOE, 2002). The proposed GLE Facility could contribute to the attainment of national energy security policy objectives by providing an additional domestic source of enriched uranium. This additional capacity would lessen U.S. dependence on foreign sources of enriched uranium.

At present, gaseous diffusion 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 (NRC, 2006). Gas centrifuge technology, which will be used at the NEF, ACP, and proposed EREF, is known to be more efficient and substantially less energy-intensive than gaseous diffusion technology. The GLE laser-based technology that would be deployed at the proposed GLE Facility is newer than gas centrifuge technology and, according to the proponent of the technology (GE-Hitachi Nuclear Energy [GEH]), offers certain advantages over both the gaseous diffusion and gas centrifuge processes (GLE, 2008a). For example, GEH considers laser-based technology to have lower operating costs and lower capital costs than either the gaseous diffusion or the gas centrifuge technology. GLE further projects the GLE laser-based technology to have advantages of two earlier-generation laser-excitation technologies in terms of anticipated high separation factors, low energy intensity, low cooling water requirements, small footprint, and low capital and operating costs (GLE, 2008a). Section 2.3.3 provides information about earlier-generation laser-excitation technologies, as well as competing technologies.

1.4 Scope of the Environmental Analysis

To fulfill its responsibilities under the *National Environmental Policy Act*, the NRC has prepared this draft EIS to analyze the potential environmental impacts (i.e., direct, indirect, and cumulative impacts) of the proposed GLE Facility as well as reasonable alternatives to the proposed action. The scope of this draft EIS includes consideration of both radiological and nonradiological (including chemical) impacts associated with the proposed action and the reasonable alternatives. In addition, this draft EIS identifies resource uses, monitoring, potential mitigation measures, unavoidable adverse environmental impacts, the relationship between short-term uses of the environment and long-term productivity, and irreversible and irretrievable commitments of resources.

The development of this draft EIS is the result of the NRC staff's review of the GLE license application (GLE, 2009a) and its supporting Environmental Report (GLE, 2008a), Environmental Report supplements (GLE, 2009b,c), and responses to the Request for Additional Information (RAI) (GLE, 2009d–i), as well as public and agency comments received during the scoping period. This review is being closely coordinated with the development of the Safety Evaluation Report being prepared by the NRC to evaluate, among other aspects, the radiological health and safety impacts of the proposed action. The Safety Evaluation Report is the outcome of the NRC safety review of the GLE license application.

1.4.1 Scope of the Proposed Action

On December 8, 2008, GLE submitted a request for exemption (GLE, 2008b) from specific NRC requirements governing "Commencement of Construction" as specified under 10 CFR 70.4, 10 CFR 70.23(a)(7), 10 CFR 30.4, 10 CFR 30.33(a)(5), 10 CFR 40.4, and 10 CFR 40.32(e). This exemption was approved by the NRC on May 8, 2009 (NRC, 2009c). The exemption allows GLE to proceed with certain activities that are considered outside of NRC regulatory purview (they are not related to radiological health and safety or the common defense and security) without an NRC license to construct and operate the GLE Facility (the proposed action). These activities, discussed further in Section 2.1.5, are referred to as "preconstruction" activities, as they are not considered construction activities under the definition of construction currently provided in 10 CFR 50.2 and10 CFR 51.4. Specifically, 10 CFR 51.4 states, in relevant part, that "construction" does not include the following activities:

i. Changes for temporary use of the land for public recreational purposes;

ii. Site exploration, including necessary borings to determine foundation conditions or other preconstruction monitoring to establish background information related to the suitability of the site, the environmental impacts of construction or operation, or the protection of environmental values;

iii. Preparation of a site for construction of a facility, including clearing of the site, grading, installation of drainage, erosion and other environmental mitigation measures, and construction of temporary roads and borrow areas;

iv. Erection of fences and other access control measures;

v. Excavation;

vi. Erection of support buildings (such as construction equipment storage sheds, warehouse and shop facilities, utilities, concrete mixing plants, docking and unloading facilities, and office buildings) for use in connection with the construction of the facility;

vii. Building of service facilities, such as paved roads, parking lots, railroad spurs, exterior utility and lighting systems, potable water systems, sanitary sewerage treatment facilities, and transmission lines;

viii. Procurement or fabrication of components or portions of the proposed facility occurring at other than the final, in-place location at the facility;

ix. Manufacture of a nuclear power reactor under a manufacturing license under Subpart F of Part 52 of this chapter to be installed at the proposed site and to be part of the proposed facility; or

x. With respect to production or utilization facilities, other than testing facilities and nuclear power plants, required to be licensed under Section 104.a or Section 104.c of the Act, the erection of buildings which will be used for activities other than operation of a facility and which may also be used to house a facility (e.g., the construction of a college laboratory building with space for installation of a training reactor).

As indicated in (iii) of the list above, site preparation is one component of preconstruction. As used in this document, the term “site preparation” includes the items specifically listed in (iii) above (i.e., clearing of the site, grading, installation of drainage, erosion and other environmental mitigation measures, and construction of temporary roads and borrow areas).

The NRC’s decision to grant the exemption request to GLE was based on the NRC staff finding that the request to perform certain preconstruction activities is authorized by law, will not endanger life or property or common defense and security, and is in the public interest (NRC, 2009b). The exemption covered the following activities and facilities:

- clearing of approximately 40 hectares (100 acres)[3]

- site grading and erosion control

[3] Due to minor adjustments in the facility layout, the proposed GLE Facility is currently estimated to encompass approximately 47 hectares (117 acres). For consistency within this draft EIS and with the GLE Environmental Report (GLE, 2008), it continues to be referred to as the approximately 40-hectare (100-acre) proposed GLE Facility. However, the impact analyses performed in this draft EIS consider the larger area.

- stormwater retention ponds

- main access roadways and guardhouses
- utilities

- parking lots

- administrative buildings not used to process, handle, or store classified information

The authorization to conduct the listed activities or construct the listed facilities prior to the NRC licensing decision was based on the condition that none of the facilities or activities subject to the exemption will be, at a later date, a component of GLE's Physical Security Plan or its Standard Practice Procedures Plan for the Protection of Classified Matter or otherwise subject to NRC review or approval. Approval of the exemption request does not indicate that a licensing decision has been made by the NRC. Preconstruction activities would be completed by GLE with the risk that a license may not be issued.

GLE indicated that the activities it undertakes under the exemption request may include all of the above-listed activities (GLE, 2009d). GLE also indicated that the actual work to be completed and the schedule are uncertain at this time, due to various business factors. In its RAI response, GLE stated that some of the activities could be up to 75 percent complete, whereas others maybe only 10 percent complete by the time the NRC decides whether or not to grant a license. Thus, although the activities covered by the NRC's May 8, 2009 exemption (NRC, 2009c) are referred to in this document as "preconstruction" activities, some of these activities may continue after the commencement of construction, if a license is issued. In addition, GLE indicated that if for any reason the proposed GLE Facility project does not reach fruition, the decision to continue to develop the area referred to as the 40-hectare (100-acre) proposed GLE Facility would be made by GE senior management. GE may continue to develop the land to construct administrative facilities (i.e., office space) if there is a future expansion of the Wilmington Site workforce. If the land would not be used in the immediate future following the decision to cancel the proposed GLE Facility project, GE would consider replanting all or a portion of the area with native trees, in accordance with then-current Wilmington Site forest management activities (GLE, 2009d).

The activities authorized under the exemption are expected to occur whether or not the license is granted. As a result, the NRC does not consider these activities as part of the proposed action or the no action alternative. However, because they are related to the construction of the proposed GLE Facility, NRC staff analyzed their impacts in Chapter 4 as part of the impacts considered under "Preconstruction and Construction." However, the staff also attempted, to the extent possible, to separate the impacts from site preparation and construction activities into those that would occur as a result of preconstruction activities and those that would occur as a result of construction activities as defined in 10 CFR 50.2 and 10 CFR 51.4. The staff also considered all of the impacts that would be expected to occur under preconstruction and construction in evaluating the cumulative impacts of the proposed action.

In addition to construction, the scope of the proposed action also includes the activities associated with the operation and decontamination and decommissioning of the proposed GLE Facility. These impacts are discussed in Chapter 4.

1.4.2 Scoping Process and Public Participation Activities

The NRC regulations in 10 CFR Part 51 contain requirements for conducting a scoping process prior to the preparation of an EIS. Scoping was used to help identify the relevant issues to be discussed in detail and to help identify issues that are beyond the scope of this draft EIS, which do not warrant a detailed discussion, or are not directly relevant to the assessment of potential impacts from the proposed action.

On April 9, 2009, the NRC published a Notice of Intent (NOI) in the *Federal Register* (74 FR 16237) to prepare an EIS for the construction, operation, and decommissioning of the proposed GLE Facility and to conduct the scoping process for the EIS. The NOI summarized the NRC's plans to prepare the EIS and presented background information on the proposed GLE Facility. For the scoping process, the NOI invited comments on the proposed action and announced a public scoping meeting to be held concerning the project.

On July 14–17, 2008, and May 18–20, 2009, the NRC staff met with State and local officials and toured the proposed GLE Facility site. On July 17, 2009, NRC staff held a public information meeting to provide background information about the NRC's safety and environmental review processes and to notify the public to the upcoming public scoping period. On May 19, 2009, the NRC held two public scoping meetings in Wilmington, North Carolina. During the scoping meetings, a number of individuals provided oral comments to the NRC concerning the proposed GLE Facility and the development of the draft EIS. In addition, the NRC received written comments during the public scoping period that was to end on June 8, 2009. The NRC subsequently extended the scoping period to August 31, 2009, to allow members of the public to examine GLE's license application, which was submitted on June 26, 2009. The NRC reviewed and identified substantive scoping comments (both oral and written). These comments were then consolidated and categorized by topical areas.

After the scoping period, the NRC issued the *Environmental Scoping Summary Report: Proposed GE-Hitachi Global Laser Enrichment Facility in Wilmington, North Carolina* in November 2009 (see Appendix A). The report identifies categories of issues to be analyzed in detail and issues determined to be beyond the scope of the EIS.

1.4.3 Issues Studied in Detail

As stated in the NOI, the NRC identified issues to be studied in detail as they relate to implementation of the proposed action. The public identified additional issues during the subsequent public scoping process. Issues identified by the NRC and the public that could have short- or long-term impacts from the potential construction and operation of the proposed GLE Facility include:

- need for the facility
- compliance with applicable regulations
- alternatives
- decommissioning
- cumulative impacts
- land use
- air quality
- noise
- historic and cultural resources
- visual and scenic resources
- socioeconomic impacts
- public and occupational health

- transportation
- accidents
- geology and soils
- water resources
- ecological resources
- waste management
- depleted uranium disposition
- environmental justice
- costs and benefits
- resource commitments

1.4.4 Issues Eliminated from Detailed Study

No issues were eliminated from detailed study as a result of the public scoping process. However, some issues are analyzed in detail in the NRC's Safety Evaluation Report and are only summarized in the draft EIS. For example, within the area of safety and security, the Safety Evaluation Report analyzes the probabilities and consequences of various accidents at the proposed GLE Facility, as well as measures to prevent those accidents and mitigate their effects. This draft EIS does not go into the same level of detail, but summarizes, in Section 4.2.15, the accident analysis from the Safety Evaluation Report for the purpose of assessing the potential environmental impacts of accidents. Alternatives considered but not analyzed in detail are discussed in Section 2.3.

1.4.5 Issues Outside the Scope of the EIS

The following issues raised during the scoping process have been determined to be outside the scope of the EIS (see Appendix A):

- nonproliferation

- GE's pursuit of boiling water reactors

- terrorism

1.4.6 Related NEPA and Other Relevant Documents

The following NEPA documents were reviewed as part of the development of this draft EIS.

- *Environmental Impact Statement for the Proposed American Centrifuge Plant in Piketon, Ohio, Final Report, NUREG-1834, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, April, 2006.* This EIS analyzes the potential environmental impacts of the proposed siting, construction, operation, and decommissioning of a gas centrifuge uranium enrichment facility at the existing DOE reservation in Piketon, Ohio. Its description of the purpose of and need for the proposed action, as well as its review of alternatives to the proposed action, are highly relevant to the proposed GLE Facility analysis. The environmental impacts discussed for the proposed ACP are also relevant to the impact analysis for the proposed GLE Facility, especially the analysis of cumulative impacts associated with the management of depleted uranium hexafluoride (UF_6) generated by the ACP and NEF, and the proposed GLE Facility and EREF as well as the existing DOE inventory of depleted UF_6.

- *Environmental Impact Statement for the Proposed National Enrichment Facility in Lea County, New Mexico, Final Report, NUREG-1790, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, June, 2005.* This EIS analyzes the potential environmental impacts of the proposed siting, construction, operation, and decommissioning of a gas centrifuge uranium enrichment facility near Eunice, New Mexico. Its description of the purpose of and need for the proposed action, as well as its review of alternatives to the proposed action, are highly relevant to the proposed GLE Facility analysis. The environmental impacts discussed for the proposed NEF are also relevant to the impact analysis for the proposed GLE Facility, especially the analysis of cumulative impacts associated with the management of depleted UF_6 generated by the ACP and NEF, and the proposed GLE Facility and EREF as well as the existing DOE inventory of depleted UF_6.

- *Final Environmental Impact Statement for the Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the Portsmouth, Ohio, Site, DOE/EIS-0360, Oak Ridge Operations, Office of Environmental Management, U.S. Department of Energy, June, 2004.* This site-specific EIS analyzes the impacts associated with the construction, operation, and decommissioning of a depleted UF_6 conversion facility at the Portsmouth, Ohio, site. The EIS also evaluates the impacts of transporting cylinders (depleted UF_6, enriched uranium, and empty) that used to be stored at the East Tennessee Technology Park near Oak Ridge, Tennessee, to Portsmouth. Transportation of depleted UF_6 conversion products and waste materials to a disposal facility, transportation and sale of the hydrogen fluoride produced as a conversion co-product; and neutralization of hydrogen fluoride to calcium fluoride and its sale or disposal in the event that the hydrogen fluoride product is not sold are also evaluated. The results presented in the EIS are relevant to the management, use, and potential impacts associated with the depleted UF_6 that would be generated at the proposed GLE Facility and the cumulative impacts of depleted UF_6 from the ACP and NEF, and the proposed GLE Facility and EREF as well as the existing DOE inventory of depleted UF_6.

- *Final Environmental Impact Statement for the Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the Paducah, Kentucky, Site, DOE/EIS-0359, Oak Ridge Operations, Office of Environmental Management, U.S Department of Energy, June, 2004.* This site-specific EIS is very similar to the EIS for the Portsmouth, Ohio, site, except that the conversion facility is at the Paducah, Kentucky, site.

- *Environmental Assessment: Disposition of Russian Federation Titled Natural Uranium. DOE/EA-1290, Office of Nuclear Energy, Science and Technology, U.S. Department of Energy, June 1999.* This Environmental Assessment (EA) analyzed the environmental impacts of transporting natural UF_6 from the gaseous diffusion plants to the Russian Federation. Transportation by rail and truck within the United States were considered. The EA addresses both incident-free transportation and transportation accidents. The results presented in this EA are relevant to the transportation of UF_6 for the proposed GLE Facility.

- *Final Programmatic Environmental Impact Statement for Alternative Strategies for the Long-Term Management and Use of Depleted Uranium Hexafluoride, DOE/EIS-0269, Office of Nuclear Energy, Science and Technology, U.S. Department of Energy, April 1999.* This EIS analyzes strategies for the long-term management of the depleted UF_6 inventory that was stored at three DOE sites near Paducah, Kentucky; Portsmouth, Ohio; and Oak Ridge, Tennessee at the time the EIS was prepared. This EIS also analyzes the potential environmental consequences of implementing each alternative strategy for the period 1999 through 2039. The results presented in this EIS are relevant to the management, use, and potential impacts associated with the depleted UF_6 that would be generated at the proposed GLE Facility and the cumulative impacts of depleted UF_6 from the ACP and NEF and the proposed GLE Facility and EREF as well as the existing DOE inventory of depleted UF_6.

1.5 Applicable Statutory and Regulatory Requirements

This section provides a summary assessment of the major environmental requirements, agreements, Executive Orders, and permits relevant to the construction, operation, and decommissioning of the proposed GLE Facility.

1.5.1 Federal Laws and Regulations

1.5.1.1 *National Environmental Policy Act of 1969*, as amended (42 U.S.C. 4321 et seq.)

The *National Environmental Policy Act* (NEPA) establishes national environmental policy and goals for the protection, maintenance, and enhancement of the environment to ensure for all Americans a safe, healthful, productive, and aesthetically and culturally pleasing environment. The Act provides a process for implementing these specific goals within the Federal agencies responsible for the action. This draft EIS has been prepared in accordance with NEPA requirements and NRC regulations (10 CFR Part 51) for implementing NEPA.

1.5.1.2 *Atomic Energy Act of 1954*, as amended (42 U.S.C. 2011 et seq.), and the *Energy Reorganization Act of 1974* (42 U.S.C. 5801 et seq.)

The *Atomic Energy Act* (AEA), as amended, and the *Energy Reorganization Act of 1974* (Title 42, Section 5801 et seq. of the *United States Code* [42 U.S.C. 5801 et seq.]) give the NRC the licensing and regulatory authority for nuclear energy uses within the commercial sector. If the license application for the proposed GLE Facility is approved, the NRC would license and regulate the possession, use, storage, and transfer of special nuclear, source, and by-product materials to protect public health and safety as stipulated in 10 CFR Parts 30, 40, and 70.

1.5.1.3 *Clean Air Act of 1970,* as amended (42 U.S.C. 7401 et seq.)

The *Clean Air Act* (CAA) establishes regulations to ensure air quality and authorizes individual States to manage permits. The CAA requires (1) the U.S. Environmental Protection Agency (EPA) to establish National Ambient Air Quality Standards as necessary to protect the public health, with an adequate margin of safety, from any known or anticipated adverse effects of a regulated pollutant (42 U.S.C. 7409 et seq.); (2) the establishment of national standards of performance for new or modified stationary sources of atmospheric pollutants (42 U.S.C. 7411); (3) specific emission increases to be evaluated so as to prevent a significant deterioration in air quality (42 U.S.C. 7470 et seq.); and (4) specific standards for releases of hazardous air pollutants (including radionuclides) (42 U.S.C. 7412). These standards are implemented through plans developed by each State and approved by the EPA. The CAA requires sources to meet standards and obtain permits to satisfy those standards. The North Carolina

Department of Environment and Natural Resources (NCDENR) Division of Air Quality implements the CAA in the State. Construction and operating permits are required for the proposed GLE Facility but emissions during operation will not rise to the CAA's major source threshold.

1.5.1.4 *Clean Water Act of 1977* (amending the *Federal Water Pollution Control Act of 1948*), as amended (33 U.S.C. 1251 et seq.)

The *Clean Water Act* (CWA) requires the EPA to set national effluent limitations and water quality standards and establishes a regulatory program for enforcement. Specifically, Section 402(a) of the Act establishes water quality standards for contaminants in surface waters. The CWA requires a National Pollutant Discharge Elimination System (NPDES) permit before discharging any point source pollutant into surface waters of the United States. The NPDES permit program contains a program applicable to discharges of stormwater to waters of the United States from construction and industrial operations. Section 404 of the CWA authorizes the U.S. Army Corps of Engineers (USACE) to issue permits for the discharge of dredged or fill material into the waters of the United States. The Section 401 water quality certification and NPDES provisions of the CWA have been delegated to the NCDENR Division of Water Quality. The proposed GLE Facility will require a Section 404 permit. Existing NPDES permits for Wilmington Site operations will require modification to incorporate the proposed GLE Facility; a new NPDES permit for construction of the facility will be required.

1.5.1.5 *Resource Conservation and Recovery Act of 1976* (amending the *Solid Waste Disposal Act of 1965*), as amended (42 U.S.C. 6901 et seq.)

The *Resource Conservation and Recovery Act* (RCRA), as amended, requires the EPA to define and identify hazardous waste; establish standards for its transportation, treatment, storage, and disposal; and require permits for persons engaged in hazardous waste activities. Section 3006 (42 U.S.C. 6926) allows States to establish and administer these permit programs with EPA approval; the NCDENR Division of Waste Management has received that approval. EPA regulations implementing RCRA are found in 40 CFR Parts 260 through 283. Regulations imposed on a generator or on a treatment, storage, and/or disposal facility vary according to the type and quantity of material or waste generated, treated, stored, and/or disposed. The method of treatment, storage, and/or disposal also affects the extent and complexity of the requirements. A RCRA treatment, storage, or disposal permit will not be required for the proposed GLE Facility due to the amount of hazardous waste generated and the stated plans for the wastes to be shipped to a RCRA-permitted facility within the 90-day accumulation period. A hazardous waste generator number will be required.

1.5.1.6 *Low-Level Radioactive Waste Policy Act of 1980*, as amended (42 U.S.C. 2021 et seq.)

The *Low-Level Radioactive Waste Policy Act of 1980* amended the AEA to specify that the Federal Government is responsible for disposal of low-level radioactive waste generated by its activities and that States are responsible for disposal of other low-level radioactive waste (LLRW). The *Low-Level Radioactive Waste Policy Act of 1980* provides for and encourages interstate compacts to carry out the State responsibilities. The LLRW generated at the proposed GLE Facility is Class-A waste; this class has the lowest concentration of radioactive material and poses the least potential hazard of the LLRW classes. Plans call for shipment of the LLRW to the Energy*Solutions* disposal facility in Clive, Utah.

1.5.1.7 *Emergency Planning and Community Right-to-Know Act of 1986* (42 U.S.C. 11001 et seq.) (also known as Superfund Amendments and Reauthorization Act of 1986 [SARA] Title III)

The *Emergency Planning and Community Right-to-Know Act of 1986*, which is the major amendment to the *Comprehensive Environmental Response, Compensation, and Liability Act* (42 U.S.C. 9601), establishes the requirements for Federal, State, and local governments; Indian tribes; and industry regarding emergency planning and "Community Right-to-Know" reporting on hazardous and toxic chemicals. The "Community Right-to-Know" provisions increase the public's knowledge and access to information about chemicals at individual facilities, their uses, and releases into the environment. States and communities working with facilities can use the information to improve chemical safety and protect public health and the environment. The Act requires emergency planning and notice to communities and government agencies concerning the presence and release of specific chemicals. The EPA implements this Act under regulations found in 40 CFR Parts 355, 370, and 372. The Act requires the proposed GLE Facility to provide the State Emergency Planning Committee and local fire departments with information on the storage and use of chemicals above certain threshold levels and comply with toxic chemical reporting requirements if thresholds for chemical releases are exceeded.

1.5.1.8 *Safe Drinking Water Act of 1974*, as amended (42 U.S.C. 300f et seq.)

The *Safe Drinking Water Act* was enacted to protect the quality of public water supplies and sources of drinking water through establishing minimum national standards for public water supply systems. The Act includes the Sole Source Aquifer Program and provisions for the protection of public drinking water systems. The NCDENR Division of Environmental Health, Public Water Supply Section enforces the *Safe Drinking Water Act*. The proposed GLE Facility would use groundwater for industrial process water and drinking water from wells on the Wilmington Site. North Carolina requires the registration of water withdrawals above certain thresholds; the Wilmington Site registers its withdrawals with the State.

1.5.1.9 *Noise Control Act of 1972*, as amended (42 U.S.C. 4901 et seq.)

The *Noise Control Act* delegates 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. New Hanover County enacted a noise ordinance pursuant to the authority granted it by a North Carolina law. The noise ordinance established decibel levels for areas zoned nonresidential with which the proposed GLE Facility must comply.

1.5.1.10 *National Historic Preservation Act of 1966*, as amended (16 U.S.C. 470 et seq.)

The *National Historic Preservation Act* was enacted to create a national historic preservation program, including the *National Register of Historic Places* (NRHP) and the Advisory Council on Historic Preservation (ACHP). Section 106 requires Federal agencies to take into account the effects of their undertakings on historic properties. The ACHP regulations implementing

Section 106 of the Act are found in 36 CFR Part 800. The regulations call for public involvement in the Section 106 consultation process, including American Indian tribes and other interested members of the public, as applicable. The NRC has initiated the Section 106 consultation process (see Section 1.5.6.2 and Appendix B).

1.5.1.11 ***Endangered Species Act of 1973,*** **as amended (16 U.S.C. 1531 et seq.)**

The *Endangered Species Act* (ESA*)* was enacted to prevent the further decline of endangered and threatened species and to restore those species and their critical habitats. Section 7 of the Act requires consultation with the U.S. Fish and Wildlife Service (FWS) of the U.S. Department of the Interior or the National Marine Fisheries Service of the U.S. Department of Commerce to determine whether endangered and threatened species or their critical habitats are known to be in the vicinity of the proposed action, and to determine whether the proposed Federal action may affect listed species or critical habitat. The NRC has initiated the ESA consultation process (see Section 1.5.6.1 and Appendix B).

1.5.1.12 ***Coastal Zone Management Act of 1972*****, as amended (16 U.S.C. 1451 et seq.)**

The *Coastal Zone Management Act* (CZMA) provides for management of the nation's coastal resources and balances economic development with environmental conservation. It encourages States and tribes to voluntarily preserve, protect, develop, and where possible, restore or enhance valuable natural coastal resources such as wetlands, floodplains, estuaries, beaches, dunes, barrier islands, and coral reefs, as well as the fish and wildlife using those habitats. The Act makes federal financial assistance available to any coastal State, tribe, or territory that is willing to develop and implement a comprehensive coastal management program. The CZMA is implemented by the North Carolina Division of Coastal Management through the state's Coastal Area Management Act.

1.5.1.13 ***Magnuson-Stevens Fishery Conservation and Management Reauthorization Act*** **of** ***2006*****, as amended (16 U.S.C. 1801 et seq.)**

The *Magnuson-Stevens Fishery Conservation and Management Reauthorization Act* provides for a national program for the conservation and management of the fishery resources of the United States. The purposes of the program are to prevent overfishing, rebuild overfished stocks, ensure conservation, facilitate long-term protection of essential fish habitats, and realize the full potential of the nation's fishery resources. The Act establishes regional fishery management councils which can develop fishery management plans; North Carolina is a member of the South Atlantic Council.

1.5.1.14 ***Occupational Safety and Health Act of 1970*****, as amended (29 U.S.C. 651 et seq.)**

The *Occupational Safety and Health Act* establishes standards to enhance safe and healthy working conditions in places of employment throughout the United States. The Act is administered and enforced by the Occupational Safety and Health Administration (OSHA), a U.S. Department of Labor agency. The identification, classification, and regulation of potential occupational carcinogens are found in 29 U.S.C. 1910.101, while the standards pertaining to hazardous materials are listed in 29 U.S.C. 1910.120. The Occupational Health and Safety

Administration regulates mitigation requirements and mandates proper training and equipment for workers. The proposed GLE Facility would be required to comply with these regulations.

1.5.1.15 *Hazardous Materials Transportation Act of 1975* (49 U.S.C. 1801 et seq.)

The *Hazardous Materials Transportation Act* regulates transportation of hazardous material (including radioactive material) in and between States. According to the Act, States may regulate the transport of hazardous material as long as they are consistent with the Act or the U.S. Department of Transportation regulations provided in 49 CFR Parts 171 through 177. 49 CFR Part 173, Subpart I, contains other regulations regarding packaging for transportation of radionuclides. The transport of radioactive materials to and from the proposed GLE Facility would be required to comply with these regulations.

1.5.1.16 *United States Enrichment Corporation Privatization Act of 1996* (42 U.S.C. 2011 et seq.)

The *United States Enrichment Corporation Privatization Act* establishes a disposal option for depleted uranium if it is determined to be low-level radioactive waste; the NRC made that determination in 2005. The Act allows any person licensed by the NRC to operate a uranium enrichment facility to request that the U.S. Department of Energy accept for disposal as low-level radioactive waste depleted uranium it generated. GLE thus has the option of requesting that its depleted uranium be accepted by the Department of Energy for disposal.

1.5.1.17 *Environmental Standards for the Uranium Fuel Cycle* (40 CFR Part 190, Subpart B)

These regulations establish maximum doses to the body or organs of members of the public as a result of operational normal releases from uranium fuel cycle activities, including uranium enrichment. These regulations were promulgated by the EPA under the authority of the AEA, as amended, and have been incorporated by reference in the NRC regulations in 10 CFR 20.1301(e). The proposed GLE Facility would be required to comply with these regulations for releases from normal operations.

1.5.2 Applicable Executive Orders

- *Executive Order 11988* (Floodplain Management) directs Federal agencies to establish procedures to ensure that the potential effects of flood hazards and floodplain management are considered for any action undertaken in a floodplain and that floodplain impacts be avoided to the extent practicable.

- *Executive Order 11990* (Protection of Wetlands) directs Federal agencies to avoid new construction in wetlands unless there is no practicable alternative and unless the proposed action includes all practicable measures to minimize harm to wetlands that might result from such use.

- *Executive Order 12898* (Environmental Justice) calls for Federal agencies to address environmental justice in minority and low-income populations, and directs Federal agencies to identify and address, as appropriate, disproportionately high and adverse health or environmental effects of their programs, policies, and activities on minority and low-income populations. In response to this Executive Order, the NRC issued a final policy statement on the "Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions" (69 FR 52040; August 24, 2004) and environmental justice procedures to be followed in NEPA documents prepared by the NRC's Office of Nuclear Material Safety and Safeguards (NRC, 2003).

1.5.3 Applicable State of North Carolina Requirements

Certain environmental requirements, including some discussed earlier, have been delegated to State authorities for implementation, enforcement, or oversight. Table 1-2 lists the State of North Carolina environmental requirements.

1.5.4 Permit and Approval Status

Several construction and operating permits must be prepared and submitted, and regulatory approval and/or permits must be received prior to construction or operation of the proposed GLE Facility. Table 1-3 lists the Federal, State, and local permits that may be required and their present status.

1.5.5 Cooperating Agencies

No Federal, State, or local agencies are cooperating agencies in the preparation of this draft EIS.

1.5.6 Consultations

As a Federal agency, the NRC is required to comply with the consultation requirements of the *Endangered Species Act of 1973*, the *National Historic Preservation Act of 1966,* and the *Fish and Wildlife Coordination Act of 1934.*

Table 1-2 State of North Carolina Environmental Regulations

Law/Regulation	Citation	Requirements
Air Pollution Control Requirements	*15A North Carolina Administrative Code* (NCAC) 02D, authorized by *North Carolina General Statutes* (NCGS) 143, Article 21B, Air Pollution Control[a]	Establishes a system for classifying air pollution sources which the Environmental Management Commission uses to classify air pollution sources it believes to be of sufficient importance to justify classification or control.
Air Quality Permit Procedures	15A NCAC 02Q, authorized by NCGS 143, Article 21B, Air Pollution Control	Establishes the requirements and procedures for applying for construction and operation air quality permits and exceptions to them; incorporates 40 CFR Parts 61 to 80 by reference.

Table 1-2 State of North Carolina Environmental Regulations (Cont.)

Law/Regulation	Citation	Requirements
Archaeology and Historic Preservation Section	07 NCAC 04R, authorized by multiple NCGS	Establishes the role of the State Historic Preservation Officer (SHPO), the procedures for archaeological review, and the process for making nominations to the NRHP.
Coastal Management	15A NCAC 07, authorized by NCGS 113A, Article 7, Coastal Area Management	Requires a permit before undertaking any development in any area of environmental concern. Establishes a cooperative program of coastal area management between local and State governments.
Discharges to Isolated Wetlands and Isolated Waters	15A NCAC 02H.1300, authorized by NCGS 143, Article 21, Water and Air Resources	Defines the terms “discharge” and “isolated wetlands” and requires an Individual Permit or a Certificate of Coverage to operate under a General Permit for any regulated discharges to isolated wetlands.
Endangered and Threatened Species	15A NCAC 10I , authorized by NCGS 113, Article 24, Endangered and Threatened Wildlife and Wildlife Species of Special Concern	Bans open seasons for taking any of the species listed as endangered or threatened; establishes permit protocols for taking or possessing an endangered, threatened, or special concern species.
Hazardous Waste Management	15A NCAC 13A, authorized by NCGS 130A, Article 9, Solid Waste Management	Establishes the general requirements for the State’s hazardous waste management program and permit program; adopts applicable RCRA regulations by reference.
Hazardous Waste Permit Program	15A NCAC 13A.0113, authorized by NCGS 130A, Article 9, Solid Waste Management	Establishes the procedures and requirements for hazardous waste permits; incorporates 40 CFR 270.1 through 270.6 by reference.
Historic Sites Regulation	07 NCAC 04N authorized by NCGS 121, Article 1, General Provisions	Itemizes activities banned from state historic site properties unless specifically authorized via a written work order or permit; describes the permit process.

Table 1-2 State of North Carolina Environmental Regulations (Cont.)

Law/Regulation	Citation	Requirements
Human Skeletal Remains	NCGS 70, Article 3, *Unmarked Human Burial and Human Skeletal Remains Protection Act*	Requires cessation of activities disturbing unmarked human burials or human skeletal remains when they are encountered as a result of construction until authorization to resume the activity is received either from the county medical examiner or the State Archaeologist.
Noise	*New Hanover County Code of Ordinances*, Chapter 23, Article II, authorized by GS 153A-133, Noise Regulation	Establishes the lawful decibel levels and corresponding time periods for non-residentially zoned districts.
Point Source Discharges to the Surface Waters	15A NCAC 02H.0100, authorized by NCGS 143, Article 21, Water and Air Resources	Provides the requirements and procedures for application and issuance of State NPDES permits for discharges from outlets, point sources, or disposal systems discharging to the surface waters of the State.
Radiation Protection	15A NCAC 11 authorized by NCGS 104E, *North Carolina Radiation Protection Act*	Regulates the use of source material, by-product material, and special nuclear material in quantities not sufficient to form a critical mass for the protection of public health, safety, or property. Requires a specific or general license to receive, possess, use, transfer, own, or acquire radioactive material.
Surface Water and Wetland Standards	15A NCAC 02B, authorized by NCGS 143, Article 21, Water and Air Resources	Establishes the rules for the series of State classifications and water quality standards applicable to surface waters and wetlands.
Waste Not Discharged to Surface Waters	15A NCAC 02T, authorized by NCGS 143, Article 21, Water and Air Resources, and NCGS 130A, Article 11, Wastewater Systems	Establishes the requirements and procedures for application and issuance of permits for systems such as sewer systems, disposal systems, and treatment works that do not discharge to surface waters of the State.

Table 1-2 State of North Carolina Environmental Regulations (Cont.)

Law/Regulation	Citation	Requirements
Water Quality Certification	15A NCAC 02H.0500, authorized by NCGS 143, Article 21, Water and Air Resources	Outlines the application and review procedures for activities requiring water quality certifications because they involve discharges into navigable waters.
Water Use Registration and Allocation	15A NCAC 02E, authorized by NCGS 143, Article 21, Water and Air Resources	Establishes the requirements and procedures for registering water withdrawals above certain thresholds and periodic updates of the registration.

[a] 15A = Title; NCAC = *North Carolina Administrative Code*; 02 = Chapter; D = Subtitle. The number following NCGS is the chapter number.

1.5.6.1 *Endangered Species Act of 1973* Consultation

The *Endangered Species Act* was enacted to prevent the further decline of endangered and threatened species and to restore those species and their critical habitats. Section 7 of the Act requires consultation with the FWS of the U.S. Department of the Interior or the NMFS of the U.S. Department of Commerce to determine whether endangered and threatened species or their critical habitats are known to be in the vicinity of the proposed action, and to determine whether the proposed Federal action may affect listed species or critical habitat. On May 1, 2009, the NRC staff sent a letter to the FWS Raleigh Field Office describing the proposed action and requesting a list of threatened and endangered species and critical habitats that could potentially be affected by the proposed action (NRC, 2009b). A similar letter was sent to the NMFS Southeast Regional Office (NRC, 2009d). By letter dated June 8, 2009, the FWS Raleigh Field Office indicated that nine listed species are present in New Hanover County and that several of the species may occur in the area of the Wilmington Site (FWS, 2009). The FWS wanted those species to be considered in the draft EIS. By e-mail sent August 3, 2009, the NMFS sent information on the protected species under its purview that may occur in the area of the Wilmington Site (NOAA, 2009).

1.5.6.2 *National Historic Preservation Act of 1966* Section 106 Consultation

The *National Historic Preservation Act* was enacted to create a national historic preservation program, including the *National Register of Historic Places* (NRHP) and the Advisory Council on Historic Preservation (ACHP). Section 106 requires Federal agencies to take into account the effects of their undertakings on historic properties. The ACHP regulations implementing Section 106 of the Act are found in 36 CFR Part 800. The regulations call for public involvement in the Section 106 consultation process, including American Indian tribes and other interested members of the public, as applicable. In response to an April 29, 2009, letter from the NRC (NRC, 2009a), the North Carolina Department of Cultural Resources confirmed via a letter dated June 2, 2009, that an archeological site was eligible for listing on the NRHP (NCDCR, 2009). On September 2, 2009, the NRC sent letters to 16 American Indian tribes

Table 1-3 Potentially Applicable Permit and Approval Requirements for the Construction and Operation of the Proposed GLE Facility

License, Permit, or Other Required Approval	Responsible Agency	Authority	Relevance and Status
Federal			
Rules of General Applicability to Domestic Licensing of By-product Material, Domestic Licensing of Source Material, and Domestic Licensing of Special Nuclear Material	NRC	10 CFR Parts 30, 40, and 70, authorized by the AEA	The proposed GLE Facility must obtain a license to possess and use source material, special nuclear material, and by-product material; an application for the required license has been submitted.
Section 404 Permit	USACE	40 CFR Part 230, authorized by the CWA	The discharge of dredged or fill material into the waters of the United States will be associated with the proposed GLE Facility; an application for the permit allowing such discharge will be made.
Endangered Species Act Consultation	FWS	50 CFR Part 402, authorized by the ESA	Formal consultation will be required if a listed species will be affected.
National Historic Preservation Act Consultation	ACHP	36 CFR Part 800, authorized by the *National Historic Preservation Act*	Consultation regarding possible inclusion of a site on the NRHP
State			
Construction and Operating Permit	North Carolina Division of Air Quality	15A NCAC 02Q.0300, Construction and Operation Permits; authorized by NCGS 143, Article 21B, Air Pollution Control	Air emissions from the construction phase of the proposed GLE Facility are expected to be minimal and will not rise to the level of meeting the threshold for a major source when operations commence. Application will be made for a construction and operating permit.

Table 1-3 Potentially Applicable Permit and Approval Requirements for the Construction and Operation of the Proposed GLE Facility (Cont.)

License, Permit, or Other Required Approval	Responsible Agency	Authority	Relevance and Status
State (Cont.)			
Section 401 Water Quality Certification	North Carolina Division of Water Quality	15A NCAC 02H.0500, authorized by NCGS 143, Article 21, Water and Air Resources	The proposed GLE Facility will require a CWA Section 404 permit, which is dependent on issuance of a water quality certification; the certification will be sought.
NPDES Individual Permit for Construction Stormwater Management	North Carolina Division of Water Quality	15A NCAC 2H.0100, authorized by NCGS 143, Article 21, Water and Air Resources	Stormwater discharge will be associated with construction of the proposed GLE Facility; an application will be made for an NPDES permit.
NPDES Individual Permit for Stormwater Management (Operations)	North Carolina Division of Water Quality	15A NCAC 2H.0100, authorized by NCGS 143, Article 21, Water and Air Resources	The existing Wilmington Site permit, NCS000022, will be modified to accommodate anticipated increased stormwater discharge associated with operation of the proposed GLE Facility.
NPDES Individual Permit for Industrial and Sanitary Waste Treatment	North Carolina Division of Water Quality	15A NCAC 02T.0100, authorized by NCGS 143, Article 21, Water and Air Resources	The existing Wilmington Site final process lagoon and sanitary wastewater treatment facilities will be used to process wastewater and sanitary wastewater from the proposed GLE Facility. The existing Wilmington Site permit, NC0001228, will be modified.
Isolated Wetlands Permit	North Carolina Division of Water Quality	15 NAC 02H.1300, authorized by NCGS 143, Article 21, Water and Air Resources	A permit will be requested if impacts on isolated wetlands will result from construction or operations as apparent from the final facility design.
Hazardous Waste Generator Identification Number	North Carolina Division of Waste Management	15A NCAC 13A.0107(a), authorized by NCGS 130A, Article 9, Solid Waste Management	The proposed GLE Facility will produce hazardous waste at volumes requiring a generator identification number; application for the number will be made.

Table 1-3 Potentially Applicable Permit and Approval Requirements for the Construction and Operation of the Proposed GLE Facility (Cont.)

License, Permit, or Other Required Approval	Responsible Agency	Authority	Relevance and Status
State (Cont.)			
Radioactive Materials License	North Carolina Radioactive Materials Branch	15A NCAC 11, authorized by NCGS 104E, *North Carolina Radiation Protection Act*	The use of radioactive materials at the proposed GLE Facility will require a license from the State; the license will be requested.
Coastal Area Management Act Permit	North Carolina Division of Coastal Management	15A NCAC 7, authorized by NCGS 113A, Article 7, Coastal Area Management	A preliminary review revealed that a coastal area management permit was not necessary; however, the project could be subject to additional review and a possible permit depending on the status of the USACE-granted Section 404 permit.
Driveway and Right-of-Way Permits	North Carolina Department of Transportation	19A NCAC 02B.0602, authorized by NCGS 136, Article 6D, Controlled Access Facilities	An entrance off NC 133 (Castle Hayne road) to the proposed GLE Facility is planned requiring a driveway permit; the permit will be requested.
Local Agencies			
Tree Removal Permit or Letter of Exemption	New Hanover County	Zoning Ordinance, Article VI, Supplementary District Regulations	If the final design for the proposed GLE Facility requires the removal of significant or regulated trees, a tree removal permit or a letter of exemption from the County Zoning Administrator will be required; if required, it will be requested.
Land-Disturbing Permit	New Hanover County	Chapter 23, Article VI, Erosion and Sedimentation	The proposed GLE Facility will disturb more than 0.4 hectare (1 acre) of land, thereby triggering the need for an approved erosion and sedimentation control plan and permit; a permit will be requested.

Table 1-3 Potentially Applicable Permit and Approval Requirements for the Construction and Operation of the Proposed GLE Facility (Cont.)

License, Permit, or Other Required Approval	Responsible Agency	Authority	Relevance and Status
Local Agencies (Cont.)			
Stormwater Permit	New Hanover County	Chapter 23, Article VII, Stormwater Management	The proposed GLE Facility must comply with the county stormwater ordinance; the permit will be requested.
Floodplain Development Permit	New Hanover County	Chapter 29, Article II, Flood Hazard Reduction	If the final facility design includes development of the proposed GLE Facility within areas of special flood hazard lying within the regulatory jurisdiction of the county, a permit may be required.

inquiring if the tribes believed the site under consideration had any traditional cultural or religious significance (see Section 9.2 for a list of the tribes that were contacted, and Appendix B for copies of the communications). None of the tribes indicated that they had any concerns. Consultation between the NRC and the North Carolina State Historic Preservation Office (SHPO) has been ongoing. At the request of the SHPO, the NRC has contacted the ACHP concerning the GLE project.

1.5.6.3 *Fish and Wildlife Coordination Act of 1934*

The consultation component of the *Fish and Wildlife Coordination Act* requires that "whenever the waters of any stream or other body of water are proposed or authorized to be impounded, diverted, the channel deepened, or the stream or other body of water otherwise controlled or modified for any purpose whatever, including navigation and drainage, by any department or agency of the United States, or by any public or private agency under Federal permit or license, such department or agency first shall consult with the U.S. Fish and Wildlife Service, Department of the Interior, and with the head of the agency exercising administration over the wildlife resources of the particular State wherein the impoundment, diversion, or other control facility is to be constructed, with a view to the conservation of wildlife resources by preventing loss of and damage to such resources as well as providing for the development and improvement thereof in connection with such water-resource development." Because the proposed action does not involve such modifications to a stream or other body of water, the NRC is not implementing consultations under the *Fish and Wildlife Coordination Act.* The NRC is consulting with the FWS and the State agency that exercises administrative control over the wildlife resources under the ESA as noted in Section 1.5.6.1.

1.6 Organizations Involved in the Proposed Action

Two organizations have specific roles in the implementation of the proposed action:

GE-Hitachi Global Laser Enrichment LLC (abbreviated as GLE for the purposes of this draft EIS) is the NRC license applicant. If the license is granted, GLE would be the holder of an NRC license for the possession and use of special nuclear, source, and by-product material at the proposed GLE Facility. GLE would be responsible for constructing, operating, and decommissioning the proposed facility in compliance with that license and applicable NRC regulations.

GLE is a Delaware limited liability company. It currently is the only subsidiary of majority owner GE-Hitachi (GEH) Nuclear Energy Americas, LLC, a global supplier of nuclear energy-related equipment and services. GEH, also a Delaware limited liability company, is a wholly owned subsidiary of GE-Hitachi Nuclear Energy Holdings LLC (Holdings). Holdings is a subsidiary of majority owner GENE Holding LLC (GENE), a Delaware limited liability company wholly owned by GE, a U.S. corporation, and of minority owner Hitachi America, Ltd., which is a wholly owned subsidiary of Hitachi Ltd., a Japanese corporation. Cameco Enrichment Holdings, LLC ("Cameco Enrichment"), has a 24 percent ownership interest in GLE, and GENE owns 13.5 percent of GLE. Cameco Enrichment is a Delaware limited liability company wholly owned by Cameco U.S. Holdings, Inc., a Nevada corporation, which is in turn wholly owned by Cameco Corporation, a Canadian corporation (GLE, 2009a). The foreign ownership, control, and influence issue is beyond the scope of this EIS but will be addressed by the NRC.

The NRC is the licensing agency. The NRC has the responsibility to evaluate the license application for compliance with the NRC regulations associated with uranium enrichment facilities. These include standards for protection against radiation in 10 CFR Part 20 and requirements in 10 CFR Parts 70, 40, and 30 that would authorize GLE to possess and use special nuclear material, source material, and by-product material, respectively, at the proposed GLE Facility. The NRC is responsible for regulating activities performed within the proposed GLE Facility through its licensing review process and subsequent inspection program. To fulfill the NRC responsibilities under NEPA, the environmental impacts of the proposed action are evaluated in accordance with the requirements of 10 CFR Part 51 and documented in this draft EIS.

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2 ALTERNATIVES

This chapter describes and compares the proposed action and alternatives. As discussed in Chapter 1, the proposed action is for General Electric (GE)-Hitachi Global Laser Enrichment, LLC (GLE) to construct and operate a laser-based uranium enrichment facility near Wilmington, North Carolina. To allow the proposed action, the U.S. Nuclear Regulatory Commission (NRC) would need to grant GLE a license to possess and use special nuclear material, source material, and byproduct material at the proposed Global Laser Enrichment Facility. The NRC staff also evaluated the no-action alternative in this draft EIS. Under the no-action alternative, GLE would not construct, operate, or decommission the proposed GLE Facility. Therefore, the no-action alternative provides a basis for evaluating and comparing the potential impacts of the proposed action. In addition to the proposed action and alternatives to the proposed action, alternatives for the disposition of depleted uranium hexafluoride (UF_6) resulting from enrichment operations over the lifetime of the proposed GLE Facility are analyzed.

Section 2.1 presents technical details of the proposed action and connected actions, including descriptions of the proposed site, laser enrichment technology, facilities to be constructed, and the activities at the proposed GLE Facility. The activities are grouped under preconstruction and construction, operation, and decontamination and decommissioning. Section 2.2 describes the no-action alternative and provides a comparison of predicted environmental impacts for the proposed action and no-action alternatives. Section 2.3 discusses alternatives to the proposed action that were considered but not analyzed in detail, including alternative sites, enrichment technologies other than the proposed laser technology, and use of alternate sources of enriched uranium. Gas centrifuge technology is discussed in Section 2.3.4, along with a comparison of the potential impacts of the laser-based and gas centrifuge technologies. The chapter concludes with a preliminary recommendation from NRC staff regarding the proposed action (Section 2.4).

2.1 Proposed Action

The proposed action is for GLE to construct and operate a laser-based uranium enrichment facility near Wilmington, North Carolina. To allow the proposed action, NRC would need to grant GLE a license to possess and use special nuclear material, source material, and byproduct material. The initial NRC license, if granted, would be for a period of 40 years, after which GLE would request renewal of the license or begin decommissioning of the facility. GLE plans to start preconstruction activities for the proposed GLE Facility in early 2011, under an exemption granted by NRC (see Section 1.4.1). If NRC grants the license, GLE would begin construction of the proposed GLE Facility (anticipated in 2012), commence commercial enrichment operations in 2013, and increase to the initial maximum target production capacity of 6 million separative work units[1] (SWU) by 2017, at an enrichment of up to 8 percent

[1] A separative work unit (SWU) is a unit of measurement used in the nuclear industry, pertaining to the process of enriching uranium for use as fuel for nuclear power plants. It describes the effort needed to separate uranium-235 and uranium-238 atoms in natural uranium to create a final product that is richer in uranium-235 atoms. Given 100 kilograms (220 pounds) of natural uranium, it takes about 60 SWU to produce 10 kilograms (22 pounds) of uranium enriched to 4.5 percent uranium-235. It takes on the order of 100,000 SWU of enriched uranium to fuel a typical 1000-megawatt commercial nuclear reactor for a year (USEC, 2001).

uranium-235 by weight. Although there is currently no demand for enrichment greater than 5 percent, GLE believes that there is potential for future demand to change (GLE, 2009c).

Section 2.1.1 describes the location of the proposed site. The proposed facility and GLE's laser-based enrichment process are described in Section 2.1.2 and the management options for management of the depleted UF_6 tails generated at the proposed facility are reviewed in Section 2.1.3. Section 2.1.4 describes the anticipated decontamination and decommissioning activities at the proposed facility and Section 2.1.5 provides the projected timelines for the three phases of the proposed action.

2.1.1 Location and Description of Proposed Site

The GE property, on which the proposed GLE Facility would be sited, is located in an unincorporated area of New Hanover County, North Carolina, the most populated of three counties that comprise the Wilmington Metropolitan Statistical Area. The site is located approximately 10 kilometers (6 miles) north of Wilmington, North Carolina, and is hereafter referred to as the Wilmington Site. Figures 1-1 and 1-2 show the location of the Wilmington Site in relation to the surrounding counties and municipalities.

The Wilmington Site consists of approximately 656 hectares (1621 acres), and GE owns an additional 10 hectares (24 acres) to the east of the site. Figure 2-1 shows the Wilmington Site and the location of GE's existing principal manufacturing facilities (namely, the Global Nuclear Fuels-Americas [GNF-A] Fuel Manufacturing Operation [FMO] facility and the GE Aircraft Engines/Services Components Operation [AE/SCO] facility). The land to the west of the Wilmington Site (across the Northeast Cape Fear River) is dominated by industrial use, and the area to the north and northwest is privately owned and used for timber management and private hunting. The areas to east and south of the site are dominated by residential development. The southeast corner of the site borders Interstate 140 (I-140) (GLE, 2008).

The proposed GLE Facility would occupy approximately 40 hectares (100 acres) of the North-Central Site Sector. A North access road would be built along the northeast portion of the Eastern Site Sector to connect the proposed GLE Facility to NC Route 133, using existing site road service where practical (Figure 2-2).

The nearest major population center is Skippers Corner, approximately 1 kilometer (0.6 mile) northeast of the site boundary on NC Route 133 (Castle Hayne Road). The distance from the proposed GLE Facility to the nearest member of the public (i.e., actual permanent residence) is about 1352 meters (0.84 mile). The environmental characteristics of the proposed site and surrounding areas are described in detail in Chapter 3 of this draft EIS.

The Wilmington Site is served by two of southeastern North Carolina's major highway systems: Interstate 40 (I-40) ("Outer Loop Freeway") and U.S. Route 17 (see Figure 1-2). The site can be accessed by two access roads (south access road and north access road) from Castle Hayne Road (NC Route 133) just north of the junction of I-140 and Castle Hayne Road (GLE, 2008).

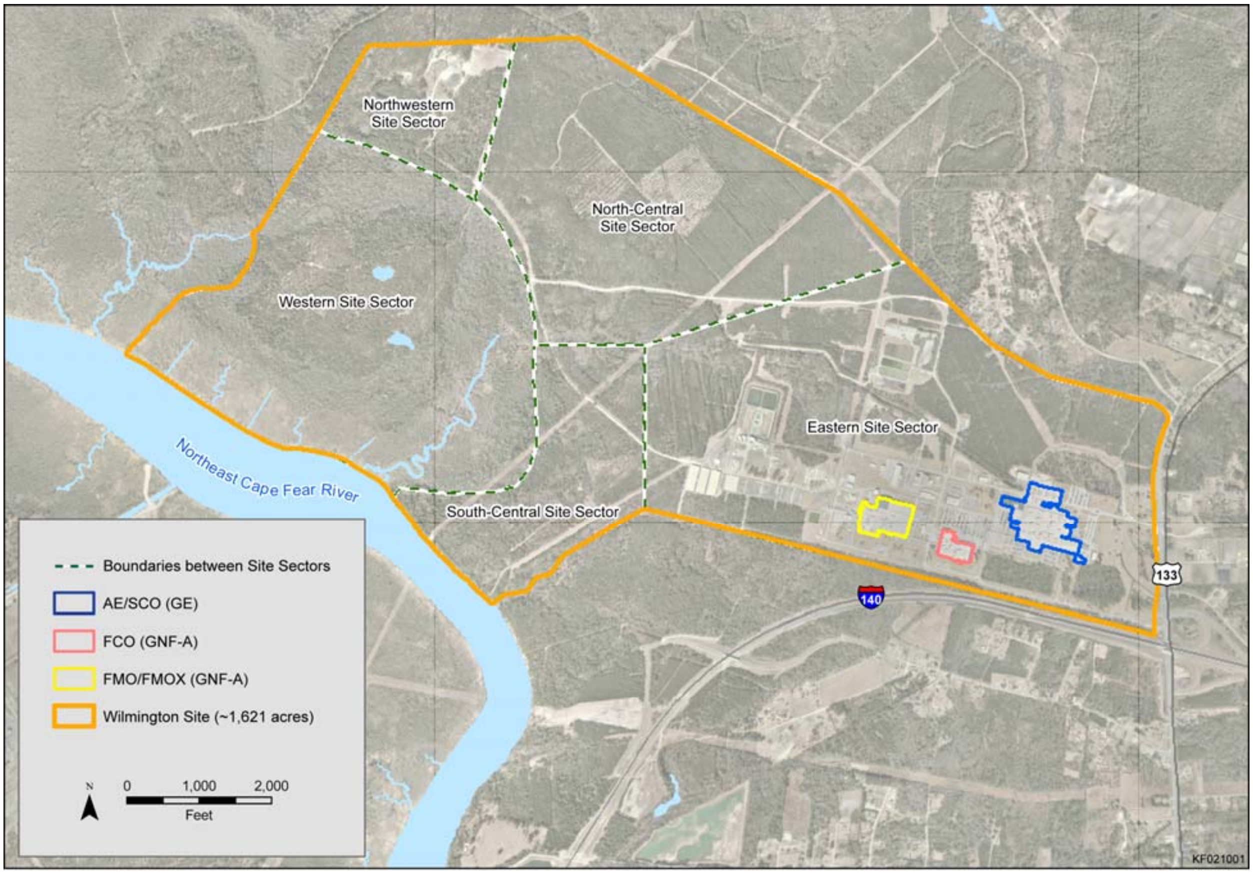

Figure 2-1 Schematic of the Existing Wilmington Site (GLE, 2008)

The Wilmington Site does not have rail access (and GLE does not anticipate the use of freight rail for shipping needs), but freight service to the region is provided by CSX Transportation, Inc.; the primary rail service foci are the Port of Wilmington and Military Ocean Terminal Sunny Point (MOTSU).

2.1.2 Description of the Proposed GLE Facility

Figure 2-2 shows the location of the GLE study area, which includes the proposed GLE Facility site and the areas that would be disturbed by preconstruction and construction activities. The proposed facility would comprise various buildings and areas that house systems and equipment necessary to support the uranium enrichment process. These buildings and areas would include the operations building and UF_6 storage areas. UF_6 would be stored temporarily onsite as normal feed material to the enrichment process and as depleted UF_6 and enriched product UF_6 after the enrichment process. There would be other ancillary and support buildings and areas onsite.

Primary facilities are those critical to the enrichment process, while secondary facilities provide indirect support to the process. These facilities are described in Sections 2.1.2.1 and 2.1.2.2, respectively. These sections are followed by summary descriptions of the laser-based

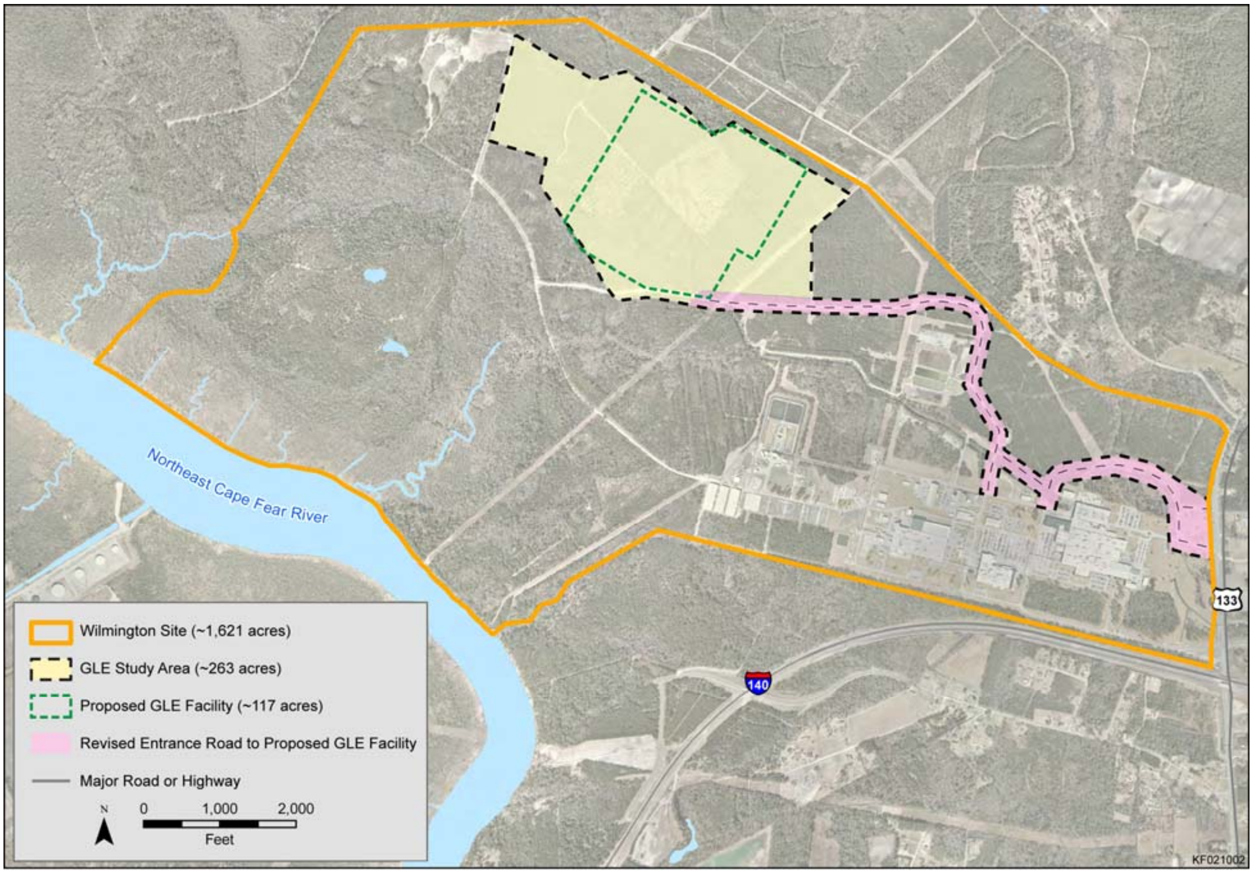

Figure 2-2 Location of Proposed GLE Facility at the Wilmington Site (GLE, 2009b)

enrichment process proposed by GLE (Section 2.1.2.3), Waste Management Systems (Section 2.1.2.4), and Liquid and Air Effluents (Section 2.1.2.5).

2.1.2.1 Primary Facilities

The primary facilities include an operations building and six cylinder storage pads where licensed material would be used or stored; these are considered to be key facilities in support of the uranium enrichment process. The primary facilities are located or would be constructed adjacent to each other in the North-Central Site Sector. Technical details regarding primary facilities are presented in Appendix H. This information is considered proprietary and contains security-related information and will not be disclosed in this draft EIS.

Operations Building

The primary purpose of the operations building would be to house the laser equipment and support systems necessary to perform the actual enrichment process. The Operations Building would include the following process and support areas:

- Cylinder Shipping and Receiving Area

- UF_6 Feed and Vaporization Area

- Product Withdrawal Area

- Tails Withdrawal Area

- Cascade/Gas Handling Area

- Blending Area

- Sampling Area

- Radioactive Waste Area

- Heating, Ventilation, and Air Conditioning (HVAC) Equipment Area

- Decontamination/Maintenance Area

- Laboratory Area

- Laser Area

The functional descriptions of these areas are summarized below, based on the information provided in Chapter 1 of the License Application (GLE, 2009a).

Cylinder Shipping and Receiving Area

The operations performed in this area would include:

- receipt of feed UF_6 cylinders from offsite

- weighing the feed cylinders and performing other material control functions

- providing interim storage of feed, product, and depleted UF_6 cylinders

- preparing the product and full depleted UF_6, and empty cylinders for transfer to other locations onsite such as the UF_6 Cylinder Pads or offsite

Feed and Vaporization Area

The UF_6 Feed and Vaporization Area would contain the necessary equipment to perform the following operations:

- receive UF_6 feed cylinders from the Cylinder Shipping and Receiving Area

- vaporize the UF_6 contained within the feed cylinders

- feed the vaporized UF_6 to the feed header between the Vaporization Area and the Cascade/Gas Handling Area within the Operations Building

The UF_6 feed rates to the feed header would be maintained within the design basis temperature and pressure range. The residual UF_6 from the emptied feed cylinders (known as heels) would be sufficiently recovered to meet U.S. Department of Transportation (DOT) offsite cylinder shipping requirements for empty cylinders.

Product Withdrawal Area

In the Product Withdrawal Area, the empty to-be-filled cylinders would be received from interim storage within the Cylinder Shipping and Receipt Area and would be filled with the enriched UF_6 product.

Tails Withdrawal Area

This area would be used to receive empty cylinders from interim storage within the Cylinder Shipping and Storage Area, and fill them with the tails (depleted UF_6) for interim storage and later disposition.

Cascade/Gas Handling Area

The Cascade/Gas Handling Area is where the enrichment process would occur. The UF_6 gas would be exposed to laser-emitted light and two process streams are generated; one enriched in uranium-235 and one depleted in uranium-235. The enriched stream would go to the Product Withdrawal Area and the depleted stream would be sent to the Tails Withdrawal Area.

Blending Area

The Blending Area is where the product cylinders that meet the customer specifications would be filled. This would be accomplished by mixing the right quantities of enriched product at different enrichment levels to produce the exact enrichment level required by customers. The 76- or 122-centimeter (30- or 48-inch) cylinders that would contain the original product (called donor cylinders) would be received from interim storage within the Cylinder Shipping and Receiving Area. The UF_6 within the donor cylinders would be vaporized and fed into the receiver cylinders that would be sent to customers.

Sampling Area

In the Sampling Area, the receiver cylinders would be sampled to assure that the enrichment level of UF_6 in the filled cylinders meets the customer specifications. The cylinders would be heated and the UF_6 would be liquefied before samples were taken. This would be the only place in the proposed GLE Facility where conversion of solid UF_6 to liquid UF_6 would take place.

Liquid and Solid Radioactive Waste Areas

The various processes and operations that would take place in the proposed GLE Facility would likely generate quantities of radiologically contaminated, potentially contaminated, and non-contaminated liquid and solid waste streams. The equipment and processes used to temporarily store, treat as appropriate, and prepare for offsite shipment of liquid and solid wastes are described in Section 2.1.2.4. Section 2.1.2.5 discusses the systems used to control liquid emissions from the proposed GLE Facility.

HVAC Equipment Areas

Various heating and ventilation systems throughout the operations building would be used to control the environmental conditions such as the pressure, temperature, humidity, and airflow in different parts of the building to meet requirements for personnel, process equipment, and supporting systems and utilities. The systems used to control atmospheric air emissions are discussed in Section 2.1.2.5.

Decontamination/Maintenance Area

The Decontamination/Maintenance Area would provide a place for personnel to remove contamination from, and make repairs to, equipment and process components used in various parts of the GLE Facility.

Laboratory Area

The Laboratory Area would contain the various onsite laboratories used to analyze the samples taken at the proposed GLE Facility. The analyses performed would include wet chemistry and safety and regulatory testing and analysis.

Laser Area

All necessary equipment needed to operate the laser systems that are part of the GLE laser-based enrichment technology would be located in this area.

UF_6 Cylinder Pads

There would be three UF_6 Cylinder Pads at the proposed GLE Facility:

- The Product Pad, which would occupy approximately 4462 square meters (48,000 square feet) and be used to store enriched product in 76-centimeter (30-inch) cylinders.

- The In-Process Pad, which would occupy approximately 12,084 square meters (130,000 square feet) and be used to store feed material and cylinders emptied on site (with or without heels).

- The Tails Pad, which would occupy approximately 43,224 square meters (465,000 square feet) and be designed to store 122-centimeter (48-inch) cylinders containing tails (depleted UF_6). This pad would be sized to accommodate the tails cylinders resulting from ten years of facility operation (9000 cylinders).

All of the pads would be constructed to provide for rainwater drainage to the edges of the pads. Saddles would be used to store the cylinders and, except for the tails cylinders, the cylinders would not typically be stacked. Stormwater collected from the cylinder pads would be directed to a new holding pond specifically constructed for the cylinder pads and then to a new onsite wet detention basin.

2.1.2.2 Other Facility Buildings and Supporting Infrastructure

New facility buildings and supporting infrastructure would include three administrative buildings, waste storage buildings, an electrical substation, backup diesel generators, potable and process water systems, a holding pond for cylinder storage pad stormwater, a stormwater wet detention basin, parking areas, and roads.

The new potable and process water supply lines to the GLE Facility would be connected to the existing Wilmington Site water supply infrastructure. Sanitary waste, process wastewater, and treated liquid radiological wastewater that would be generated at the proposed GLE Commercial Facility would be routed to the existing facilities at the Wilmington Site via underground lines for final processing and disposition. In particular, the sanitary wastewaters would be routed to the existing Site Sanitary Waste Water Treatment Facility, and the process and treated wastewaters would be sent to the existing Final Process Lagoon Treatment Facility.

Two detention basins (one new and one existing) would receive stormwater runoff from the GLE Facility. An existing collection basin on the Wilmington Site would receive the majority of the runoff from the GLE Facility, including the Operations Building. The remaining runoff, including runoff from the UF_6 Cylinder Pads, would drain to a new GLE site wet detention basin.

In addition, there would be a new water tower and a firewater retention basin located on the proposed GLE Facility site. The water in the tower would be used for process water at the proposed GLE Facility, but it would be designed to always maintain a reserved level for firefighting. The firewater retention basin and associated diesel-powered firewater pumps would be designed as a backup source for fire protection systems.

The proposed GLE Facility would be served by two main roads on the Wilmington Site. The first road would connect the proposed GLE Facility to Castle Hayne Road and would serve as the main entrance to the facility. The other road would lead to the GNF-A Fuel Manufacturing Operation (FMO) Facility and would be used mainly for transport of enriched product to the FMO facility for fuel manufacturing.

2.1.2.3 Process Description

The proposed GLE Facility would employ the Separation of Isotopes by Laser Excitation (SILEX) process, a third-generation laser-based technology for enriching natural uranium that was developed by Silex Systems Ltd, in partnership with GLE (and formerly, the U.S. Enrichment Corporation [USEC]). Isotopes of the same element, though chemically identical, have different electronic energies and absorb different colors of laser light. The isotopes of most elements can be separated by a laser-based process if they can be vaporized efficiently into individual atoms. In laser excitation enrichment, UF_6 vapor is illuminated with a tuned laser of a specific wavelength that is absorbed only by uranium-235 atoms while leaving other isotopes unaffected.

Given below is an overview of the GLE laser-based enrichment process. A more detailed description of the process is provided in the license application (GLE, 2009a). However, the technical details of the GLE laser-based enrichment process are proprietary, subject to export control, and in many cases, may also fall into the categories of security-related, safeguards, or classified information, to which access is limited by U.S. laws and regulations. As such, the details of this process are not contained in this draft EIS.

The proposed GLE Facility is designed to separate a feed stream of UF_6 containing the naturally occurring proportions of uranium isotopes (approximately 0.7 percent uranium-235, 99.3 percent uranium-238, and 0.0055 percent uranium-234) into a product stream (enriched in the uranium-235 isotope) and a tails stream (depleted in the uranium-235 isotope). Except for the actual step in the enrichment process that involves the use of lasers, the processes that would be used for receipt and handling of the feedstock and the enriched and depleted UF_6 streams are very similar to those used at other enrichment facilities. The cylinders that would be used for transportation and storage of UF_6 are industry-standard containers. The proposed GLE Facility is designed to produce an enriched UF_6 stream that is up to eight percent uranium-235 with a nominal capacity of six million SWUs per year.

The four major processing steps involved in enriching the natural UF_6 at the proposed GLE Facility would be (1) UF_6 Feed and Vaporization, (2) Cascade/Gas Handling, (3) Product Withdrawal, and (4) Tails Withdrawal.

The UF_6 Feed Vaporization System would provide a continuous supply of gaseous UF_6 from the feed cylinders to the Cascade/Gas Handling Area (where the enrichment takes place). Approximately nine hundred 122-centimeter (48-inch) cylinders would be processed annually. Feed cylinders would be loaded into solid feed stations; vented for removal of light gases (primarily air and hydrogen fluoride); and heated to sublime the UF_6 (converting it directly from solid to gas phase without going through the liquid phase). The light gases and UF_6 gas generated during feed purification would be routed to the Feed Purification Subsystem, where the UF_6 would be desublimed (converted directly from gas to solid phase without passing though the liquid phase). The Feed Purification Subsystem would remove any light gases such as air and hydrogen fluoride from UF_6 prior to introduction into the Cascade/Gas Handling Area.

After purification, UF_6 from the solid feed stations would be routed to the Cascade/Gas Handling Area. The UF_6 in gaseous form would be exposed to laser-emitted light and separated into two streams (one enriched in uranium-235 and one depleted in uranium-235). Enriched UF_6 from the Cascade/Gas Handling Area would be transported to the Product Withdrawal Area, where it would be placed in the product cylinders and desublimed. The heat from desublimation of the UF_6 would be removed by air. Filling of product cylinders would be monitored, and filled cylinders would be transferred to the Sampling Area for sampling and sent to the Blending Area or put into interim storage on the Product Pad.

The enriched UF_6 in product cylinders forwarded to the Blending Area would be vaporized and pumped into receiver cylinders. During this process, the enrichment level of UF_6 put into the receiver cylinders would be carefully controlled to meet the customer specifications as well as transportation standards.

As a final step, the receiver cylinders would be sent back to the Sampling Area, where the UF_6 would be liquefied to create a homogenous mixture of UF_6 and would be sampled to make sure that it meets the applicable requirements. A cylinder to be sampled would be moved into an autoclave with heating and cooling capability, where the UF_6 in the cylinder would be liquefied by electrically heated air, to homogenize the liquefied UF_6, and a representative sample of the contents would be taken. The UF_6 in the cylinder would then be solidified in the autoclave using cold air before removing the cylinder from the autoclave. The autoclaves would be designed to contain a UF_6 release in the autoclave.

Depleted UF_6 from the Cascade/Gas Handling Area would be transported to the Tails Withdrawal Area, where it would be placed in the tails cylinders and desublimed. The heat of desublimation of the UF_6 would be removed by air. Filling of tails cylinders would be monitored, and filled cylinders would be transferred to the Tails Pad.

2.1.2.4 Waste Management Systems

This section describes the systems used to treat and disposition the liquid and solid wastes generated at the proposed GLE Facility. The quantities of waste generated and the waste management impacts are discussed in Section 4.2.12.

Liquid Wastes

GLE provided a summary of the systems and operations that would be used to manage the wastewater generated at the proposed GLE Facility, as shown in Table 2-1 (GLE, 2009a). Liquid radioactive wastes generated in the Operations Building would be collected in closed-drain systems that discharge to an accumulator tank. Subsequently, the liquid would be treated in the Radiological Liquid Waste Treatment System (RLETS) at the proposed GLE Facility to remove uranium through precipitation and fluoride through evaporation. The resulting solids would be dried and disposed of as low-level radioactive waste (LLRW).

The treated wastewaters from the RLETS would meet discharge requirements in 10 CFR Part 20, Appendix B (GLE, 2009c), before discharge to the Final Process Lagoon Treatment Facility (FPLTF). The FPLTF is an existing facility at the Wilmington Site that is currently used to treat liquid effluents from existing industrial operations. It would also be used to treat the effluents from the proposed GLE Facility. The treated effluent from the FPLTF is currently discharged via National Pollutant Discharge Elimination System (NPDES)-permitted Outfall 001 to the Wilmington Site effluent channel, where it is combined with stormwater, discharging groundwater, and treated sanitary wastewater effluent. The effluent channel flows to the Unnamed Tributary #1, which drains to the Northeast Cape Fear River. GLE has stated that these operations would continue in the same mode when the proposed GLE Facility becomes operational.

A new cooling tower would be constructed for the proposed GLE Facility. The cooling tower would use a closed-loop system that does not contact any uranium materials or uranium-contaminated wastewater streams. To minimize the amount of dissolved solids and other impurities in the circulating water, a portion of the circulating water from the cooling tower loop (called blowdown) would be regularly removed from the cooling tower loop and discharged to

Table 2-1 Management of Wastewater Generated by Proposed GLE Facility Operations

Wastewater Type	Onsite Waste Management	Offsite Waste Treatment/Disposal
Process liquid radiological waste	Wastewaters collected in closed drain system connected to Radiological Liquid Waste Treatment System (RLETS). Treated radiological waste effluent is discharged to existing Wilmington Site process wastewater aeration basin and Final Process Lagoon Treatment Facility (FPLTF).	Treated effluent from the Wilmington Site FPLTF is discharged at National Pollution Discharge Elimination System (NPDES)-permitted Outfall 001 to the onsite effluent channel.
Cooling tower blowdown	Blowdown is pumped from cooling tower to existing Wilmington Site FPLTF.	Treated effluent from the Wilmington Site FPLTF is discharged at NPDES-permitted Outfall 001 to the onsite effluent channel.
Sanitary waste	Sanitary waste is collected in sewer system connected to existing Wilmington Site Sanitary Wastewater Treatment Plant. Waste stream is treated by activated sludge aeration process.	Treated effluent from the Wilmington Site Sanitary Wastewater Treatment Plant is discharged at NPDES-permitted Outfall 002 to the onsite effluent channel.
Stormwater	Stormwater runoff is collected in drainage conduits and channels flowing to onsite retention basins.	Stormwater from onsite retention basins is discharged per requirements of NPDES storm water permit.

Source: GLE 2009a

the existing Wilmington Site FPLTF. Fresh water or treated sanitary wastewater effluent would be added to the cooling tower loop to make up for the water loss.

The sanitary wastes generated at the proposed GLE Facility would be collected in a sewer system connected to the existing Wilmington Site Sanitary Wastewater Treatment Facility (WWTF), which employs an Activated Sludge Aeration Process. The treated effluent from the WWTF could be reused as makeup water in cooling towers at the Wilmington Site or discharged at NPDES-permitted Outfall 002 to the onsite effluent channel.

Stormwater runoff from outdoor impervious surfaces within the GLE Facility site would be collected in drainage conduits and channels flowing into detention basins used for collection of runoff. The detention basins would be routed to one of the unnamed tributaries on the Wilmington Site that flow into the Northeast Cape Fear River. Stormwater collected from the cylinder storage pads would be directed to a new holding pond and from there to a new wet detention basin on the proposed GLE Facility site.

Solid Wastes

Solid wastes that would be generated by the proposed GLE Facility include municipal solid waste, nonhazardous industrial wastes, wastes designated as *Resource Conservation and Recovery Act* (RCRA) hazardous wastes, and LLRW. No high-level radioactive wastes would be generated by the proposed GLE Facility operations. GLE provided a summary of the methods used to manage these wastes onsite and for offsite treatment and disposal, as shown in Table 2-2 (GLE, 2009a).

Table 2-2 Management of Solid Waste Generated at Proposed GLE Facility During Operations

Solid Waste Source	Onsite Waste Management	Offsite Waste Treatment/Disposal
Municipal solid waste (MSW)	Collected and temporarily stored in rolloff containers	Filled rolloff containers are transported by commercial refuse collection service to an approved disposal site
Non-hazardous wastes from operations equipment cleaning and maintenance activities that are recyclable or not accepted by MSW landfill	Collected and temporarily stored in containers	Filled containers are transported by truck to an approved disposal site[a]
Wastes designated RCRA hazardous wastes	Collected and temporarily stored in containers	Filled containers are transported by truck to an approved disposal site[b]
Laboratory waste from UF_6 feed sampling and analysis	Collected and temporarily stored in containers	Either transported by truck to an approved disposal site or transported to an approved uranium recovery vendor
Combustible used or spent uranium-contaminated materials	Collected and temporarily stored in containers	Either transported by truck to an approved disposal site or transported to an approved uranium recovery vendor
Non-combustible used or spent uranium-contaminated materials	Collected and temporarily stored in boxes	Filled boxes are transported by truck to an approved disposal site[c]
Liquid Radiological Waste Treatment System filtrate/sludge	Collected and temporarily stored in metal cans	Filled cans are transported by truck to an approved disposal site

[a] Licensed RCRA Subpart D landfill.
[b] Licensed RCRA Subpart C Treatment, Storage, and Disposal Facility (TSDF).
[c] Licensed Low-Level Radioactive Waste Disposal Facility.
Source: GLE 2009a

The municipal solid waste would be collected and placed in rolloff-type containers. A commercial refuse collection service would regularly collect the filled containers and transport the waste to a RCRA-permitted Subtitle D landfill for disposal. The nonhazardous industrial waste, such as spent coolant and used filter media, would be collected and temporarily stored in containers appropriate for the waste type. Depending on their composition, these wastes would either be shipped directly to a permitted RCRA Subpart D landfill for treatment and burial, or routed to other approved facilities for reuse, reclamation, or treatment. The RCRA hazardous waste would be collected, packaged in DOT-approved shipping containers, and temporarily stored onsite for shipment to a RCRA-permitted Subtitle C treatment, storage, and disposal facility. LLRW would be collected in containers and shipped by truck to an approved disposal facility.

2.1.2.5 Liquid and Air Effluents

This section discusses the potential liquid and air effluents from the proposed GLE Facility. The impacts associated with these effluents are discussed in Section 4.2.11.

Liquid Effluents

Uranium enrichment operations performed at the proposed GLE Facility would generate process wastewater that would contain small concentrations of uranium and fluoride. This wastewater would be generated from decontamination operations, cleaning wash water, and laboratory wastes, and is collectively referred to as liquid radioactive waste.

The process wastewater would be treated to remove the uranium and the fluoride. The treated wastewater would meet the discharge requirements in 10 CFR Part 20, Appendix B, before discharge to the existing Wilmington Site FPLTF (GLE, 2009c). This facility currently receives Wilmington Site process wastewater, including the treated effluent from the GNF-A FMO Facility Radiological Waste Treatment System. The treated effluent from the FPLTF is discharged via NPDES-permitted Outfall 001 to the Wilmington Site effluent channel, where it is combined with stormwater, discharging groundwater, and treated sanitary wastewater effluent. The effluent channel flows to the Unnamed Tributary #1, which flows into the Northeast Cape Fear River.

As discussed in Section 2.1.2.4 and in Table 2-1, there would be three other liquid effluents from the proposed GLE Facility. These effluents would not contain radioactive constituents. The cooling tower blowdown effluent would be discharged to the effluent channel at Outfall 001 along with the process wastewater from the FPLTF. Treated sanitary wastewater would either be reused as makeup water for cooling towers or released to the effluent channel at Outfall 002. The stormwater overflow from the onsite wet detention basins would be discharged to one of the unnamed tributaries to the Cape Fear River.

Air Effluents

Because the laser-based enrichment process proposed by GLE is a closed process, no routine venting of process gases would occur during operations. However, some short-term gaseous releases could occur inside the Operations Building during certain operations, such as the connection/disconnection of UF_6 cylinders to process equipment and process equipment maintenance. These gaseous releases would be routed through the building's ventilation system.

The ventilation system air stream would pass through a series of emissions-control devices, consisting of high-efficiency particulate air (HEPA) filters and high-efficiency gas absorption (HEGA) filters. The exhaust air stream from these emission controls would be vented to the atmosphere and would meet the discharge requirements in 10 CFR Part 20, Appendix B (GLE, 2009c).

2.1.3 Depleted Uranium Management

> ***Waste Classification of Depleted Uranium***
>
> *Depleted uranium is different from most low-level radioactive waste in that it consists mostly of long-lived isotopes of uranium, with small quantities of thorium-234 and protactinium-234. Depleted uranium is source material as defined in 10 CFR Part 40, and, if treated as a waste, it falls under the definition of low-level radioactive waste per 10 CFR 61.2. The Commission affirmed that depleted uranium is properly considered a form of low-level radioactive waste in Louisiana Energy Services, L.P. (National Enrichment Facility), CLI-05-5, 61 NRC 22 (January 18, 2005). This means that depleted uranium could be disposed of in a licensed low-level radioactive waste facility if the licensing requirements for land disposal of radioactive waste as indicated in 10 CFR Part 61 are met.*
>
> *Sources: NRC, 1991, 2005b.*

The term "depleted uranium" refers to any chemical form of uranium (e.g., UF_6 and U_3O_8) that contains uranium-235 in concentrations less than the 0.7 percent found in natural uranium. As discussed in Section 2.1.2.3, the uranium enrichment process would generate a depleted UF_6 stream (also called tails). In contrast to the uranium in the enriched UF_6 produced by the enrichment facility, the uranium in the depleted UF_6 stream would be depleted in uranium-235 isotope of uranium. At full production, the proposed GLE Facility would generate 900 full 122-centimeter (48-inch) cylinders of depleted UF_6 per year. Initially, the depleted UF_6 would be stored on Tails Storage Pad (GLE, 2009a). Each 122-centimeter (48-inch) cylinder would hold approximately 12.5 metric tons (13.8 tons), which means that at full production, the site would generate approximately 11,250 metric tons (12,375 tons) of depleted UF_6 every year. During the operation of the facility, the plant could store up to 9000 cylinders (10 years worth of generation) of depleted UF_6 (GLE, 2009a). GLE would own the depleted UF_6 and maintain the cylinders while they are in storage. Maintenance activities would include periodic inspections for corrosion, valve leakage, or distortion of the cylinder shape, and touch-up painting as required. Problem cylinders would be removed from storage and the material transferred to another storage cylinder. The proposed storage area would be kept neat and free of debris, and all stormwater or other runoff would be routed to the onsite holding pond for monitoring and evaporation.

The Defense Nuclear Facilities Safety Board (DNFSB) has reported that long-term storage of depleted UF_6 in the UF_6 form represents a potential chemical hazard if not properly managed (DNFSB, 1995). For this reason, the strategic management of depleted uranium includes the conversion of depleted UF_6 stock to a more stable uranium oxide (e.g., triuranium octaoxide [U_3O_8]) form for long-term management (OECD, 2001). The U.S. Department of Energy (DOE) also evaluated multiple disposition options for depleted UF_6 and agreed that conversion to U_3O_8 was preferable for long-term storage and disposal of the depleted uranium in its oxide form, due to the chemical stability of U_3O_8 (DOE, 2000). Therefore, the disposal option considered in the draft EIS is the conversion of the depleted UF_6 to U_3O_8 at either a DOE-owned or commercial conversion facility followed by disposal as U_3O_8. Direct disposal of depleted UF_6 was ruled out because of its chemical reactivity (DOE, 1999).

2.1.3.1 Conversion of Depleted UF_6

Section 3113 of the 1996 *USEC Privatization Act* (42 U.S.C. 2297h-11), states that DOE "shall accept for disposal low-level radioactive waste, including depleted uranium if it were ultimately determined to be low-level radioactive waste, generated by ... any person licensed by the Nuclear Regulatory Commission to operate a uranium enrichment facility under [Sections 53, 63, and 193 of the *Atomic Energy Act of 1954* (42 U.S.C. 2073, 2093, and 2243)]." As a result, unless GLE finds a beneficial use for its inventory of depleted UF_6 generated at the proposed GLE Facility or makes alternate arrangements for conversion to another chemical form elsewhere, GLE would send it to DOE for conversion to the oxide form for disposal. On January 18, 2005, the Commission issued its ruling that depleted uranium is considered a form of low-level radioactive waste (NRC, 2005a). The Commission also stated that, pursuant to Section 3113 of the USEC Privatization Act, disposal by DOE at an approved facility represents a 'plausible strategy' for the disposition of depleted uranium tails (NRC, 2005a).

DOE is currently constructing two conversion plants to convert the depleted UF_6 now in storage at Portsmouth, Ohio, and Paducah, Kentucky, to U_3O_8 and hydrofluoric acid. GLE would transport the depleted UF_6 generated by the proposed GLE Facility to either of these new facilities and pay DOE to convert and dispose of the material. The proposed GLE Facility would generate approximately 450,000 metric tons (495,000 tons) in total over its 40-year operating lifetime. The depleted UF_6 would be processed in a DOE-operated conversion facility and then shipped offsite for disposal.

In addition to the DOE disposition option for depleted UF_6, one or more NRC-licensed commercial depleted UF_6 conversion facilities may become available during the proposed GLE Facility's operational lifetime. At least one private entity (International Isotopes, Inc.) has announced plans to construct and operate a new depleted UF_6 conversion facility in Hobbs, New Mexico (GLE, 2008). International Isotopes submitted a license application on December 31, 2009, and the NRC staff is currently reviewing this application (NRC, 2010). If a commercial facility performs the conversion to U_3O_8, DOE is still obligated to accept the U_3O_8 for disposal if requested by GLE, per Section 3113 of the *USEC Privatization Act*.

2.1.3.2 Disposal of Depleted Uranium

The Commission stated that transfer of depleted uranium tails to DOE for disposal represents a plausible alternative for disposition, and that depleted uranium is considered a form of low-level waste (NRC, 2005a). Disposal of U_3O_8 at a commercial low-level waste disposal facility would also be a viable option, if the commercial waste disposal facility could satisfy the requirements of 10 CFR Part 61.

2.1.4 Decontamination and Decommissioning

At the end of useful plant life, the proposed GLE Facility would be decontaminated and decommissioned in accordance with applicable NRC license termination requirements. Decontamination and decommissioning of the proposed GLE Facility would be funded in accordance with the Decommissioning Funding Plan (DFP) for the proposed GLE Facility (GLE, 2008). The DFP, prepared by GLE in accordance with 10 CFR 70.25(a), provides information required by 10 CFR 70.25(e) regarding GLE's plans for funding the decommissioning of the proposed GLE Facility and the disposal of depleted uranium tails generated as a result of plant operations. Funding would be provided by GLE in accordance with NRC regulations in 10 CFR Part 70 and guidance in NUREG-1757 (NRC, 2003).

The intent of decommissioning is to return the proposed GLE Facility site to a state that meets NRC requirements for release for unrestricted use after decontamination and decommissioning is completed (GLE, 2008). It is anticipated that at the end of the useful life of the plant, some of the support buildings and outdoor areas would already meet NRC requirements for unrestricted use in accordance with 10 CFR 20.1402. Any buildings, outdoor areas, or equipment that do not already meet the NRC requirements at the time the GLE Facility ceases operations would be decontaminated and decommissioned in accordance with NRC regulations at 10 CFR 70.38.

Decontamination and decommissioning activities for the proposed GLE Facility are anticipated to occur approximately 40 years in the future, and therefore, only a general description of the activities that would be conducted for the proposed GLE Facility can be developed for this draft EIS. The proposed facility would follow NRC decommissioning requirements in 10 CFR 70.38.

Depleted UF_6 Conversion Process

Depleted UF_6 conversion is a continuous process in which depleted UF_6 is vaporized and converted to U_3O_8 by reaction with steam and hydrogen in a fluidized-bed conversion unit. The hydrogen is generated using anhydrous ammonia, although an option of using natural gas is being investigated. Nitrogen is also used as an inert purging gas and is released to the atmosphere through the building stack as part of the clean off-gas stream. The depleted U_3O_8 powder is collected and packaged for disposition. The process equipment would be arranged in parallel lines. Each line would consist of two autoclaves, two conversion units, a hydrofluoric acid recovery system, and process off-gas scrubbers. The Paducah facility would have four parallel conversion lines. Equipment would also be installed to collect the hydrofluoric acid co-product and process it into any combination of several marketable products. A backup hydrofluoric acid neutralization system would be provided to convert up to 100 percent of the hydrofluoric acid to calcium fluoride for storage and/or sale in the future, if necessary.

Sources: DOE, 2004a,b.

The NRC anticipates that decontamination and decommissioning will involve the following activities:

- installation of decontamination facilities
- purging of process systems and equipment
- dismantling and removal of facilities and equipment
- decontamination and destruction of confidential materials
- decontamination of equipment, facilities, and structures
- survey and spot decontamination of outdoor areas
- removal and sale of any salvaged materials
- removal and disposal of wastes
- management and disposal of depleted uranium
- final radiation survey to confirm that the release criteria have been met

2.1.5 Description and Anticipated Schedule for the Phases of the Proposed Action

As discussed previously, the proposed action would be conducted in three phases starting with (1) preconstruction and construction, (2) facility operation, and (3) decontamination and decommissioning. Each of these phases is described briefly and the anticipated schedule of activities under each phase is provided below.

As discussed in Section 1.4.1, NRC has approved an exemption request from GLE for GLE to conduct certain preconstruction activities prior to NRC issuing a license to GLE for the construction and operation of the proposed GLE Facility (NRC, 2009a). Pre-construction activities covered by the exemption include the following activities and facilities:

- clearing of approximately 40 hectares (100 acres) for the proposed GLE Facility (e.g., removal of trees and vegetation)
- site grading and erosion control (e.g., leveling, installation of physical barriers, and construction of drainages and culverts)
- installing stormwater retention system (e.g., including a holding pond for the cylinder storage pads, wet detention basin, and associated drainage ditches)
- constructing main access roadways and guardhouse(s) (e.g., North access road)

- installing utilities (electricity, potable water, process water, water for fire suppression, sanitary sewer, and natural gas) (e.g., aboveground electrical lines, electrical substation, wastewater lift stations, and new water tower)

- constructing parking lots and minor roadways (e.g., employee and visitor parking lot and connections to site access roads)

- constructing administrative building(s) (e.g., office space and personnel Entry Control Facility)

GLE estimates that it will begin the preconstruction activities in early 2011 (Figure 2-3), and NRC's licensing decision is anticipated to take place by June 2012.[1] If the license is granted, GLE would begin the actual construction activities at that time. As discussed in Section 1.4.1, GLE has indicated that the schedule for preconstruction activities is uncertain at this time. Therefore, some of the preconstruction activities could still be ongoing after the construction starts. However, for the purposes of the analyses in this draft EIS (and as indicated in Figure 2-3), it has been assumed that the preconstruction phase of the project will be completed before the construction phase begins (anticipated to be in 2012).

GLE anticipates that the construction would take place over an approximately six-year period starting in 2012 and would be completed in 2017 or earlier. This would include construction of the Operations Building, cylinder storage pads, holding pond for cylinder storage pad stormwater runoff, wet detention basin, and security buffer area. Construction would be phased in such a way that the operations would begin in 2013, while the rest of the facility is being constructed. When the construction is fully completed (in late 2017), the facility would begin operating at its rated capacity of six million SWUs per year.

GLE is seeking a license for the proposed facility for a period of 40 years. Assuming it is granted in 2012, the license would expire in 2052. Prior to 2052, GLE would decide to either seek a new license to continue to operate the facility or plan for the decontamination and decommissioning of the facility per the applicable licensing conditions and NRC rules and regulations. As discussed in Section 2.1.4, decontamination and decommissioning activities would entail installation of decontamination facilities; purging of process systems and equipment; dismantling and removal of facilities and equipment; decontamination and destruction of confidential materials; decontamination of equipment, facilities, and structures; survey and spot decontamination of outdoor areas; removal and sale of any salvaged materials; removal and disposal of wastes; management and disposal of depleted uranium; and final radiation survey to confirm that the release criteria have been met.

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[1] The analyses in this draft EIS, are based on the assumption that a licensing decision would be made in late 2011, construction (if authorized) would start in 2011, and license termination would occur in 2051. Subsequently, the Commission's *Notice of Hearing and Commission Order* (75 FR 1819) specified that a licensing decision be made within 30 months of the Order (i.e., June 2012). The NRC staff expects that any resulting changes in the licensing and construction schedule would cause slight changes to certain analyses (e.g., air quality, socioeconomics, and cost–benefit) but would not affect the conclusions regarding impacts on these resource areas. Any necessary changes to the analyses will be reflected in the final EIS.

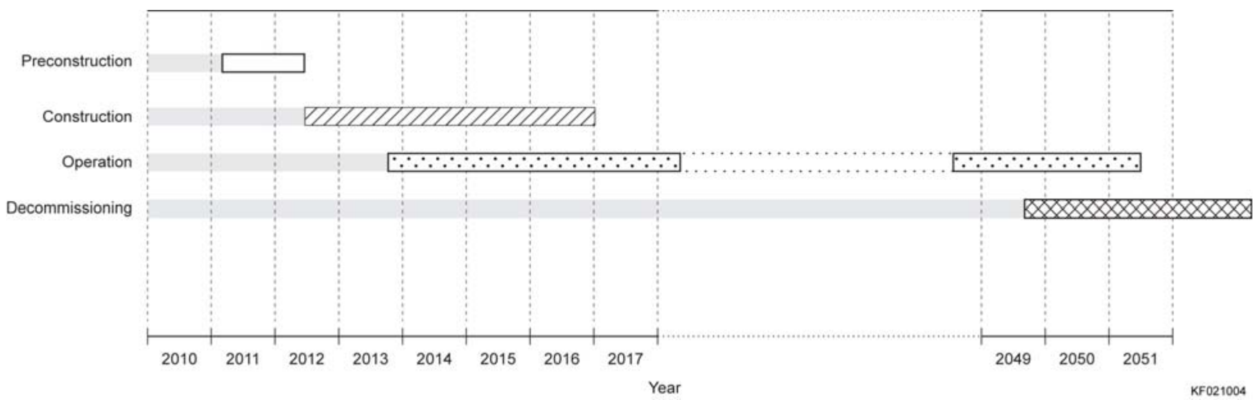

Figure 2-3 Anticipated Timeline for the Proposed GLE Facility

During operations, GLE intends to use natural uranium in the form of UF_6 for the proposed GLE Facility. The UF_6 would be transported to the plant in 122-centimeter (48-inch) cylinders that are designed, fabricated, packaged and shipped in accordance with American National Standards Institute (ANSI) N14.1, "Uranium Hexafluoride-Packaging for Transport" (ANSI, 1990). Feed cylinders are expected to be transported to the site by truck. It is anticipated that approximately 900 shipments of feed cylinders per year would arrive at the proposed GLE Facility. Expected feed suppliers include the Cameco Corporation (Port Hope, Ontario, Canada), Honeywell Specialty Chemical Plant (Metropolis, Illinois), and possibly foreign sources (through ports at Baltimore, Maryland, and Portsmouth, Virginia).

The uranium enrichment process as described in Section 2.1.2.3 would occur within the Operations Building. Enrichment would normally be three to five percent by weight of uranium-235, although GLE's license application indicates GLE seeks authorization to produce enriched uranium up to 8 percent by weight of uranium-235 (GLE, 2008).

Filled customer product cylinders (Type 30B) would be transported to customers (nuclear fuel fabrication facilities), while empty feed cylinders would be returned to the customers for refilling. All cylinders would be prepared for shipment and shipped in accordance with the applicable NRC and DOT regulations.

All product cylinders shipped from the proposed GLE Facility would be transported by truck. These cylinders would be designed, fabricated, and shipped in accordance with the ANSI standard for packaging and transporting UF_6 cylinders, ANSI N14.1. An average product shipment frequency of six cylinders per day is anticipated at full production capacity, with an annual total of approximately 2100 shipments. Some of these cylinders would be transported to the FMO on the Wilmington Site for fabrication into nuclear fuel.

All wastes generated by the GLE facility would be treated onsite or shipped offsite for treatment and/or disposal. The non-hazardous solid wastes would be disposed of in a local landfill or shipped to an offsite treatment and disposal or reuse facility. The low-level radioactive waste would be collected in appropriate containers and shipped by truck to a licensed disposal facility (Energy*Solutions*) in Clive, Utah. RCRA waste would be appropriately packaged and temporarily stored onsite for quarterly shipment (with RCRA waste generated by existing site facilities) to a RCRA-permitted treatment, storage, and disposal facility (Heritage Environmental Services) in Indianapolis, Indiana.

Approximately 900 Type 48Y or 48G cylinders of depleted UF_6 tails are expected to be generated by the GLE Facility per year during full operation. There are no plans for onsite processing or disposal of depleted UF_6, so the cylinders would be stored on the Tails Storage Pad and monitored until they are ready to be shipped offsite. The planned storage pad will have sufficient capacity to store 9000 double-stacked cylinders, with approximately 24 hectares (60 acres) available for expansion of storage capacity. However, GLE anticipates the availability of at least one offsite UF_6 disposition option, enabling the offsite shipment of depleted UF_6 cylinders prior to reaching the 9000-cylinder capacity. Should the 9000-cylinder capacity be reached during facility operation, GLE would evaluate available options, including expansion of onsite storage capacity.

2.2 No-Action Alternative

Under this alternative, GLE would not construct, operate, or decommission the proposed GLE Facility at the Wilmington Site. Under the no-action alternative, the uranium fuel fabrication facilities in the United States would continue to obtain low-enriched uranium from the currently available sources or potential new sources. As described in Section 1.3.1, the only domestic source of low-enriched uranium currently available to fuel fabricators is from production of the Paducah Gaseous Diffusion Plant (GDP). Foreign sources are currently supplying as much as 85–90 percent of U.S. nuclear power plant demand (EIA, 2009).

Currently, the “Megatons to Megawatts” program will expire in 2013, potentially eliminating downblending as a source of low-enriched uranium (DOE, 2010). The Paducah GDP, which opened in 1952, uses gaseous diffusion technology, a process that is more energy-intensive than newer technologies such as gas centrifuge. The NRC has already granted licenses to two commercial entities to construct and operate gas centrifuge enrichment facilities: the Louisiana Energy Services (LES) National Enrichment Facility (NEF) in New Mexico, and the USEC American Centrifuge Plant (ACP) in Ohio. These two facilities are currently under construction and designed to produce 3.0 million and 3.5 million SWUs per year, respectively, when complete and generating at full capacity. In addition, the NRC is currently reviewing an application from AREVA Enrichment Services, LLC (AES) to construct and operate the Eagle Rock Enrichment Facility (EREF), a proposed gas centrifuge facility that would be located in Idaho. If the EREF is licensed and constructed, it would produce enriched uranium with annual production levels of up to 6.6 million SWU annually. If the three facilities begin operations, this would represent a more efficient and less costly means of producing low-enriched uranium than the current gaseous diffusion technology at the Paducah GDP.

Chapter 4 of this draft EIS presents a more detailed evaluation of the environmental impacts of the proposed action and the no-action alternative. Table 2-3 summarizes the environmental impacts for the proposed and the no-action alternative. A common element between the two alternatives is the occurrence of preconstruction activities. It is assumed that preconstruction activities take place under both alternatives and therefore, the impacts associated with preconstruction activities take place regardless of which alternative is selected. As a result, the comparison of alternatives presented in Table 2-3 is intended primarily to highlight the differences between the two alternatives after preconstruction activities have occurred.

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina	No-Action Alternative: The proposed GLE Facility would not be constructed, operated, and decommissioned. Enrichment services would continue to be met with existing, planned, or future domestic and foreign suppliers.
Land Use	SMALL. The project area is owned by GE, contains mostly mixed pine forest, and is bordered by existing GE facilities, the Northeast Cape Fear River, and residential development. The project area is zoned for heavy industrial use, and an enrichment facility is consistent with current zoning. Construction will alter the current land use of undeveloped forest but is not expected to affect surrounding land use. Operation of a uranium enrichment facility will affect land use and could affect nearby residential developments. However, operation of such a facility does not represent a significant departure from existing industrial developments at the Wilmington Site.	SMALL. Under the no-action alternative, other uses of the land would not be precluded. Land use impacts would be SMALL. Should another domestic enrichment facility be constructed at an alternate location, land use impacts could occur and could range from SMALL to LARGE.
Historic and Cultural Resources	SMALL to MODERATE. The study area comprises 106 hectares (263 acres). Construction would take place on ground previously disturbed by preconstruction, activities and most impacts on historic or archaeological resources would occur prior to construction. While there is potential for ground disturbance in previously undisturbed areas during construction, no construction activities are expected to occur in the portion of the Wilmington Site, where historic and cultural resources are known to exist. Facility operation has the potential to affect historic and cultural resources, but impacts are not expected. Operational impacts are possible and depend largely on procedures for protecting historic and archaeological resources. Resources could be affected if expansion of the facility is deemed necessary and occurs in areas that contain these resources. No facility activities are expected that would affect site 31NH801, but no plan to protect the site has been disclosed.	SMALL. Under the no-action alternative, additional land disturbance at the Wilmington Site would not occur, depending on future plans for the project site. Anticipated impacts on historic and cultural resources in New Hanover County would be SMALL. Should another domestic enrichment facility be constructed at an alternate location, historic and cultural resource impacts could occur and could range from SMALL to LARGE. These impacts could be similar to those of the proposed action but would be addressed by the NRC at that time. Consideration of historic and cultural resources at the alternate location would be reviewed in consultation with the appropriate State Historic Preservation Officer (SHPO).

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina	No-Action Alternative: The proposed GLE Facility would not be constructed, operated, and decommissioned. Enrichment services would continue to be met with existing, planned, or future domestic and foreign suppliers.
Visual and Scenic Resources	SMALL. The project area has low scenic quality and the environment in the project area is not unique for the area. The proposed facility site is adjacent to other industrial developments and will not alter a pristine environment. Likewise, the project area is not in a location that is sensitive to visual intrusions. There is limited expectation that the area would be kept in a wilderness condition. Construction activities would be concentrated on the Wilmington Site. The greatest visual impacts would result from increased truck and worker traffic, but these impacts would be temporary. The main project area is surrounded by a vegetation barrier, so construction activities would be largely screened. Construction cranes would be visible from greater distances, but this impact would be temporary. During operation, the two most visible (i.e., tallest) features of the proposed facility would be the water tower and the operations building tower. The operations building tower will have front and side profiles of 37 meters (120 feet) by 200 meters (660 feet), and could reach up to 49 meters (160 feet) above grade. The proposed water tower is the same height as the water tower that currently exists on the Wilmington Site, the top of which is only visible from south of I-140. Although the operations building tower could be approximately 10 meters (30 feet) taller than the existing water tower, it would be visible primarily from Castle Hayne Road and the residential subdivision to the northeast because it would be further from I-140 than the existing water tower. The intrusion of these features would not represent a major alteration of the existing visual environment. Portions of the proposed facility may be visible from I-140, and the planting of additional vegetation may minimize visual impacts.	SMALL. Under the no-action alternative, the vegetation screen that surrounds the proposed facility site would remain intact, and no additional visual disturbance would be introduced at the Wilmington Site. Local visual impacts would be SMALL. Should another domestic enrichment facility be constructed at an alternate location, visual and scenic resource impacts could occur and could range from SMALL to LARGE. These impacts could be similar to those of the proposed action but would be addressed by the NRC at that time.

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina	No-Action Alternative: The proposed GLE Facility would not be constructed, operated, and decommissioned. Enrichment services would continue to be met with existing, planned, or future domestic and foreign suppliers.
Air Quality	SMALL to MODERATE. Potential air quality impacts from construction activities would be the highest during this initial three-year period of construction (i.e., MODERATE, but temporary in nature). Air emissions of criteria pollutants, volatile organic compounds (VOCs), greenhouse gases, and hazardous air pollutants (HAPs) would include primarily fugitive dust emissions and engine exhaust emissions. Potential impacts of SO_2, NO_2, and CO emissions on ambient air quality would be well below applicable standards, and construction activities would have small impacts on ambient air quality for all criteria pollutants. Lead emissions are expected to be negligible and potential CO_2 emissions would be small. Because the proposed facility will not employ any continuous combustion activities during operation, criteria pollutant and HAP emission rates are expected to be small. Uranium-related and/or hydrogen fluoride (HF) stack emissions would be minimal. Fugitive air emissions from diesel fuel handling would be very low. Vehicles using onsite roads would contribute emissions, but these would decrease with time. Fugitive dust emissions during operation would be minimal, as most working areas and roads would be paved. Ozone precursor emissions would be relatively small, so the potential impacts on regional ozone would not be of concern. Potential air quality impacts from facility operations are anticipated to be SMALL.	SMALL. Under the no-action alternative, existing air emission sources at the Wilmington Site would continue to operate according to the allowable emission limits and emission control requirements set forth in operating permits issued by the North Carolina Division of Air Quality (NCDAQ). Point source emissions from current operations are negligible compared with the annual total emissions in New Hanover County. Should another domestic enrichment facility be constructed at an alternate location, air quality impacts could occur and could range from SMALL to LARGE. The nature and scale of air impacts resulting from the operation of similar enrichment technologies at alternative locations would be similar to those predicted for the proposed action, but the impacts on the local environments of such alternative facilities would be dependent on extant local conditions and cannot be predicted at this time. In the event that uranium enrichment activities are not undertaken at alternative locations or through expansion of planned and existing enrichment facilities, the national enrichment capacity would be diminished. This could lead to curtailment of planned new or expanded nuclear power plants, necessitating the generation of electricity to meet current and future demands through the application of other energy technologies, some of which will have significant air impacts. A precise analysis of the air impacts associated with such scenarios is not possible at this time.

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	**Proposed Action:** **GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina**	**No-Action Alternative:** **The proposed GLE Facility would not be constructed, operated, and decommissioned. Enrichment services would continue to be met with existing, planned, or future domestic and foreign suppliers.**
Geology and Soil Resources	SMALL. Approximately 91 hectares (226 acres) of land would be disturbed under the proposed action, including the proposed facility site, support structures, and road construction. Construction vehicles and equipment could potentially leak fuel, oil, or grease to site soils. Soil-related aspects of construction would include soil excavation, soil storage and removal, and stormwater management. Construction would not impact site geologic resources because the site lacks significant geologic resources. Soil disturbance during operations would occur at a reduced level, as some construction projects would be completed while others are ongoing. Restoration and seeding would limit erosion due to stormwater. Roads, parking lots, and roofs would create impervious surfaces and increase runoff, increasing the erosion potential. Large storm events could create erosion along drainages or at culverts, requiring maintenance or drainage system improvement. Vehicles and equipment used in unpaved areas could potentially leak fuel, oil, or grease to site soils. Groundwater pumping is expected to have a minimal effect on the potentiometric surface, and the associated degree of subsidence is expected to be negligible. Other geologic hazards to the site are not anticipated.	SMALL. Under the no-action alternative, additional ground-disturbing activities may or may not occur, depending on future plans for the project site. Because no additional land disturbance is anticipated, the no-action alternative would have SMALL geological or soil impacts. Should another domestic enrichment facility be constructed at an alternate location, geology and soil impacts could occur and could range from SMALL to LARGE, depending on the design of the facility, the construction and operations methods used, and the local geology and soils conditions. These impacts could be similar to those of the proposed action, but the nature and scale of these impacts would be assessed by the NRC at that time.

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina	No-Action Alternative: The proposed GLE Facility would not be constructed, operated, and decommissioned. Enrichment services would continue to be met with existing, planned, or future domestic and foreign suppliers.
Surface Water Resources	SMALL. Excavations during construction would lead to possible short-term soil erosion with impacts on surface water quality. The proposed North access road would have a new stream crossing and possibly change a jurisdictional channel, which could lead to erosion and increased sediment load. Construction vehicles and equipment pose the possibility of leaks or spills of fuels, oil, or grease, which could run off and impact nearby surface water. However, it is unlikely that a minor spill would reach the Northeast Cape Fear River or Prince George Creek. Infiltration into site soil would likely eliminate runoff. Process wastewater would be discharged at an existing outfall during operation, increasing the site's process wastewater volume by about seven percent. Liquid radioactive waste would be pretreated to reduce uranium to acceptable levels before transfer to the existing wastewater treatment facility. Treatment would produce an effluent similar to current process wastewaters. Treated sanitary wastewater effluent would be reused in site cooling towers. No consumption of surface water would take place during operation. Stormwater runoff would collect in a State-permitted detention basin before discharge and would be regulated by a National Pollutant Discharge Elimination System (NPDES) permit. Stormwater runoff from the UF_6 cylinder storage pads would collect in a lined holding pond. If monitoring demonstrates a lack of radioactivity, basin effluent would be discharged to the stormwater detention basin, and ultimately, to the effluent channel. Any increase in turbidity and sediment loading to streams as a result of construction would subside during operation. Oil, grease, metals, and other automotive-related contaminants would be	SMALL. Under the no-action alternative, no changes to surface water quality would be expected, and the impact on surface water is expected to be SMALL. Should another domestic enrichment facility be constructed at an alternate location, surface water impacts could occur and could range from SMALL to LARGE. These impacts could be similar to those of the proposed action, but the nature and scale of these impacts would be assessed by the NRC at that time.

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina	No-Action Alternative: The proposed GLE Facility would not be constructed, operated, and decommissioned. Enrichment services would continue to be met with existing, planned, or future domestic and foreign suppliers.
	present in limited quantities due to general traffic. The use of herbicides in landscaped areas would be similar to their use elsewhere at the Wilmington Site.	
Groundwater Resources	SMALL. Construction equipment poses the potential for leaks of fuel, oil, and grease to soil and groundwater; implementation of best management practices (BMPs) would reduce these impacts. The use of portable toilets during construction would eliminate sanitary system impacts on groundwater. Potable and nonpotable construction water requirements would be met by transport of offsite water by tanker truck. During operation, the stormwater collected from the cylinder storage pad is expected to have no more than trace amounts of radiological contaminants, and the liner is expected to limit infiltration to groundwater. Discharge at site outfalls would be from process and sanitary wastewater. Some portion of these effluents may potentially infiltrate the Peedee sand aquifer. However, treatment and monitoring are expected to result in no significant contaminant concentrations in the effluent channel. The proposed facility will obtain additional groundwater from the Wilmington Site's production wells for potable purposes. Water level data show these wells to be cross-gradient of the overall Wilmington Site, and they do not result in significant drawdown. Groundwater will also be needed as a source of process water. A small amount of increased drawdown is expected, without significant effect on flow directions, water quality, or availability for offsite users. Diesel tanks at the facility would presumably be of proper construction and have adequate leak detection equipment. A groundwater monitoring plan would be developed after the facility is constructed.	SMALL. Under the no-action alternative, additional water use may or may not occur, depending on future plans for the project site. Groundwater quality would not be reduced at the proposed facility site, but would gradually improve sitewide through continued use and improvement of site remediation systems and due to natural attenuation. Because no additional groundwater use or adverse changes to groundwater quality would be expected, the impact on groundwater resources is expected to be SMALL. Should another domestic enrichment facility be constructed at an alternate location, groundwater impacts could occur and could range from SMALL to LARGE. These impacts could be similar to those of the proposed action, but the nature and scale of these impacts would be assessed by the NRC at that time.

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina	No-Action Alternative: The proposed GLE Facility would not be constructed, operated, and decommissioned. Enrichment services would continue to be met with existing, planned, or future domestic and foreign suppliers.
Ecological Resources	SMALL to MODERATE. Construction activities that could impact ecological resources at the Wilmington Site include constructing the UF_6 storage pads, constructing the operations building, and adding security fencing around the proposed facility. Most construction activities would occur in areas that would have already been disturbed by preconstruction activities. Impacts on vegetation would occur primarily from vegetation clearing, habitat fragmentation, alteration of topography, changes in drainage patterns, and soil compaction. Remaining potential impacts on vegetation include decline or mortality of trees near the construction boundary, effects related to hydrologic changes, deposition of dust and other particulate matter, introduction of invasive plant species, and accidental releases of hazardous materials (e.g., fuel spills). Wetlands could be impacted by alteration of surface water runoff patterns, soil compaction, or groundwater flow. No wetlands would be directly impacted by construction of the proposed facility, but three jurisdictional wetlands and one isolated wetland occur within the corridor for the revised entrance and roadway. It is probable that the isolated wetland would be directly impacted, resulting in a wetland loss. However, impacts on, or loss of, this wetland would not be significant. Indirect impacts on wetlands could occur from increased stormwater runoff, decreased groundwater recharge, disconnected hydrologic conductivity, or changes in groundwater or surface water flow patterns. Impacts from increased or decreased runoff are expected to be negligible. Except for the probable impact on wetlands, no environmentally sensitive areas would be directly impacted by construction. Only minor, localized indirect impacts on environmentally sensitive	SMALL. Most impacts on ecological resources would occur during the preconstruction phase. Because changing the license would not result in additional land disturbance on the Wilmington Site, anticipated impacts on ecological resources from the no-action alternative are expected to be SMALL. Should another domestic enrichment facility be constructed at an alternate location, ecological impacts could occur and could range from SMALL to LARGE. These impacts could be similar to those of the proposed action. However, the nature and scale of impacts would depend on the resources present and type of facility and would be assessed by the NRC at that time.

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina	No-Action Alternative: The proposed GLE Facility would not be constructed, operated, and decommissioned. Enrichment services would continue to be met with existing, planned, or future domestic and foreign suppliers.
	areas may occur from erosion and sedimentation or from changes in drainage patterns. Impacts on wildlife from construction would include habitat disturbance, wildlife disturbance, and injury or mortality of wildlife. Habitats within the footprint disturbed by construction would be reduced or altered, and construction activities would result in habitat fragmentation. Construction would cause a loss of habitat, which could result in a long-term reduction in wildlife abundance and richness. Although habitats adjacent to the proposed facility site would mostly remain unaffected, wildlife might make less use of these areas due to disturbance (i.e., indirect habitat loss). Habitat disturbance, including roads, could facilitate the spread and introduction of invasive plant species. Wildlife habitat could be adversely affected if invasive vegetation became established in the disturbed areas and adjacent offsite habitats. If exposure of wildlife to fugitive dust was of sufficient magnitude and duration, the effects could be similar to those on humans. A more probable effect would be the dusting of plants, which could make forage less palatable. Construction activities could cause wildlife disturbance, including interference with behavioral activities. Wildlife could respond in various ways, including attraction, habituation, and avoidance. Principal sources of noise would include vehicle traffic and operation of machinery. Regular or periodic noise could cause adjacent areas to be less attractive to wildlife and result in a long-term reduction in use. Construction activities could result in the direct injury or death of certain wildlife species. Wildlife could also be exposed to accidental fuel spills or releases of other hazardous materials.	

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina	No-Action Alternative: The proposed GLE Facility would not be constructed, operated, and decommissioned. Enrichment services would continue to be met with existing, planned, or future domestic and foreign suppliers.
	No aquatic habitats are located within the footprint of the areas that will be cleared for the proposed facility, and no significant adverse impacts on aquatic biota are expected from construction activities. No population-level impacts would be expected on any Federally listed threatened, endangered, or other special status species from construction activities. Similarly, no population-level impacts would be expected to any State-listed species. During operation, impacts on vegetation would include moving, hand-cutting, and chemical control of vegetation around the proposed facility, support facilities, utility corridors, and access road. No effects on vegetation would be expected from the cooling tower or air emissions, wastewaters, and solid wastes generated during operation. It is unlikely that radionuclide releases would have adverse effects on ecological resources. Facility operation would not encroach upon or have any other adverse effect on wetlands. Impervious surfaces generally result in increased runoff and reduced infiltration, but routing drainage to the stormwater detention and retention basins would minimize the potential for wetland water-level fluctuations. No environmentally sensitive areas would be impacted by operations. Potential impacts on wildlife from operations would include ongoing habitat disturbance (i.e., reduction, alteration, and fragmentation of habitat), and wildlife injury or mortality.	

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina	No-Action Alternative: The proposed GLE Facility would not be constructed, operated, and decommissioned. Enrichment services would continue to be met with existing, planned, or future domestic and foreign suppliers.
	No natural water bodies occur within the immediate area of the proposed facility. During operations, aquatic habitats and biota could be affected by continued erosion and sedimentation and exposure to contaminants. Increased liquid effluent discharges could increase turbidity and sedimentation until the stream channel adjusts. Wastewater would be treated to meet NPDES permit requirements, so aquatic biota would not be adversely impacted. The potential exists for toxic materials (e.g., fuel, lubricants, and herbicides) to be accidentally introduced into aquatic habitats, but an uncontained spill would probably affect only a limited area and lubricants and fuel would not be expected to enter wetlands or waterways. Only trace levels of radiological contamination would be released to surface waters during operation, so adverse radiological impacts on aquatic biota would not be expected. No adverse impacts on threatened, endangered, or other special status species would be expected from facility operations due to the lack of suitable habitats within the immediate project area.	

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina	No-Action Alternative: The proposed GLE Facility would not be constructed, operated, and decommissioned. Enrichment services would continue to be met with existing, planned, or future domestic and foreign suppliers.
Noise	SMALL to MODERATE. During construction, vehicular traffic around the proposed facility and along nearby traffic routes would generate intermittent noise, but the noise contribution from these sources would be limited to the immediate vicinity of the traffic routes and would be minor in comparison with the contribution from continuous sources used during construction. Noise levels from planned construction activities would be comparable to those from other construction sites of similar size. The dominant noise source for most construction equipment is the diesel engine without sufficient muffling. Major construction activities would include building erection and electrical and mechanical installation, and some activities would occur inside the structures. Typically, heavy equipment with lower noise levels than used during road construction would be employed. Traffic accessing the site might increase but would largely consist of smaller passenger vehicles, vans, and pickup trucks. Potential construction noise impacts on the nearest subdivision would be anticipated to be SMALL, except during road construction (when potential noise impacts on the surrounding community could be MODERATE but temporary in nature). During facility operation, noise sources would be primarily enclosed within buildings. Various outbuildings are planned with exterior equipment, such as pumps, heat pumps, transformers, and cooling towers. Other noise sources would include vehicular traffic on the proposed north access road, as well as hauling vehicles around the proposed facility. Noise levels at the fenceline receptor closest to the Wooden Shoe residential subdivision are estimated to be below the day and night equivalent sound level for the local noise ordinance and the EPA noise guideline. Potential noise impacts on the subdivision are anticipated to be SMALL.	SMALL. Noise associated with construction would not occur and additional noise from operations at the existing Wilmington Site would not likely change, depending on future plans for the project site. Because additional noise sources would not be created, noise impacts on surrounding communities would be SMALL. Should another domestic enrichment facility be constructed at an alternate location, noise impacts could occur and could range from SMALL to LARGE. These impacts could be similar to those of the proposed action. However, impacts would be dependent on circumstantial factors and would be addressed by the NRC at that time.

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina	No-Action Alternative: The proposed GLE Facility would not be constructed, operated, and decommissioned. Enrichment services would continue to be met with existing, planned, or future domestic and foreign suppliers.
Transportation	SMALL to MODERATE. Construction involves the movement of personnel and equipment to and from the site, the delivery of materials and supplies, and the removal of construction debris and waste. The number and type of truck shipments will vary over the course of construction. Construction activities are estimated to add an average of approximately 35 trucks per day, with a small impact on local traffic. Prior to start-up, an average increase of up to 815 daily trips by construction personnel is anticipated, with the heaviest traffic occurring in the immediate vicinity of the site entrance. Impacts would be lessened if shift changes did not coincide with local peak road usage times. Impacts could be SMALL to MODERATE in the vicinity of the site; regional impacts are expected to be SMALL. Facility operations would overlap with the construction period for five years, during which time vehicular traffic from commuting operations personnel will add to increased local traffic from construction workers and shipments. The remaining years of operation will involve vehicular traffic from operations personnel, occasional visitors, incoming truck shipments for materials and supplies, and outgoing shipments of product materials and wastes. An average of approximately six additional heavy haul truck shipments per day to and from the Wilmington Site would occur during operations. The average number of workers (construction and operations personnel) on a daily basis during start-up and construction completion is anticipated to be 743, with about 350 permanent operations personnel employed over the remainder of the operational period. The average number of additional daily vehicle trips from facility activities will increase by about 1560 at the Wilmington Site during joint construction and operations activities. Once construction is complete, the average	SMALL. Under the no-action alternative, increased construction and operations traffic would not occur and there would not likely be any additional local transportation impacts at the Wilmington Site, depending on future plans for the project site. There would be no additional traffic entering and leaving the Wilmington Site, and additional national impacts from the transportation of radioactive materials to and from the Wilmington Site would not occur in the short term. Because the no-action alternative would not directly result in additional traffic on the site, potential impacts on transportation resources near the Wilmington Site are expected to be SMALL. Should another domestic enrichment facility be constructed at an alternate location, transportation impacts could occur and could range from SMALL to LARGE. These impacts could be similar to those of the proposed action, depending on the existing road network and traffic patterns. National impacts from radioactive material transportation would likely increase. There would also the potential for increased shipping traffic to and from the Wilmington Site to support the enriched uranium demands of the existing FMO facility.

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina	No-Action Alternative: The proposed GLE Facility would not be constructed, operated, and decommissioned. Enrichment services would continue to be met with existing, planned, or future domestic and foreign suppliers.
	number of daily trips associated with operations personnel is estimated to be approximately 740. The range of additional daily vehicle trips from facility activities (740 to 1560) could have a SMALL to MODERATE impact on the local road network. The impact on regional traffic flow is expected to be SMALL. Operations of the proposed facility will require the shipment (by truck) of various radioactive materials to and from the facility, with multiple origins or destinations. Vehicle-related risks result from moving from one location to another (independent of cargo characteristics), while cargo-related risk refers to that attributable to the cargo being shipped. In the case of the uranium, cargo-related risks include exposure to ionizing radiation during normal transportation and accident conditions, as well as chemical hazards during accident conditions. Less than one latent cancer fatality is anticipated for the public and transportation crews from all shipments on an annual basis. No latent fatalities from vehicle emissions are anticipated on an annual basis, so impacts on the public from vehicle emissions would be SMALL. Annual transportation accident impacts from the proposed action are anticipated to be SMALL. Chemical impacts would be negligible, as past analyses of depleted UF_6 shipments have shown the estimates of irreversible adverse effects to be approximately 1 to 3 orders of magnitude lower than the estimates of public latent cancer fatalities from radiological accident exposure. No fatalities are expected from accidents (direct physical trauma) on an annual basis.	

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina	No-Action Alternative: The proposed GLE Facility would not be constructed, operated, and decommissioned. Enrichment services would continue to be met with existing, planned, or future domestic and foreign suppliers.
Public and Occupational Health	SMALL. Impacts on occupational safety from construction would be SMALL. Occupational exposures during construction would be minor and minimized using work practices and personal protective equipment. Impacts on air quality during construction would be SMALL. Construction activities are not expected to cause any exceedances of ambient air quality criteria, with the possible exception of short-term criteria for particulate matter from fugitive dust. Radiological impacts during construction would be primarily accrued to construction workers. Offsite exposures would not be expected. Construction activities would not generate radiological contamination but could disturb previously contaminated areas. Construction workers could also be exposed to emissions from the proposed facility during the overlap of construction and early operation. The maximum possible dose is a small fraction of background radiation exposure and less than the 10 CFR 20.1301(a)(1) limit of 1 millisievert per year. Impacts on construction workers from radiological exposure would be SMALL. Dose to the offsite public would be significantly less, as they have no potential for measurable exposure from existing site contamination. Impacts on the offsite public from construction would be SMALL. A total of 450 total recordable incidents, 247 lost workday incidents, and less than one fatal injury are projected for 38 years of facility operation. Impacts on occupational health and safety during facility operation would be SMALL.	Under the no-action alternative, impacts on construction workers would not occur. Exposure to the public outside the Wilmington Site boundary would remain unchanged, depending on future plans for the project site. Therefore, the public and occupational health impacts of the no-action alternative would be SMALL. Should another domestic enrichment facility be constructed at an alternate location, public and occupational health impacts could occur and could range from SMALL to LARGE. These impacts could be similar to those of the proposed action but would be addressed by the NRC at that time.

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina	No-Action Alternative: The proposed GLE Facility would not be constructed, operated, and decommissioned. Enrichment services would continue to be met with existing, planned, or future domestic and foreign suppliers.
	The greatest potential for occupational exposure in the main process building would be from connecting and disconnecting UF_6 cylinders. Airborne concentrations of HF and uranyl fluoride inside facilities are expected to be insignificant, and workers would use ventilation equipment to minimize exposures. Concentrations near the release point could be as high as 10 percent of the Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit and would be limited by ventilation equipment. Impacts associated with routine occupational exposures to HF and UF_6 in the workplace would be SMALL. Large volumes of UF_6 would be present as feed and product material, but there would be no routine exposures to solid UF_6. Exposure to industrial chemicals would be limited by minimizing airborne releases and use of protective equipment. Non-radiological impacts on workers from operations would be SMALL. Lasers would normally be operated within enclosures, equipped with interlocks to prevent inadvertent worker exposure. With laser protections in place, impacts of lasers on worker health would be SMALL. Public health impacts associated with non-radiological liquid effluent releases would be SMALL. Potential long-term, low-level HF and uranium exposure to the public would be the primary offsite chemical exposures of concern. However, public health impacts from such exposures would be SMALL. Only minor quantities of UF_6 or HF would escape the facility ventilation system, and the quantity of HF passing through the emissions control devices would be below levels established in the facility air permit and protective of public health. The estimated HF and uranium concentrations at onsite exposure locations are orders of	

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina	No-Action Alternative: The proposed GLE Facility would not be constructed, operated, and decommissioned. Enrichment services would continue to be met with existing, planned, or future domestic and foreign suppliers.
	magnitude below safe levels established by OSHA. UF_6 and HF levels at the site boundary and the location of the nearest resident would be lower than onsite levels. HF concentrations at all exposure locations are far below the most stringent state or federal ambient air quality standards for the general public. No criteria air pollutants would be produced by the enrichment process. Facility operation could result in radiation exposure to the public via uranium releases or direct external radiation exposure. UF_6 gas released in the main process building would pass through a ventilation system to minimize external release. Liquid effluents would be treated and sampled to limit releases. Direct exposure to the public could occur from onsite uranium and transportation both onsite and offsite. Direct radiation and skyshine from airborne releases would be undetectable at offsite areas. The main process building would release small amounts of airborne uranium during operation, but impacts on members of the public from air emissions would be SMALL. Radioactive materials at the proposed facility would present the possibility for onsite members of the public to receive a direct radiation dose. Only depleted uranium would be continuously present in sufficient quantity to represent a potential source of direct radiation dose. Measurements from existing sources at the Wilmington Site were used to estimate the public dose from direct radiation. Site dosimetry indicated no readings above background at the site boundary. Because of cylinder shielding and the distance to receptors, stored cylinders are expected to have only a minor effect on the exposure rate at the site boundary.	

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina	No-Action Alternative: The proposed GLE Facility would not be constructed, operated, and decommissioned. Enrichment services would continue to be met with existing, planned, or future domestic and foreign suppliers.
	Therefore, the impact from direct exposure to the public is expected to be SMALL. The proposed facility would generate process and sanitary liquid effluent streams. Radioactive wastewater would be collected, sampled, and routed to a treatment system. Treated effluent and cooling water blowdown would be discharged to the final process lagoon facility, and water from the lagoon facility would be discharged through an NPDES-permitted outfall. Sanitary wastewater would be treated in the existing sanitary wastewater treatment facility and used to replace cooling tower blowdown. Stormwater runoff would drain to a detention basin before discharge, and a holding pond would collect stormwater runoff from the cylinder storage pad. Monitoring would be conducted before discharge of the holding pond to the detention basin. Impacts of normal operations on public health and occupational exposure would be SMALL.	
Waste Management	SMALL. Solid nonhazardous wastes generated during construction would be similar to wastes from other industrial construction sites and transported offsite to an approved local landfill. Construction activities would generate less than two percent of the waste that the New Hanover County Landfill receives annually from all other sources. Small quantities of	SMALL. Under the no-action alternative, there would not likely be any additional waste management impacts at the Wilmington Site, depending on future plans for the project site. There would be no additional waste generated at the Wilmington Site beyond that generated by existing activities.

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina	No-Action Alternative: The proposed GLE Facility would not be constructed, operated, and decommissioned. Enrichment services would continue to be met with existing, planned, or future domestic and foreign suppliers.
	organic solvent-based residuals could be used and may require management as hazardous waste. Hazardous wastes from construction would be packaged and shipped offsite to licensed facilities. Impacts from construction-generated hazardous and nonhazardous waste would be SMALL. Facility operations would result in the generation of wastewaters that would be treated onsite before discharge and solid wastes that would be treated (onsite or offsite) and shipped for disposal offsite. Sanitary wastewater would be collected by a sewer system connected to the existing Wilmington Site sanitary wastewater treatment facility, increasing the load on the existing system by about one-third. Treated sanitary wastewater effluent could be used as makeup water in onsite cooling towers. Should discharges to surface waters be necessary, the existing NPDES discharge permit would be adequate to cover the additional effluent volume. Impacts from sanitary wastewater would be SMALL. Cooling tower blowdown would be sent to the Wilmington Site's final process lagoons, and impacts from cooling tower blowdown would be SMALL. Radioactive process wastewater from facility operations would be collected and treated to remove uranium, other metals, and fluoride. The treated effluent would be discharged to the process wastewater aeration basin and final process lagoon facility. Impacts from process wastewater would be SMALL.	Should another domestic enrichment facility be constructed at an alternate location, waste management impacts could occur and could range from SMALL to LARGE. These impacts could be similar to those of the proposed action but would be addressed by the NRC at that time.

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina	No-Action Alternative: The proposed GLE Facility would not be constructed, operated, and decommissioned. Enrichment services would continue to be met with existing, planned, or future domestic and foreign suppliers.
Accidents	SMALL. The consequence of a criticality accident would be high for a worker in close proximity (less than 6 meters [15 feet]). Worker health consequences are Low to Intermediate from four scenarios involving the release of UF_6. Worker health consequences are Low to High from four scenarios involving HF exposure. Worker health consequences are Low to Intermediate from four scenarios involving uranium chemical exposure. Radiological consequences to a maximally exposed individual at the Controlled Area Boundary are Low for the criticality accident, Low for all four UF_6 release scenarios, Low to High for the four HF exposure scenarios, and Low to Intermediate for the four scenarios involving uranium chemical exposure. Risk to the offsite public in the direction of highest exposure is estimated to be less than one lifetime cancer fatality for all accidence scenarios. Plant design, passive and active engineered controls, and administrative controls would reduce the likelihood of accidents. Therefore, impacts from accidents are expected to be SMALL.	SMALL. Under the no-action alternative, potential accidents and accident consequences from construction and operation of the proposed GLE Facility would not occur. Should another domestic enrichment facility be constructed at an alternate location, accident impacts could occur and could range from SMALL to LARGE. These impacts could be similar to those of the proposed action but would be addressed by the NRC at that time.
Socioeconomics	SMALL. Construction activities in the peak year (2012) would create 680 direct jobs at the facility site and an additional 3131 indirect jobs in the region of interest (ROI). Construction would produce $139.8 million in income in the ROI in 2012, $1.7 million in direct State income taxes, and $1.2 million in direct State sales taxes. Given the scale of construction and the likelihood of local worker availability, in-migration of workers and their families from outside the ROI would be required. Although in-migration may potentially impact local housing markets, the relatively small number of in-migrants (between 299 and 598 persons) and the availability of temporary accommodations would limit the impact on the number of vacant rental housing units. In-migration would affect local–community educational and	SMALL. Under the no-action alternative, any positive or adverse consequences of the proposed action would not occur. Population and employment in the ROI would be expected to grow in accordance with current projections. Activities completed prior to the no-action alternative (i.e., preconstruction) would not expected to have a noticeable effect on these trends or on county services, and the no-action alternative would not directly result in changes to current county services or growth projections. Socioeconomic impacts would be SMALL. Should another domestic enrichment facility be constructed at an alternate location, socioeconomic

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina	No-Action Alternative: The proposed GLE Facility would not be constructed, operated, and decommissioned. Enrichment services would continue to be met with existing, planned, or future domestic and foreign suppliers.
	medical services employment to maintain existing levels of service. Approximately one additional police officer and one additional firefighter would be required in the peak construction year. Between 84 and 169 additional school-age children would be expected in the ROI in 2012, requiring approximately one additional teacher to maintain existing student-teacher ratios. Facility start-up activities would create 200 direct jobs and an additional 218 indirect jobs in the ROI. Start-up would produce \$28.0 million in income in the ROI in 2013, \$1.3 million in direct State income taxes, and \$0.9 million in direct State sales taxes. Given the scale of start-up activities and the likelihood of local worker availability, in-migration of workers and their families from outside the ROI would be required. Although in-migration may potentially impact local housing markets, the relatively small number of in-migrants (92 to 120) and the availability of temporary accommodations would limit the impact of start-up on the number of vacant rental housing units. In-migration would affect local-community educational and medical services employment to maintain existing levels of service. Less than one additional police officer and less than one additional firefighter would be required in the start-up year. Between 26 and 40 additional school-age children would be expected in the ROI in 2013, requiring one additional teacher to maintain existing student-teacher ratios. Facility operations in 2017 would create 350 direct jobs and an additional 382 indirect jobs in the ROI. Operations would produce \$51.5 million in income in the ROI in 2017, \$2.3 million in direct State income taxes, and \$1.7 million in direct State sales taxes. Corporate income taxes would also be collected by the State during the operating period, totaling \$49.2 million annually. Given the scale of operations and the likelihood of local worker availability, facility operation would require in-migration of workers	impacts could occur and could range from SMALL to LARGE. These impacts could be similar to those of the proposed action but would be addressed by the NRC at that time.

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina	No-Action Alternative: The proposed GLE Facility would not be constructed, operated, and decommissioned. Enrichment services would continue to be met with existing, planned, or future domestic and foreign suppliers.
	(161 to 210) and the availability of temporary accommodations would limit the impact of facility operation on the number of vacant owner-occupied housing units. In-migration would affect local–community educational and medical services employment to maintain existing levels of service. Less than one additional police officer and less than one additional firefighter would be required in the peak operations year. Between 46 and 70 additional school age children would be expected in the ROI in 2017, meaning less than one additional teacher would be required to maintain existing student-teacher ratios.	
Environmental Justice	Although the NRC staff has concluded that potential impacts could be SMALL to MODERATE in a number of resource areas during construction and operation of the proposed facility, the impacts in each resource area would not appear to be disproportionately high and adverse for minority or low-income populations. The majority of environmental impacts associated with construction and operation of the proposed facility are SMALL to MODERATE and would generally be mitigated. Any remaining environmental impacts would affect primarily residents in the immediate vicinity. The neighborhood immediately surrounding the proposed facility site includes a mix of minority and nonminority residents, as well as a mix of low-income and more affluent residents. Because impacts on the general population are generally SMALL to MODERATE, and because the greatest impact is expected to occur in the immediate vicinity (and in an area with a mix of ethnicities and income levels), the various phases of facility development would not be expected to result in disproportionately high or adverse impacts on low-income or minority residents, and would not, therefore, produce any environmental justice concerns.	SMALL. The no-action alternative would not be expected to cause any high and adverse impacts, so environmental justice impacts would be SMALL. Should another domestic enrichment facility be constructed at an alternate location, environmental justice impacts could occur and could range from SMALL to LARGE. These impacts could be similar to those of the proposed action but would be addressed by the NRC at that time.

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina	No-Action Alternative: The proposed GLE Facility would not be constructed, operated, and decommissioned. Enrichment services would continue to be met with existing, planned, or future domestic and foreign suppliers.
	Even when environmental impacts are anticipated to be SMALL, the behaviors of some population groups, such as higher participation in outdoor recreation, home gardening, or subsistence fishing, may lead to disproportionate exposure. One Census block group with a high percentage of low-income and minority residents is located downstream of the proposed facility on the Northeast Cape Fear River. If radioactive contaminants were released, these residents could face increased risk of exposure. However, air and liquid releases of total uranium and UF_6 are projected to be extremely low, and indirect exposure through fish consumption would be even lower.	

2.3 Alternatives Considered but Not Analyzed in Detail

As required by NEPA and NRC regulations, the NRC staff has considered other alternatives to the construction, operation, and decommissioning of the proposed GLE Facility, and the disposition of UF_6. The range of alternatives was determined by considering the underlying purpose and need for the proposed action. Specifically, the range of alternatives was determined by considering other ways to provide enriched uranium to fulfill electricity generation requirements and provide reliable and economic domestic supplies of enriched uranium for national energy security. This analysis led to the following set of alternatives:

- alternative sites outside of the Wilmington Site

- alternative sites within the Wilmington Site

- alternative sources of low-enriched uranium

- alternative technologies available for uranium enrichment

These alternatives – with the exception of gas centrifuge – were considered but eliminated from further analysis due to economic, environmental, national security, or technological maturity. The following sections discuss these alternatives and the reasons NRC staff eliminated them from further consideration. The gas centrifuge alternative is discussed in Section 2.3.4.

2.3.1 Alternative Sites

This section discusses GLE's site-selection process, identifies the candidate sites for the proposed GLE Facility, and discusses the criteria used in the selection process. GLE undertook a site-selection process to identify viable locations for the proposed GLE Facility (GLE, 2008), which yielded one alternate candidate site in addition to the proposed site. The details of these two alternative sites are discussed below.

Since many environmental impacts can be avoided or significantly reduced through proper site selection, the NRC staff reviewed the GLE site-selection process to determine if a site considered by GLE was obviously superior to the proposed site in Wilmington, North Carolina (NRC, 2002). The NRC staff has determined that the process used by GLE is rational and objective, and that its results are reasonable. None of the candidate sites was obviously superior to the GLE preferred site in Wilmington, North Carolina.

2.3.1.1 Alternative Sites Outside of the Wilmington Site

GLE considered two approaches for the examination of alternate candidate sites: (1) the purchase of undeveloped land (i.e., an undisturbed "greenfield" site) and (2) colocation at an existing nuclear facility site or at a site that has been previously considered for a nuclear facility (including sites where planning and construction of a nuclear facility were halted). Due to the environmental advantages, and for commercial reasons (including scheduling considerations), GLE focused on the second approach (GLE, 2008).

GLE Site-Selection Process

GLE evaluated 22 sites throughout the eastern United States. The site-selection process, used to locate a suitable site for construction and operation of the proposed GLE Facility, was based on various technical, safety, economic, and environmental factors. A multi-attribute utility-analysis methodology was used for site selection that incorporated all of these factors to assess the relative benefits of a site with multiple, often competing, objectives or criteria. Figure 2-4 shows the site-selection process used by GLE and the results from the application of the process (GLE, 2008).

The GLE multi-step site-selection process consisted of:

- identification of candidate sites
- initial screening
- coarse screening
- site-reconnaissance visits
- fine screening
- qualitative cost-benefit analysis

Because most of the fuel-cycle facilities and ports of entry for feed material are located in the eastern United States or Ontario, Canada, and because the material would be transported by truck within the borders of the United States, GLE chose its region of interest for the purposes of site selection to be the area inside a 600-mi radius that encompasses the locations of the operating fuel-cycle facilities in the eastern United States (Figure 2-5). It follows, for GLE's analysis, that the Richland, Washington, facility was excluded due to its distant location.

The 22 candidate sites considered by GLE are listed in Table 2-4. Initial screening included evaluation of "Go/No Go" criteria, including the impacts and hazards from seismic zones, proximity to Quaternary fault zones, and flood potential. This initial screening resulted in elimination of three sites from further consideration: Westinghouse Electric Company (Columbia, South Carolina); Honeywell Specialty Chemicals/ConverDyn (Metropolis, Illinois); and the DOE site in Paducah, Kentucky.

Coarse screening criteria – also "Go/No Go" – included sufficient land availability, government ownership, potential litigation or political opposition, and *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) Superfund or RCRA Corrective Action status. Application of the coarse screening criteria resulted in the elimination of 16 sites; one due to insufficient land availability, ten due to government ownership, four due to potential litigation or political opposition, and four due to CERCLA Superfund or RCRA Corrective Action status (three of which are also government-owned). At the conclusion of the coarse screening evaluation, three sites remained: the GE site in Wilmington, North Carolina (the proposed site); the GE-owned site in Morris, Illinois; and the Duke Energy site in Cherokee, South Carolina.

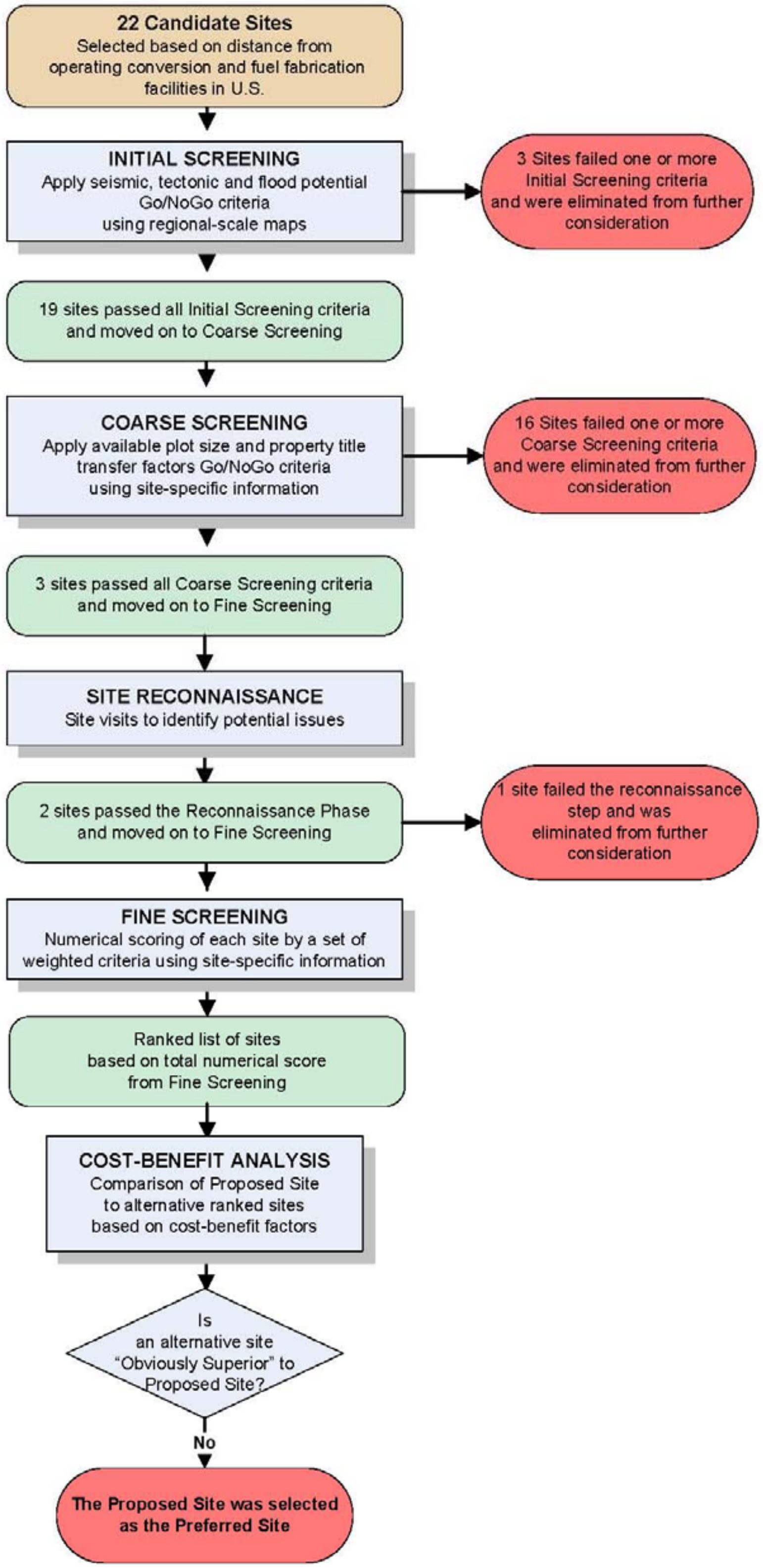

Figure 2-4 GLE Site-Selection Results Summary (GLE, 2008)

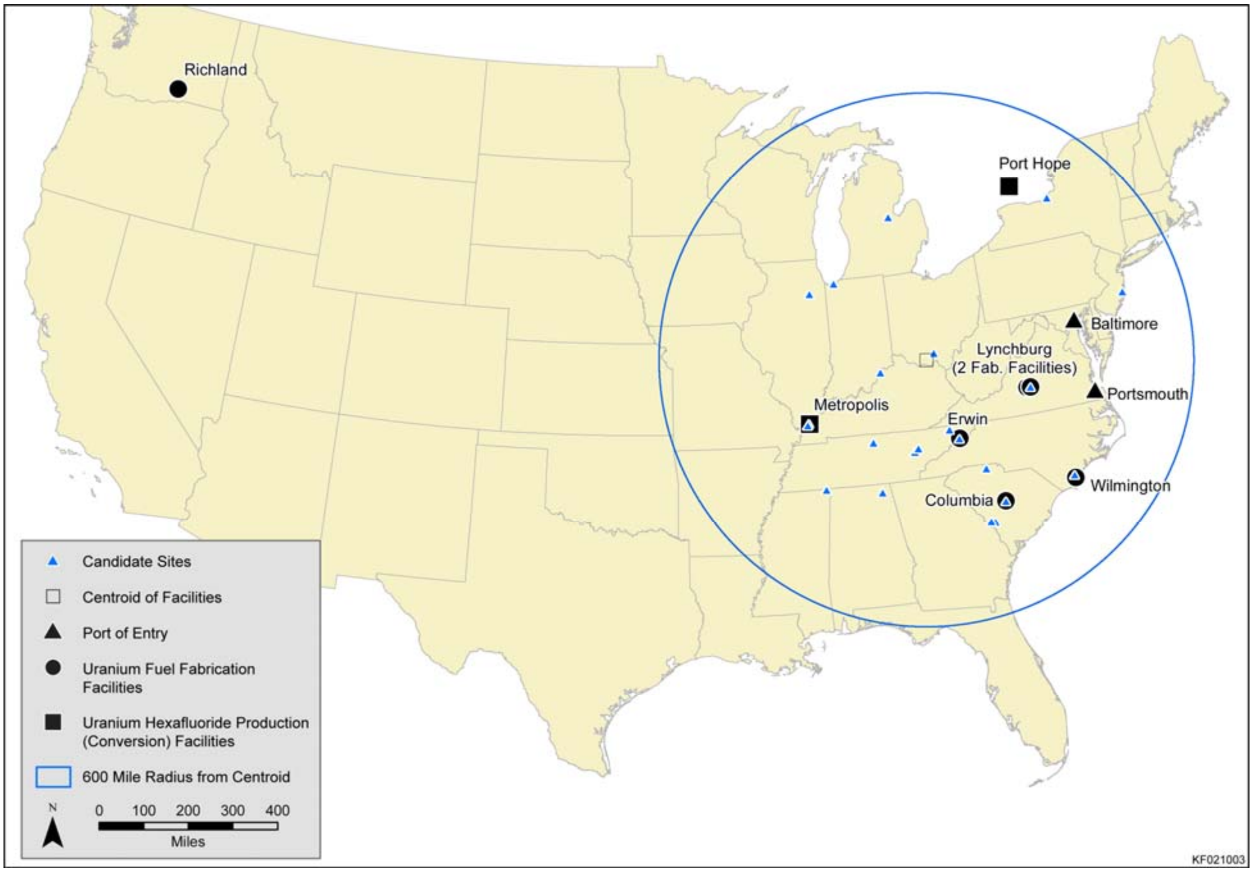

Figure 2-5 Candidate Sites for the Proposed GLE Facility (GLE, 2008)

As indicated in Figure 2-3, GLE evaluated the three remaining sites in a subsequent site-reconnaissance step. The GLE team visited all three sites to identify potential issues that contributed to the “Go/No Go” decision. Among the factors considered were additional planned land use, physical layout of existing facilities and infrastructure, current and future plans at the site, and potential complications related to properties adjacent to the site. Based on these considerations, GLE determined that Duke Energy’s plans for the Cherokee site (specifically, the construction and operation of a new nuclear power plant) were not compatible with GLE’s plans and needs for the construction and operation of an enrichment facility. Therefore, the Cherokee site was eliminated from further consideration.

GLE evaluated the final two candidate sites (the Wilmington Site and the 889-acre [356 hectare] Morris site), including multi-attribute decision analysis based on a set of fine screening criteria and a cost-benefit analysis. The fine screening criteria were grouped around four general clusters as shown below. Weighting factors were derived by a panel of experts considering a set of subcriteria for each of the four clusters. These subcriteria are listed below under each cluster. In most cases, the subcriteria are further subdivided into finer criteria. For example, the subcriterion listed as water resources under the “Impacts to the Environment” cluster was divided into physical surface water impacts, water quality impacts, and water quantity impacts (GLE, 2008).

Table 2-4 Candidate Sites Considered for the Proposed GLE Facility

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, the Tennessee Valley Authority (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 687-hectare (1700-acre) area is adjacent to the Clinch River, approximately 21 kilometers (13 miles) west of Oak Ridge, and is partially developed and for sale by the TVA.	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.

Table 2-4 Candidate Sites Considered for the Proposed GLE Facility (Cont.)

Site Name	Existing Nuclear Facility	Description	Owner/Operator
Forked River, NJ	No	The site had a construction permit, which was cancelled in 1980. The 266-hectare (657-acre) 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 DOE. In addition, the NPD operates a uranium-recovery facility and a uranium-downblending facility.	AREVA NP, Inc./BWX Technologies, Inc.
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

Table 2-4 Candidate Sites Considered for the Proposed GLE Facility (Cont.)

Site Name	Existing Nuclear Facility	Description	Owner/Operator
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

Source: GLE, 2008.

1. Impacts to the Environment (weighting factor = 0.27)
    - public health and safety
    - socioeconomic impacts
    - ecology
    - water resources
    - air quality
    - noise
    - historic and archeological sites
    - visual impacts

2. Impacts to the Facility (weighting factor = 0.25)
    - geologic hazards
    - colocated or nearby hazardous land uses
    - meteorology and climatology
    - wildfires

3. Impacts to Time and Cost (weighting factor = 0.24)
    - contamination
    - existing infrastructure
    - colocation
    - site physical characteristics
    - site development

4. Employment and Stakeholders (weighting factor = 0.24)
    - stakeholder support
    - labor force

Using site-specific data, GLE ranked the two sites based on the above criteria and weighting factors. The results of this evaluation are discussed below and shown in Table 2-5. The Wilmington Site ranked more favorably in the “Impacts to the Environment,” “Impacts to Time and Cost,” and “Employment and Stakeholders” clusters, whereas the Morris site ranked more favorably in the “Impacts to Facility” category (GLE, 2008). Overall, the weighted scores for the Wilmington and Morris sites were 0.525 and 0.475, respectively.

GLE performed a qualitative cost-benefit analysis between the two sites, which indicated that the net benefits of locating the proposed GLE Facility at the Wilmington Site were slightly higher than those associated with locating the same facility at the Morris site (GLE, 2008). GLE determined that its costs would be somewhat less at the Wilmington Site than at the Morris site. This was due to lower labor cost in the Wilmington area and the fact that the colocated GE/GNF-A conversion and fuel fabrication facility would be one of the primary customers of the proposed GLE Facility, thus reducing transportation costs (GLE, 2008).

Based on the above assessment, the NRC staff has determined that the GLE site selection process has a rational, objective structure and is reasonable. None of the candidate sites was obviously superior to the GLE preferred site in Wilmington, North Carolina; therefore, no other site was selected for further analysis.

2.3.1.2 Alternative Locations at the Wilmington Site

GLE evaluated alternative locations at the Wilmington Site in North Carolina and selected the proposed location because, compared to other potential onsite locations, GLE found the proposed location to be most suitable for accommodating the footprint (construction and laydown areas) of the proposed GLE Facility. GLE found that the proposed location would result in fewer environmental impacts – specifically, to the floodplain of the North Cape Fear River – than other available areas of the Wilmington Site. The proposed site also minimizes impacts on or avoids streams, wetlands, and rare ecological resources. GLE eliminated alternative locations at the Wilmington Site from further evaluation for the reasons specified above.

2.3.2 Alternative Sources of Low-Enriched Uranium

NRC staff examined three alternatives to fulfill U.S. domestic enrichment needs (as summarized below). These alternatives were eliminated from further consideration for reasons summarized below.

2.3.2.1 Re-Activate the Portsmouth Gaseous Diffusion Facility at Piketon

USEC closed the Portsmouth GDP (in Piketon, Ohio) in 2001 to reduce operating costs (DOE, 2003). USEC cited long-term financial benefits, more attractive power price arrangements, operational flexibility for power adjustments, and a history of reliable operations as reasons for choosing to continue operations at the Paducah GDP. In a June 2000 press

Table 2-5 Ranking Results for the Sites in Morris, Illinois, and Wilmington, North Carolina

Criterion	Morris, IL, Site	Wilmington, NC, Site
Intermediate Unweighted Scores:		
Impacts to Environment	0.484	0.516
Impacts to the Facility	0.592	0.408
Impacts to Time and Cost	0.378	0.622
Employment and Stakeholders	0.439	0.561
Final Weighted Score	0.475	0.525

release, USEC explained that it "clearly could not continue to operate two production facilities." Key business factors in USEC's decision to reduce operations to a single production plant included long-term and short-term power costs, operational performance and reliability, design and material condition of the plants, risks associated with meeting customer orders on time, and other factors relating to assay levels, financial results, and new technology issues (USEC, 2000).

The NRC staff does not believe that there has been any significant change in the factors that were considered by USEC in its decision to cease uranium enrichment at the Portsmouth GDP. In addition, the gaseous diffusion technology is substantially more energy-intensive than other enrichment technologies. The higher energy consumption results in larger indirect impacts, especially those impacts that are attributable to significantly higher electricity usage (e.g., air emissions from coal-fired electricity generation plants) (DOE, 1995). The age of the existing plant also calls into question its overall reliability. Furthermore, plans are now underway to decommission the plant with a draft request being issued for a proposal for decommissioning work (DOE, 2009). Therefore, this proposed alternative was eliminated from further consideration.

2.3.2.2 Downblending Highly Enriched Uranium

Under this alternative, a domestic uranium enrichment plant would not be constructed to replace existing production. Instead, an equivalent amount of SWU would be obtained from downblending highly enriched uranium from either United States or Russian nuclear warheads. This alternative was eliminated because U.S. reliance on foreign sources of enrichment services, as an alternative to the proposed action, would not meet the national energy policy objective of a "viable, competitive, domestic uranium enrichment industry for the foreseeable future" (DOE, 2000). Also, it does not meet the need for a reliable source of enriched uranium, as discussed in Section 1.3. Furthermore, the Megatons to Megawatts downblending agreement is set to expire in 2013.

2.3.2.3 Purchase Low-Enriched Uranium from Foreign Sources

There are several potential sources of enrichment services worldwide. However, U.S. reliance on foreign sources of enrichment services, as an alternative to the proposed action, would not meet the national energy policy objective of a "viable, competitive, domestic uranium enrichment industry for the foreseeable future" (DOE, 2000). For this reason, NRC staff does not consider that this alternative meets the need for the proposed action, and therefore, has eliminated it from further study.

2.3.3 Alternative Technologies for Enrichment

A number of different processes have been invented for enriching uranium; only three (gaseous diffusion, gas centrifuge, and laser excitation) are considered candidates for commercial use, and of those, only the gaseous diffusion and gas centrifuge technologies have been deployed for large-scale industrial use. Other technologies – namely, electromagnetic isotope separation, liquid thermal diffusion, and early-generation laser enrichment – have proven too costly to operate, remain at the research and laboratory developmental scale, or in the case of laser-enrichment have been superseded by a more advanced technology. All of these technologies are discussed below.

2.3.3.1 Electromagnetic Isotope Separation Process

Figure 2-6 shows a sketch of the electromagnetic isotope separation process. In this process, a monoenergetic beam of ions of normal uranium travels between the poles of a magnet. The magnetic field causes the beam to split into several streams according to the mass of the isotope. Each isotope has a different radius of curvature and follows a slightly different path. Collection cups at the ends of the semicircular trajectories catch the homogenous streams. Because the energy requirements for this process proved very high – in excess of 3000 kilowatt hours per SWU – and production was very slow (Heilbron et al., 1981), electromagnetic isotope separation was not considered viable and has been removed from further consideration.

2.3.3.2 Liquid Thermal Diffusion

Figure 2-7 is a diagram of the liquid thermal diffusion process, which was investigated in the 1940s. It is based on the concept that a temperature gradient across a thin layer of liquid or gas causes thermal diffusion that separates isotopes of differing masses. When a thin, vertical column is cooled on one side and heated on the other, thermal convection currents are generated and the material flows upward along the heated side and downward along the cooled side. Under these conditions, the lighter UF_6 molecules diffuse toward the warmer surface and heavier UF_6 molecules concentrate near the cooler side. The combination of this thermal diffusion and the thermal convection currents causes the lighter uranium-235 molecules to concentrate on top of the thin column while the heavier uranium-238 goes to the bottom. Taller columns produce better separation. Eventually, a facility using this process was designed and constructed at Oak Ridge, Tennessee, but it was closed after about a year of operation because of cost and maintenance concerns (Settle, 2004). Based on high operating costs and high

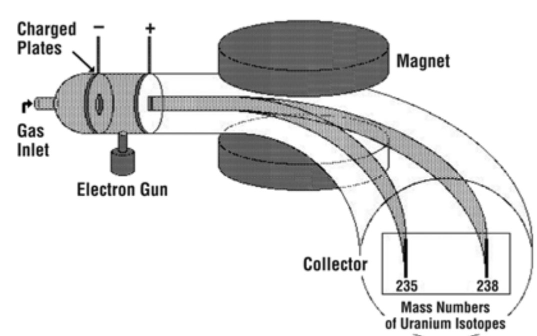

Figure 2-6 Electromagnetic Isotopic Separation Process (Milani, 2005)

maintenance requirements, the liquid thermal diffusion process has been eliminated from further consideration.

2.3.3.3 Gaseous Diffusion Process

The gaseous diffusion process is based on molecular effusion, a process that occurs whenever a gas is separated from a vacuum by a porous barrier. The gas flows from the high-pressure side to the low-pressure side. The rate of effusion of a gas through a porous barrier is inversely proportional to the square root of its mass. Thus, lighter molecules pass through the barrier faster than heavier ones. Figure 2-8 is a diagram of a single gas diffusion stage. The gaseous diffusion process consists of thousands of individual stages connected in series to multiply the separation factor.

Gaseous diffusion is the only enrichment technology in commercial use in the United States, but it has relatively large resource requirements. The Paducah GDP contains 1760 enrichment stages and is designed to produce UF_6 enriched up to 5.5 percent uranium-235. The design capacity of the Paducah GDP is approximately 8 million SWUs per year, but it has never operated at greater than 5.5 million SWUs. Paducah consumes approximately 2200 kilowatt hours per kilogram of SWU (DOE, 2000). DOE anticipates “the inevitable cessation of all domestic gaseous diffusion enrichment operations” due to the higher cost of aging diffusion facilities (DOE, 2001). Therefore, GDP has been eliminated from further consideration.

2.3.3.4 Atomic Vapor Laser Isotope Separation

The Atomic Vapor Laser Isotope Separation (AVLIS) process, shown in Figure 2-9, is based on the circumstance that different isotopes of the same element, though chemically identical, have different electronic energies and absorb different colors of laser light. The isotopes of most elements can be separated by a laser-based process, if they can be efficiently vaporized into individual atoms or molecules. In AVLIS, uranium metal is vaporized, and the vapor stream is illuminated with a laser light of a specific wavelength that is absorbed only by

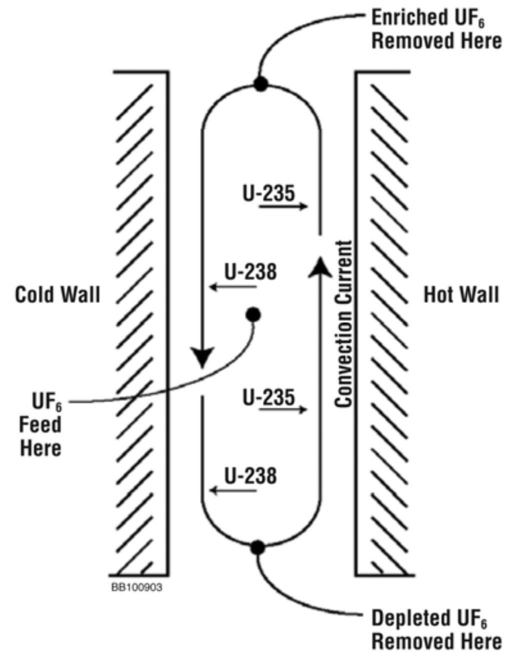

Figure 2-7 Liquid Thermal Diffusion Process (NRC, 2005b)

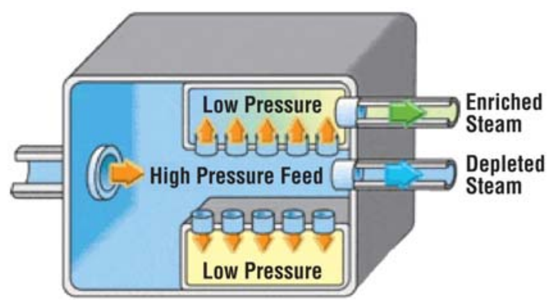

Figure 2-8 Gaseous Diffusion Stage (NRC, 2009b)

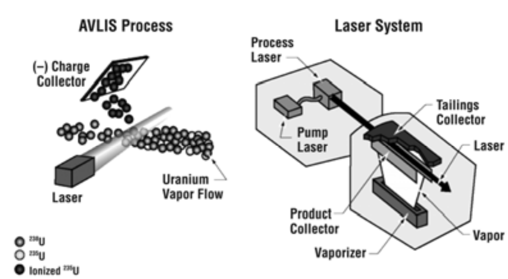

Figure 2-9 Atomic Vapor Laser Isotope Separation Process (Hargrove, 2000)

uranium-235. The laser selectively adds enough energy to ionize or remove an electron from uranium-235 atoms, while leaving the other isotopes unaffected. The ionized uranium-235 atoms are then collected on negatively charged surfaces inside the separator unit. The collected material (enriched product) is condensed as a liquid on the charged surfaces and then drains to a caster, where it solidifies as metal nuggets.

The high separation factor in AVLIS means fewer stages to achieve a given enrichment, lower energy consumption, and smaller waste volume. However, budget constraints compelled USEC to discontinue development of the U.S. AVLIS program in 1999 (USEC, 1999). Because development of the AVLIS process was not continued, and the technology has been superseded by the laser-based technology proposed by GLE, it has been eliminated from further consideration.

2.3.3.5 Molecular Laser Isotope Separation

Like AVLIS, the Molecular Laser Isotope Separation (MLIS) process uses a tuned laser to excite uranium-235 molecules in the UF_6 feed gas. A second laser then dissociates excited molecules into UF_5 and free fluorine atoms. The enriched UF_5 then precipitates and is filtered as a powder from the feed gas. Each stage of enrichment requires conversion of enriched UF_5 back to UF_6. The advantages of MLIS include low power consumption and the use of UF_6 as a process gas. However, it is less efficient and up to four times more energy-intensive than AVLIS. Therefore, all countries except Japan have discontinued development of MLIS. Because development of the MLIS process was not continued, and the technology has been superseded by the laser-based technology proposed by GLE, it has been eliminated from further consideration.

2.3.4 Gas Centrifuge

Figure 2-10 shows the basic components of the gas centrifuge enrichment process, which is a second-generation mechanical technology. A centrifuge consists of a large rotating cylinder (rotor) with piping to feed UF_6 gas into the centrifuge, and then withdraw enriched and depleted UF_6 gas streams. The rotor spins at high speed inside a protective casing, which maintains a vacuum around the rotor and provides physical containment of the rotor in the event of a major machine failure (NRC, 2006).

The enrichment level achieved by a single centrifuge is not sufficient to obtain the desired concentration of uranium-235 in a single step; therefore, a number of centrifuges are connected in series to increase the concentration of the uranium-235 isotope.

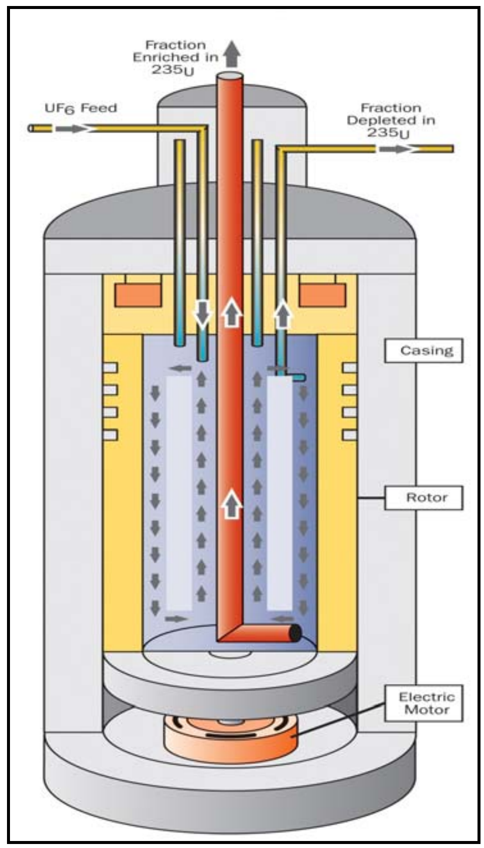

Figure 2-10 Schematic of a Gas Centrifuge (NRC, 2009b)

Additionally, a single centrifuge (or series of centrifuges) cannot process a sufficient volume for commercial production, which makes it necessary to connect multiple centrifuges in parallel to increase the volume flow rate. The arrangement of centrifuges connected in series to achieve higher enrichment and in parallel for increased volume is known as a "cascade" (NRC, 2006).

As discussed in Section 2.2, three other commercial entities are pursuing the gas centrifuge technology for enrichment of uranium in the United States. GLE has selected the laser-based technology and eliminated the gas centrifuge technology from consideration based on the reasons described in Section 1.3.3. These reasons relate primarily to GLE's belief that the proposed technology will result in lower cost and smaller environmental impacts when compared to the gas centrifuge technology (GLE, 2008).

The NRC staff recognizes that the gas centrifuge technology is commercially viable and is a reasonable alternative to the proposed laser-based technology. The impacts associated with the construction, operation, and decommissioning of a gas centrifuge enrichment facility were analyzed by NRC in two previous EISs (NRC, 2005b; NRC, 2006). In those EISs, the NRC staff concluded that the impacts associated with the construction, operation, and decommissioning of the NEF in Lea County, New Mexico, and the ACP in Piketon, Ohio, were acceptable for licensing those facilities, unless safety issues mandated otherwise. Based on NRC's safety and environmental reviews, both facilities were granted licenses and are currently under construction. In addition, NRC is currently reviewing another application to build and operate a uranium enrichment plant based on the gas centrifuge technology in Bonneville County, Idaho (AES, 2008).

The *National Environmental Policy Act* requires Federal agencies to analyze and disclose the impacts of the proposed action and reasonable alternatives to the proposed action. Therefore, NRC has provided a comparative analysis of the environmental impacts of gas centrifuge and laser technologies (see comparison in Table 2-6). The comparison is necessarily qualitative because, in order to compare the two technologies in a quantitative sense, comparable designs at the same site and with the same throughput would be required. There is no comparable design for a gas centrifuge facility at the Wilmington Site.

The sources of information used by NRC to generate Table 2-6 include Table 2-3 (which includes a more detailed summary of impacts for each resource area for the proposed GLE Facility) and the environmental reports submitted by GLE (GLE, 2008) and AREVA (AES, 2009). The application submitted by AREVA for the proposed EREF is currently under review and thus, only high-level factual information (e.g., facility footprint size) is used from the EREF environmental report. This information is relevant because the proposed EREF and the proposed GLE Facility have about the same output (design capacities of 6.6 million SWUs per year and 6 million SWUs per year, respectively). The NRC staff also used information from the NEF and ACP environmental reviews (LES, 2005; USEC, 2005; NRC, 2005b; NRC, 2006), along with professional judgment, in preparing the comparison table. Comparing the environmental impacts of different facilities with different designs and different throughputs built at different sites that have varying degrees of pre-existing infrastructure carries a high level of uncertainty. As a result, Table 2-6 is intended to identify potential differences in environmental impacts that may occur if an enrichment facility based on the gas centrifuge technology were to be constructed at GE's Wilmington, North Carolina, site instead of the proposed laser-based technology.

Table 2-6 Comparison of Environmental Impacts of the GLE Laser-Based Technology and Centrifuge Technology

Resource Area	Laser-Based Technology (proposed action)	Gas Centrifuge Technology	Greater Impact
Land Use	The fenced-in area would be approximately 100 acres (40 hectares). The disturbed area (roads, parking lots, utilities, etc.) would be approximately 226 acres (91 hectares).	The area occupied by a gas centrifuge facility with the same production capacity would be greater than the area occupied by the proposed GLE Facility. It is not clear what the increase in area would be. However, based on a review of the designs and area requirements of plants that use the gas centrifuge technology, it appears that the land area required for a centrifuge plant at the Wilmington Site could be 2 to 3 times larger than the area occupied by the proposed GLE Facility. Similarly, the disturbed area for the gas centrifuge plant could be approximately two times greater.	Centrifuge
Historic and Cultural Resources	Most impacts would occur prior to construction. While there is potential for ground disturbance in previously undisturbed areas, no construction activities are expected to occur in areas where historic and cultural resources are known to exist. Facility operation has the potential to affect historic and cultural resources, but impacts are not expected. Resources could be affected if expansion of the facility is necessary and occurs in areas that contain these resources.	Most impacts would occur prior to construction. However, because of the larger footprint and larger disturbed area for a gas centrifuge facility, the potential for impacts on significant resources due to construction would be greater. The determination of adverse impacts (and the differences between the two technologies) would largely depend on where on the Wilmington Site the facility would be constructed (or expanded during operations) and if any significant historic and cultural resources would be present.	Centrifuge
Visual and Scenic Resources	The project area, which is adjacent to other industrial developments, has low scenic quality and the environment in the project area is not unique for the area. During construction, the greatest visual impacts (from increased vehicle traffic) would be temporary. During operation, intrusion of the two most visible features would not represent a major alteration of the existing visual environment.	Impacts on the visual and scenic resources during the construction and operation of the two facilities would be similar.	Same

Table 2-6 Comparison of Environmental Impacts of the GLE Laser-Based Technology and Centrifuge Technology (Cont.)

Resource Area	Laser-Based Technology (proposed action)	Gas Centrifuge Technology	Greater Impact
Air Quality	Potential air quality impacts from construction activities would be highest during the initial three-year period and would primarily include fugitive dust and engine exhaust emissions. Potential impacts of SO_2, NO_2, and CO emissions would be well below applicable standards, and construction activities would have small impacts on ambient air quality for criteria pollutants. Because continuous combustion activities will not be employed during operation, criteria pollutant and HAP emission rates would be small. Uranium and HF emissions would be minimal.	The same types of emissions to air (e.g., emissions from construction equipment, vehicular traffic, emergency diesel generators, and fossil fuel heating equipment) would be expected regardless of which facility would be constructed. However, because of the larger footprint of the gas centrifuge facility, the impacts during construction would be expected to be higher for the centrifuge facility assuming the construction period would be the same as the laser facility. On the other hand, during operations, the emissions (e.g., uranium and HF) and impacts would be expected to be similar and negligibly small with either technology.	Centrifuge
Geology and Soil Resources	Approximately 91 hectares (226 acres) of land would be disturbed. Construction would not impact site geologic resources. Vehicles and equipment could potentially leak fuel, oil, or grease to site soils during construction and operation. Roads, parking lots, and roofs would create impervious surfaces and increase runoff, increasing the erosion potential.	The types of impacts on site soils (e.g., impacts of spills from vehicles and equipment and runoff from impervious surfaces) would be similar. Because of the larger land area requirements and consequently greater disturbance of soil by the centrifuge technology, the impacts on the geology and soil resources would also be expected to be larger during both construction and operation.	Centrifuge

Table 2-6 Comparison of Environmental Impacts of the GLE Laser-Based Technology and Centrifuge Technology (Cont.)

Resource Area	Laser-Based Technology (proposed action)	Gas Centrifuge Technology	Greater Impact
Surface Water Resources	Construction excavations could lead to short-term soil erosion with impacts on surface water quality. Vehicles and equipment pose the possibility of leaks or spills of fuels, oil, or grease, which could run off and impact nearby surface water, but infiltration into site soil would likely eliminate runoff. Process wastewater discharge would increase site process wastewater volume. Liquid radioactive waste would be treated before transfer to the existing wastewater treatment facility. Treated sanitary effluent would be reused in site cooling towers. No consumption of surface water would occur during operation. Stormwater runoff would collect in a wet detention basin before regulated discharge to the site effluent channel. Stormwater runoff from the UF_6 cylinder storage pads would collect in a lined holding pond prior to monitoring and discharge to the stormwater wet detention basin.	The types of impacts from construction (e.g., short-term erosion, runoff of spills from vehicles) and operations (e.g., discharge of process wastewater, treated liquid radioactive waste, and treated sanitary wastewater) are expected to be similar to the impacts from construction and operation of a laser-based facility. Although there may be differences between the liquid effluent emissions of the two types of facilities when they are built in different locations, significant differences in the construction or operational impacts on surface water resources would not be expected if the two facilities are assumed to be constructed on the Wilmington Site.	Same
Groundwater Resources	Construction equipment poses the potential for leaks of fuel, oil, and grease to groundwater. Potable and nonpotable construction water requirements would be met by transport of offsite water by tanker truck. Stormwater collected from the UF_6 cylinder storage pad would be expected to have no more than trace amounts of radiological contaminants, and the lined holding pond would limit infiltration to groundwater. A portion of discharged liquid effluents may infiltrate the Peedee sand aquifer. No significant contaminant concentrations are expected in the effluent channel. Additional groundwater will be obtained from existing production wells for process water and potable purposes. A small amount of drawdown would be expected, without significant effect on flow directions, water quality, or availability for offsite users.	The impacts on groundwater resources during construction (e.g., the potential for construction equipment leaks, water use) would be about the same with either technology. Similarly, the types of impacts on groundwater resources that would occur during operations are expected to be similar (e.g., stormwater from cylinder pads, infiltration of discharged liquid effluents, and groundwater use). However, the operational water requirements of a gas centrifuge facility with the same production capacity appear to be greater than those of the proposed GLE Facility. Because the groundwater use during operations could be as much as a factor of four greater for a gas centrifuge facility on the Wilmington Site, the impacts on groundwater are expected to be larger.	Centrifuge

Table 2-6 Comparison of Environmental Impacts of the GLE Laser-Based Technology and Centrifuge Technology (Cont.)

Resource Area	Laser-Based Technology (proposed action)	Gas Centrifuge Technology	Greater Impact
Ecological Resources	Most impacts would occur prior to construction. Construction could impact ecological resources (including vegetation), although most construction would occur in areas previously disturbed by preconstruction activities. No wetlands or environmentally sensitive areas would be directly impacted by construction, but wetlands occur in the roadway corridor (possibly resulting in wetland loss). Minor, localized indirect impacts on wetlands and environmentally sensitive areas may occur. No aquatic habitats are located within the areas that will be cleared, and no significant adverse impacts on aquatic biota are expected. Construction activities (and noise) would result in wildlife injury/mortality, wildlife disturbance, and a loss of habitat. Habitat disturbance could facilitate the spread and introduction of invasive plant species. No population-level impacts would be expected on any Federally listed threatened, endangered, or other special status species, or on any State-listed species. No operational effects on vegetation would be expected from the cooling tower, air emissions, wastewaters, or solid wastes. Operation would not adversely affect wetlands or environmentally sensitive areas. Potential impacts on wildlife would include ongoing habitat disturbance and wildlife injury/mortality. Aquatic habitats and biota could be affected by erosion, sedimentation, and exposure to contaminants, but aquatic biota would not be adversely impacted by treated effluents or trace contamination released to surface waters. No adverse impacts on threatened, endangered, or other special status species would be expected from operations.	Most impacts would occur prior to construction. The types of impacts from construction (e.g., potential wetland loss, wildlife injury/mortality, impacts of noise to wildlife, habitat disturbance) and operations (e.g., habitat disturbance, wildlife injury or mortality, impacts on aquatic habitat by erosion, sedimentation, and exposure to contaminants) are expected to be similar to the impacts of a laser-based facility. However, because of the larger footprint and larger disturbed area for a gas centrifuge facility with the same production capacity, the impacts on ecological resources are estimated to be proportionately larger. Actual impacts (and relative differences between the two technologies) would depend on where on the Wilmington Site the facility would be constructed or expanded during operations, and the existence of ecological resources in the affected areas.	Centrifuge

Table 2-6 Comparison of Environmental Impacts of the GLE Laser-Based Technology and Centrifuge Technology (Cont.)

Resource Area	Laser-Based Technology (proposed action)	Gas Centrifuge Technology	Greater Impact
Noise	During construction, vehicular traffic would generate intermittent noise that would be limited to the immediate vicinity and minor in comparison to other continuous sources. Potential construction noise impacts on the adjacent residential subdivision are anticipated to be small. During operation, noise sources would be primarily enclosed within buildings, and other sources would include vehicular traffic. Noise levels at the site boundary closest to the adjacent residential subdivision are estimated to be below the day and night equivalent sound level for the local noise ordinance and the EPA noise guideline.	Noise sources during construction (e.g., vehicular traffic, construction equipment) and operations (e.g., vehicular traffic, sources within buildings) would be similar to noise sources during construction and operation of a laser-based facility. Noise impacts during construction would be temporary and could be mitigated for either technology. Similarly, noise impacts during operations would not be expected to differ significantly, regardless of which technology would be employed.	Same
Transportation	The number and type of truck shipments will vary during construction, with the heaviest traffic occurring near the site entrance. Operations would overlap construction for five years, during which commuting operations personnel would add to increased local traffic from construction workers and shipments. Remaining operations would involve traffic from personnel, visitors, and incoming and outgoing truck shipments. The range of additional daily vehicle trips from operation would have a similar effect on the local road network as the increase due to construction traffic. Operations would require the shipment of radioactive materials to and from the facility. Cargo-related risks include exposure to ionizing radiation during normal transportation and accident conditions, as well as chemical hazards during accident conditions. Less than one latent cancer fatality (annually) would be anticipated for the public and transportation crews from all shipments. No latent fatalities from vehicle emissions would be anticipated, annually. No fatalities are expected from accidents (direct physical trauma), annually.	The types of transportation impacts from construction (e.g., traffic from construction equipment, material shipments, and commuting construction workers) and operations (e.g., impacts of radioactive material shipments, traffic due to commuting operational workers) would be expected to be similar for both types of facilities. Differences in transportation requirements for materials and labor during construction and operations for the two types of facilities are not significant. Therefore, the transportation impacts would be expected to be similar during both construction and operation.	Same

Table 2-6 Comparison of Environmental Impacts of the GLE Laser-Based Technology and Centrifuge Technology (Cont.)

Resource Area	Laser-Based Technology (proposed action)	Gas Centrifuge Technology	Greater Impact
Public and Occupational Health	Occupational exposures during construction would be minor, as construction would not be expected to cause any exceedances of ambient air quality criteria (with the possible exception of fugitive dust). Construction activities could disturb previously contaminated areas, and construction workers could be exposed to emissions during the overlap of construction and operation. The maximum possible dose would be a small fraction of background radiation exposure. Dose to the offsite public would be significantly less, as they have no potential for measurable exposure from existing site contamination. A total of 450 total recordable incidents, 247 lost workday incidents, and less than one fatal injury are projected for 38 years of operation. Lasers would be operated within enclosures, equipped with interlocks to prevent inadvertent exposure. The greatest potential for occupational exposure would be from UF_6 cylinders, although airborne concentrations of HF and uranyl fluoride inside the facility are expected to be insignificant. The estimated HF and uranium concentrations at onsite locations would be orders of magnitude below safe levels, and UF_6 and HF levels at the site boundary (and the nearest resident) would be even lower. Operation could result in exposure to the public via uranium releases or direct external radiation exposure. UF_6 would pass through a ventilation system to minimize external release and liquid effluents would be treated and sampled to limit releases. Radioactive materials would present the potential for onsite members of the public to receive a direct radiation dose, but measurements from existing sources indicate no readings above background at the site boundary. Skyshine from airborne releases would be undetectable at offsite areas. The maximum dose to a member of a public from liquid effluent releases would occur just south of the site boundary and would be well below the applicable regulatory limit.	The types of impacts from construction (e.g., fugitive dust exposure, exposure due to disruption of previously contaminate areas, exposures during the overlap of construction and operations) and operations (e.g., work-place injuries, potential UF_6 exposure, potential public exposure to air and liquid effluent releases) are expected to be similar except that there would be no potential for worker injury due to laser accidents. Although the estimated air emissions from operation of a gas centrifuge facility could be 5 to 10 times higher than those of the proposed GLE Facility, the releases would be small enough that the impacts on public and occupational health from either technology would be well below all applicable regulatory limits and standards. No difference in the rate or total number of occupational incidents and injuries would be expected, given a similar-sized workforce. Therefore, the impacts on the public and occupational health would be about the same with either technology during both construction and operation.	Same

Table 2-6 Comparison of Environmental Impacts of the GLE Laser-Based Technology and Centrifuge Technology (Cont.)

Resource Area	Laser-Based Technology (proposed action)	Gas Centrifuge Technology	Greater Impact
Waste Management	Solid nonhazardous wastes generated during construction would be similar to wastes from other industrial construction sites. Construction activities would generate less than two percent of the waste that the local landfill receives annually. Hazardous wastes from construction would be packaged and shipped offsite to licensed facilities. Operations would generate wastewaters that would be treated onsite prior to discharge and solid wastes that would be treated (onsite or offsite) and shipped offsite for disposal. Sanitary wastewater would be treated at the existing site treatment facility, increasing the load by about one-third. Treated sanitary wastewater effluent could be used as makeup water in onsite cooling towers, and cooling tower blowdown would be sent to the existing final process lagoon facility. The existing discharge permit would be adequate to cover the additional effluent discharge to surface waters. Radioactive process wastewater would be collected and treated to remove uranium, metals, and fluoride. Treated effluent would be discharged to the final process lagoon facility.	The types of waste generated during construction (e.g., hazardous and non-hazardous solid waste) and operations (e.g., solid waste, process wastewater, sanitary wastewater) would be expected to be treated and disposed of similarly for both types of facilities. Because of the larger footprint of the gas centrifuge facility, the quantities of waste generated during construction would likely be somewhat greater for gas centrifuge than for laser technology. However, the amount of waste generated by a gas centrifuge facility during operations is estimated to be considerably less than the proposed GLE Facility. The potential difference could be on the order of a factor of two for LLW and hazardous waste, and a factor of five or six for solid non-radioactive/nonhazardous waste.	Laser
Accidents	The consequence of a criticality accident would be High for a worker in close proximity. Worker health consequences are Low to Intermediate for scenarios involving the release of UF_6, Low to High for scenarios involving HF exposure, and Low to Intermediate for scenarios involving uranium chemical exposure. Radiological consequences to a maximally exposed individual at the Controlled Area Boundary are Low for the criticality accident, Low for UF_6 release scenarios, Low to High for HF exposure scenarios, and Low to Intermediate for scenarios involving uranium chemical exposure. Risk to the offsite public in the direction of highest exposure would be less than one lifetime cancer fatality for all accident scenarios.	The potential for criticality accidents and the release of UF_6 would be expected to be similar at both types of facilities. The consequences of accidents taking place in a gas centrifuge facility for workers and for offsite members of the public would not be expected to differ significantly from those of the proposed GLE Facility. Consequently, the accident impacts in the region would be expected to be similar.	Same

Table 2-6 Comparison of Environmental Impacts of the GLE Laser-Based Technology and Centrifuge Technology (Cont.)

Resource Area	Laser-Based Technology (proposed action)	Gas Centrifuge Technology	Greater Impact
Socioeconomics	Construction activities in the peak year would create 680 direct jobs at the facility site and an additional 3131 indirect jobs in the region of interest (ROI). Construction would produce $139.8 million in income in the ROI in 2012, $1.7 million in direct State income taxes, and $1.2 million in direct State sales taxes. Start-up activities would create 200 direct jobs and an additional 218 indirect jobs in the ROI. Start-up would produce $28.0 million in income in the ROI in 2013, $1.3 million in direct State income taxes, and $0.9 million in direct State sales taxes. Operations would create 350 direct jobs and an additional 382 indirect jobs in the ROI. Operations would produce $51.5 million in income in the ROI in 2017, $2.3 million in direct State income taxes, and $1.7 million in direct State sales taxes. Corporate income taxes would also be collected by the State during the operating period, totaling $49.2 million annually. In-migration would affect local-community educational and medical services employment to maintain existing levels of service during three periods.	The estimated direct employment numbers for construction and operation of a gas centrifuge facility would be expected to be about the same as for the proposed GLE Facility. Consequently, the socioeconomic impacts in the region during both construction and operation would be expected to be similar.	Same

Table 2-6 Comparison of Environmental Impacts of the GLE Laser-Based Technology and Centrifuge Technology (Cont.)

Resource Area	Laser-Based Technology (proposed action)	Gas Centrifuge Technology	Greater Impact
Environmental Justice	Although potential impacts could be SMALL to MODERATE in a number of resource areas during construction and operation, the impacts would not appear to be disproportionately high and adverse for minority or low-income populations. The majority of environmental impacts would be mitigated and any remaining environmental impacts would primarily affect residents in the immediate vicinity. The neighborhood immediately surrounding the site includes a mix of minority and nonminority residents, as well as a mix of low-income and more affluent residents. Because impacts on the general population are SMALL to MODERATE, and because the greatest impact would be expected to occur in the immediate vicinity (and in an area with a mix of ethnicities and income levels), construction and operation are not expected to result in disproportionately high or adverse impacts on low-income or minority residents. Even when environmental impacts are anticipated to be SMALL, the behaviors of some population groups may lead to disproportionate exposure. However, air and liquid releases are projected to be extremely low, and indirect exposure through fish consumption would be even lower.	The types of potential environmental justice concerns for a gas centrifuge facility would be expected to be the same as the potential environmental justice impacts of a laser-based facility. Because of the mix of residents in the area surrounding the Wilmington Site, and because impacts on each resource area are expected to be SMALL to MODERATE, there would not be any expected environmental justice impacts of the gas centrifuge technology, if employed at the Wilmington Site, during either construction or operation.	Same

The impacts presented in Table 2-6 are based on the assumption that an exemption request would be granted if a gas centrifuge facility were to be constructed at the Wilmington Site, similar to the exemption request granted for the proposed GLE Facility. Therefore, most construction would take place on ground previously disturbed by preconstruction activities.

2.4 Staff Recommendation Regarding the Proposed Action

After weighing the impacts of the proposed action and comparing alternatives, the NRC staff, in accordance with 10 CFR 51.71(f), sets forth its preliminary NEPA recommendation regarding the proposed action.

The NRC staff preliminarily recommends that, unless safety issues mandate otherwise, the proposed license be issued to GLE. In this regard, the NRC staff has concluded that environmental impacts are generally SMALL, and taken in combination with the applicable environmental monitoring program described in Chapter 6 and the proposed mitigation measures discussed in Chapter 5, would eliminate or substantially lessen any potential adverse environmental impacts associated with the proposed action.

The NRC staff has preliminarily concluded the overall benefits of the proposed GLE Facility outweigh the environmental disadvantages and costs based on consideration of the following:

- The need for an additional, economical, domestic source of enrichment services; and

- The environmental impacts from the proposed action are generally SMALL, although they could be as high as MODERATE in the areas of historic and cultural resources, ecological resources, and transportation.

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3 AFFECTED ENVIRONMENT

This chapter describes the existing conditions at and near the site of the proposed General Electric (GE)-Hitachi Global Laser Enrichment LLC (GLE) Facility in Wilmington, North Carolina (Figure 2-1), prior to the proposed action and before any preconstruction activities are performed. After an initial overview of the site location and activities, information is presented on surrounding land use; historic and cultural resources; visual and scenic resources; climatology, meteorology, and air quality; geology, minerals, and soils; water resources; ecological resources; noise levels; transportation systems; public and occupational health conditions; current waste generation and management practices; socioeconomic conditions; and environmental justice considerations. This information forms the basis for assessing the potential impacts (see Chapter 4) of the proposed action.

3.1 Site Location and Description

The proposed GLE Facility would be located approximately 10 kilometers (6 miles) north of the City of Wilmington in New Hanover County, North Carolina, on the General Electric Company (GE)/Global Nuclear Fuel Americas (GNF-A), property also referred to as the Wilmington Site (Section 2.1.1). The site is bordered on the east by North Carolina Highway 133 (NC 133) (Castle Hayne Road), on the southeastern corner by U.S. Interstate Highway 140 (I-140), on the southwestern perimeter by the Northeast Cape Fear River, and for most of the north and south property lines by undeveloped forestlands. A small segment of the north property line borders a residential subdivision. The Wilmington International Airport is located approximately 5.2 kilometers (3.5 miles) southeast of the Wilmington Site (Figure 1-2).

The Wilmington Site occupies approximately 656 hectares (1621 acres). The proposed GLE Facility site comprises 106 hectares (263 acres) of the Wilmington Site (GLE, 2009e). It includes approximately 40 hectares (100 acres) for the proposed GLE Facility in the North-Central Site Sector, approximately 5 hectares (13 acres) for support structures to the east, and approximately 12 hectares (29 acres) for the North access road (Figure 2-2).

Nuclear fuel assemblies for commercial light water-cooled nuclear power reactors are currently fabricated at the Wilmington Site. The fuel manufacturing complex includes the Fuel Manufacturing Operation (FMO/FMOX) buildings, the Dry Conversion Process (DCP) building, the Waste Treatment Facility, process basins, and other support facilities. Other existing facilities on the Wilmington Site include the GE Aircraft Engines/Service Component Operation (AE/SCO) facility, the Fuel Components Operation (FCO) facility, and the Wilmington Field Services Center (WFSC). Nonradioactive reactor components are manufactured in the SCO facility, and nonradioactive components for reactor fuel assemblies are manufactured in the FCO facility. In the WFSC, equipment used at reactor sites is cleaned and refurbished. Fuel manufacturing operations are not conducted at the AE facility. The existing facilities are in the eastern portion of the Wilmington Site (Figure 2-1).

The proposed GLE Facility would occupy approximately 40 hectares (100 acres) within the main portion of the site (Figure 2-2). The proposed GLE Facility would include the 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. The proposed GLE Facility would be connected to NC 133 and existing GNF-A facilities either by improving the existing roads or by building a new road segment within the proposed GLE Facility site (GLE, 2008).

3.2 Land Use

This section describes the land uses on and near the proposed GLE Facility site. The discussion covers the region within 8 kilometers (5 miles) of the proposed GLE Facility site, which includes New Hanover, Brunswick, and Pender Counties.

3.2.1 Proposed GLE Facility Site

The location of the proposed GLE Facility is part of the 656-hectare (1,621-acre) Wilmington Site, which is owned by GE. The proposed GLE Facility site is undeveloped and is currently covered by mixed pine forest. The western boundary of the Wilmington Site is the Northeast Cape Fear River. The southern boundary is I-140. Residential developments are found to the northeast and south of the Wilmington Site. The closest residence to the proposed GLE Facility site is northeast of the proposed facility on Dekker Road in the Wooden Shoe Subdivision. East of the Wilmington Site across Castle Hayne Road is the North Carolina State University Horticultural Crops Research Station, which has existed in this location since 1947. Several mobile homes are located north of the Wilmington Site along Castle Hayne Road. None of the Wilmington Site is designated prime farmland. No properties listed on the *National Register of Historic Places* (NRHP) are located within 8 kilometers (5 miles) of the proposed GLE Facility site.

The proposed GLE Facility site is located in an unincorporated portion of New Hanover County, North Carolina. The proposed GLE Facility site is 10.4 kilometers (6.5 miles) north of Wilmington, North Carolina, and on the eastern bank of the Northeast Cape Fear River. The zoning of the proposed GLE Facility site is under the jurisdiction of the New Hanover County Planning Board. The proposed GLE Facility site is zoned I-2, heavy industrial zone (New Hanover County, 2009b). This zoning class is the least restrictive, in that it allows the widest range of land uses. Examples of current industries within this zoning are the BASF Corporation and the Elementis Chromium manufacturing plants, and the L.V. Sutton Steam Electric Plant to the west. Several sand and gravel quarries are northeast of the proposed GLE Facility site, including the Martin Marietta Materials operation, which is a crushed stone mining and processing facility. The area to the southwest is also zoned I-2 (Figure 3-1). The area immediately to the south of the proposed GLE Facility site is zoned PD, planned development district. This designates an area with mixed uses, including residential, commercial, industrial, office, and institutional. The entire area north of the proposed GLE Facility site is zoned RA, rural agriculture, which allows for low-density residential with an emphasis on farming and open space. The areas to the east and southeast are zoned R-20, which indicates low-density residential (New Hanover County, 2009b).

Several residential developments are proposed in the vicinity of the Wilmington Site. These include a 600-lot residential development called Rose Hill Plantation south of the Wilmington Site, which would include a nursing home. Other proposals are for the Sunset Reach 53-lot residential development, the Blue Clay Farms development of 1800 units, and Parson's Mill with 300 lots for residential development (New Hanover County, 2009c). In addition, a new

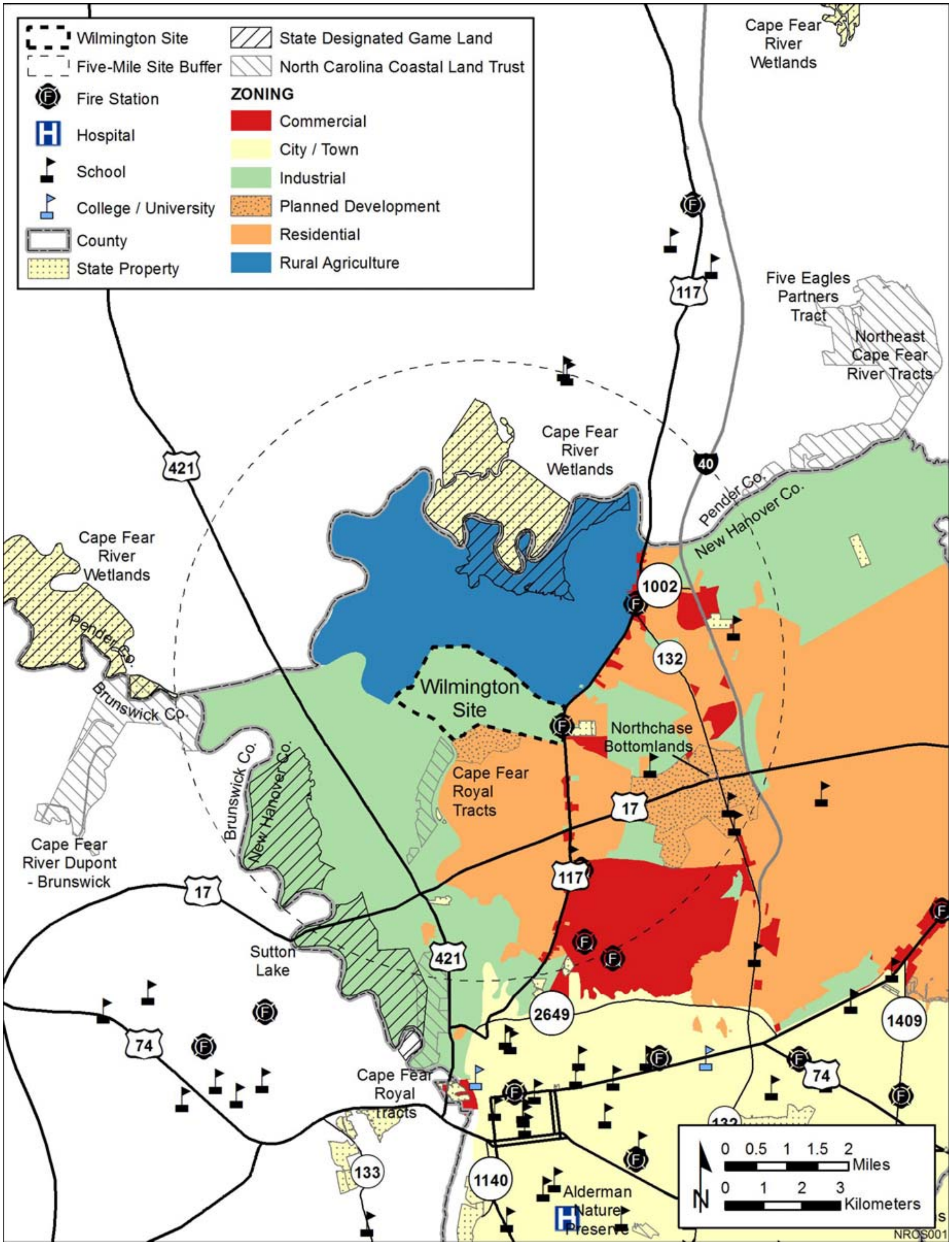

Figure 3-1 Land Use within 8 kilometers (5 miles) of the Project Area

elementary school and middle school are in the process of being completed in the Castle Hayne community to the northeast of the proposed GLE Facility site (Figure 1-1).

To implement the Federal Coastal Zone Management Act (CZMA), North Carolina passed a Coastal Area Management Act (CAMA) in 1974 that requires coastal counties to develop land use plans. New Hanover County and the City of Wilmington chose to develop a joint land use plan. The Wilmington–New Hanover County Joint Coastal Area Management Plan 2006 Update was approved in May 2006 by the North Carolina Coastal Resources Commission. This update identifies the proposed GLE Facility site as a Wetland Resource Protection Area, with the eastern portion of the proposed GLE Facility site in an Aquifer Resource Protection Area (City of Wilmington and New Hanover County, 2006). The purpose of the Wetland Resource Protection Area is to minimize the loss or degradation of wetlands. The Aquifer Resource Protection Area is intended to protect areas from diminished recharge of the aquifer and to prevent contamination of the aquifer. The area north and northwest of the proposed GLE Facility site was designated a Conservation Area by the 2006 Wilmington–New Hanover Plan. The purpose of the conservation class is to provide long-term management and protection of significant natural resources, taking into consideration the rights of property owners.

3.2.2 New Hanover County

New Hanover County is a coastal county in the southeastern portion of North Carolina. The county is bordered on the east and south by the Atlantic Ocean, on the southwest by Brunswick County, and on the north by Pender County. The Cape Fear River forms the boundary between New Hanover and Brunswick Counties. The proposed GLE Facility site is located in the northwestern corner of the county. The largest municipality in the county is Wilmington, which has a population of 97,135 (City of Wilmington and New Hanover County, 2006) and serves as the county seat. The next three largest communities are Carolina Beach (population 4701; 31 kilometers [19 miles] from the proposed GLE Facility site), Kure Beach (population 1507; 32 kilometers [20 miles] from the proposed GLE Facility site), and Wrightsville Beach (population 2593; 18 kilometers [11 miles] from the proposed GLE Facility site) (USCB, 2000).

Land cover in New Hanover County is primarily developed land (35 percent), followed by wetlands (26 percent), forest (16 percent), and grassland/cultivated fields (15 percent). The remaining 8 percent is comprised of open water (EPA, 2001).

Four State-designated use areas are within 8 kilometers (5 miles) of the proposed GLE Facility site. Two of these areas are the Cape Fear River Wetlands Game Land and the Sutton Lake Game Land, which are leased by the North Carolina Wildlife Resources Commission from Progress Energy. These areas are managed for the benefit of hunters. The other two areas are the North Chase Bottomlands Preserve and the Cape Fear Royal Tracts, which are maintained by the North Carolina Land Trust (Figure 3-1). The land trust manages its properties to retain their natural qualities.

3.2.3 Brunswick County

Brunswick County is located west of the proposed GLE Facility site. The county's population in 2000 was 73,141 (Brunswick County, 2006). The county's population concentrates in the eastern portion of the county along the Cape Fear River and along the Atlantic shoreline to the south. The major municipalities in Brunswick County are Oak Island (population 6571; 51 kilometers [31 miles] from the proposed GLE Facility site), Southport (population 2351; 47 kilometers [29 miles] from the proposed GLE Facility site), Leland (population 1938; 13 kilometers [8 miles] from the proposed GLE Facility site), and Boiling Spring Lakes (population 3866; 37 kilometers [23 miles] from the proposed GLE Facility site) (USCB, 2000). The county seat is Bolivia. The county has developed a CAMA plan that was approved in 2007. Several of the municipalities in the county have chosen to develop their own CAMA plans, including Bald Head Island, Calabash, Caswell Beach, Holden Beach, Shallotte, Southport, Sunset Beach, and Varnamtown (NCDCM, 2010).

Land cover in Brunswick County is primarily forest (35 percent), wetlands (32 percent), and grassland/cultivated fields (23 percent). The remaining land cover is split between development (8 percent) and open water (2 percent) (EPA, 2001).

3.2.4 Pender County

Pender County is located north of the proposed GLE Facility site and covers roughly 241 square kilometers (93 square miles). The total population is 48,724. Development in Pender County is concentrated in the center of the county along I-40 and in the southeast along the coast. The county seat for Pender County is Burgaw (23 kilometers [14 miles] from the Wilmington Site). The closest Pender County municipality is St. Helena (19 kilometers [11.8 miles] to the Wilmington Site). The portion of Pender County nearest the Wilmington Site is zoned as conservation area, rural, and rural clusters (Pender County, 2006).

The land cover in Pender County is primarily wetlands (41 percent), forests (27 percent), and grassland/cultivated fields (27 percent). The remaining land covers are development (4 percent) and open water (1 percent) (EPA, 2001).

3.3 Historic and Cultural Resources

This section discusses the cultural background and the known historic and cultural resources at the proposed GLE Facility and in the surrounding area.

3.3.1 Prehistoric

Prehistory in North America ranges from roughly 10,000 B.C. to A.D. 1500. Prehistory is divided into several periods that are marked by changes in technology (e.g., projectile point shapes, pottery types) and changes in subsistence patterns, which often reflect wider changes in the environment. The following is a description of the various prehistoric periods found in southeastern North America.

3.3.1.1 Paleo-Indian Period

The Paleo-Indian period (10,000 B.C. to 8000 B.C.) contains the first confirmed evidence of people in southeastern North America. The Paleo-Indian period is poorly understood. The Paleo-Indian period was a time of climatic change and of glacial retreat. Large mammals that were adapted to the colder climate were plentiful but in decline. The overall climate was cooler than today, with ocean levels more than 61 meters (200 feet) lower because of the water trapped in the glaciers. Intact evidence of these early people in North America is scarce. It is theorized that much of the evidence of human activity from this period is now submerged under the ocean. Human activity tended to concentrate in coastal regions. The coastal shoreline during the Paleo-Indian period was much farther out than the modern coast. Once the glaciers retreated, sea levels rose and inundated the sites. On the basis of variations observed in projectile point types, there appears to have been some societal shift as the Paleo-Indian period progressed. All projectile points found in the Paleo-Indian period are of the spear or lance type and include the Clovis, Cumberland, Suwanee, Simpson, Dalton, and Hardaway point types (ESI, 2008).

3.3.1.2 Archaic Period

The Archaic period (8000 B.C. to 1000 B.C.) covers the period following the end of the glacial retreat. During this period, the climate began stabilizing, modern flora and fauna were developing, and populations across North America were increasing. Subsistence strategies expanded to include capturing smaller game, such as rabbits, than was seen in the big game hunting cultures of the Paleo-Indian period. A greater reliance on gathering nuts and seeds also is evident during the Archaic period. These adaptations suggest a more intensive use of the landscape, which may have been a result of greater population sizes. These adaptations are significant since the Paleo-Indian cultures were largely homogeneous across North America.

The Archaic period is divided into Early, Middle, and Late periods. The Early Archaic period (8000 B.C. to 6000 B.C.) saw the continuation of the trends established during the Paleo-Indian period. Glacial retreat, sea level rise, and a moderating of the climate are all indicative of the Early Archaic period. A change in projectile points and other stone (lithic) artifacts led to the defining of an Archaic period. A significant climatic shift to drier and warmer weather accompanies the Middle Archaic period (6000 B.C. to 3000 B.C.). In North Carolina, there appears to have been a shift away from the subsistence use of the higher elevations of the Appalachians and Piedmont region to the lower coastal plain and major river valleys (ESI, 2008). The first widespread evidence of shellfish use is noted during the Middle Archaic period. Regional adaptations become evident during the Middle Archaic period. The modern climate develops in the Late Archaic period (3000 B.C. to 1000 B.C.). Temperatures moderate and rainfall increases during the Late Archaic period. Ocean levels stabilized and wetlands increased significantly (ESI, 2008). The first ceramics appear toward the latter half of the Late Archaic period. Evidence of long-distance trade also is evident in the Late Archaic period. Site types include villages, short-term use sites, resource procurement camps, and cemeteries.

3.3.1.3 Woodland Period

The Woodland period (1000 B.C. to A.D. 1000) in Eastern North America is usually associated with three major technological innovations – horticulture, pottery, and the bow and arrow. Along with the development of horticulture comes a more sedentary way of life. In the Southeastern portion of North America, reliance on horticulture came late in the Woodland period, roughly around A.D. 200 to A.D. 400 and was not widespread until around A.D. 1000 (ESI, 2008). Pottery use began in the Late Archaic period but became widespread during the Woodland period. Pottery styles are used to differentiate between the Early, Middle, and Late Woodland periods in the region. Another defining factor for the Woodland period was burial practices. Burials become more elaborate during the Woodland period and involve mounds and in some cases ceramic ossuaries. Most Native groups encountered by Europeans practiced Woodland cultural patterns (Claggett, 1996).

A group known as the Mississippian Culture (A.D. 1000 to A.D. 1650) was also found in North Carolina in the late prehistoric period. Mississippian cultural groups engaged in many of the practices associated with the Woodland period; however, there is evidence for a higher level of social and political hierarchy. Mississippian cultural groups were living in North Carolina alongside Woodland peoples.

3.3.2 Ethno-Historic

Information on the native populations preceding European contact is poor for several reasons. Native groups from this part of North Carolina left or were removed shortly after European contact. Early European records provide an inaccurate description of the native groups that were encountered. Through research and archaeological excavation, some information is available. The groups living in south-central North Carolina fell between two well-defined cultural traditions, those of the southeast and the northeast. Cultural traditions in the region appear to be consistent with Woodland cultures. Mississippian influences are possible but are not easily identifiable in the archaeological record. Excavation in the Cape Fear River area suggests that there may be ties to the Piedmont region and the tribes that resided there (Russ and Postlewaite, 2008). Modern tribal organizations that claim ancestral ties to North Carolina include the Indians of Persons County, Haliwa-Saponi, Coharie, Cumberland County Association of Indian People, Lumbee, Waccamaw-Siouan, Guilford Native American Association, Metrolina Native American Association, and the Eastern Band of Cherokee Indians (NCCIA, 2004).

3.3.3 Historic Euro-American

European presence in the North American southeast began in 1524 when Giovanni da Verrazano traveled along the coast of what would become North Carolina. Spanish and English exploration of the area continued throughout the latter half of the sixteenth century. The English attempted to establish a colony on Roanoke Island in 1587; the colony failed within three years. The first successful European settlement in the region was the English colony of Jamestown in 1607. The first settlement on the Cape Fear River came in the 1660s by English settlers; however, the settlement only lasted a few years. Permanent settlement on the Cape Fear River did not occur until the eighteenth century. The town of Brunswick was established at the mouth of the Cape Fear River in 1726. New Hanover County was created in 1729. In the 1730s, the town of Newton was settled at the juncture of the Northeast and Cape Fear Rivers. In 1740, the town of Newton was incorporated as Wilmington. Once Wilmington was established, the town of Brunswick deteriorated and was eventually abandoned after 1781. Wilmington became an important town for supplying the shipping trade. During the American Revolution, the British commander Lord Cornwallis occupied Wilmington for three weeks in 1781. After the revolution, an agrarian economy based on plantations flourished along the Cape Fear River. Wilmington became one of the major ports along the eastern seaboard. Railroads were built to the city in the 1840s. Wilmington served as a key part of the Confederate supply line during the American Civil War. Fort Fisher protected the port, but Union troops took it in the winter of 1864 to 1865. Union troops took possession of Wilmington in February 1865. After the Civil War, Wilmington became a major textile port. Several textile factories operated in Wilmington. In the twentieth century, the economy diversified further to include large shipyards. The shipyards expanded during World War II (ESI, 2008).

The region containing the proposed GLE Facility site was once part of the Rose Hill plantation, which was first established in 1736. Other nearby plantations included Castle Hayne, The Hermitage, Point Pleasant, Rocky Run, and Rock Hill. The first major structure built at the plantation was constructed in 1769. Indications are that the plantation focused mainly on rice production. The property remained intact until after the American Civil War. With the abolition of slavery, the property was eventually sold off in 20-hectare (50-acre) plots. The land was owned by Gore Estate Corporation in the 1920s and is currently owned by GE (ESI, 2008).

3.3.4 Historic and Archaeological Resources at the Proposed GLE Site

There are 799 archaeological sites recorded in New Hanover County, North Carolina. Fifteen archaeological sites and one shipwreck are within 500 meters (1640 feet) of the proposed GLE Facility site. Archaeological surveys conducted in 1978 and 1994 examined areas in the vicinity of the proposed GLE Facility site and identified numerous prehistoric archaeological sites. The 1978 research conducted by Wilde-Ramsing identified numerous archaeological sites; however, the methods used during the survey make the findings difficult to verify (Wilde-Ramsing, 1978). The 1994 survey (Klein et al., 1994) was undertaken for the construction of a Wilmington Bypass and reinvestigated some of the sites identified in 1978 that are in close proximity to the proposed GLE Facility site. The 1994 survey identified a cluster of Middle Woodland archaeological sites that the authors recommended as an archaeological district (Klein et al., 1994). The district, which consists of 11 sites, is partially located on the Wilmington Site.

Archaeological surveys conducted for the proposed action identified three archaeological sites (ESI, 2008). The surveys relied on a combination of pedestrian investigation of exposed soils and shovel testing at 30-meter (100-foot) intervals with 15-meter (50-foot) intervals used for archaeological site investigations. The three discovered sites, 31NH800, 31NH801, and 31NH804, are the remains of two historic-age sites and a prehistoric site. Site 31NH800 appears to be the remains of a farmstead, consisting of artifacts from the eighteenth to twentieth centuries. Site 31NH801 is the remains of a Middle Woodland prehistoric site. Artifacts recovered from the site include ceramics, lithic tools, and animal bone fragments. Site 31NH804 is a historic site dating to the late 19th to mid-20th century. In consultation with the North Carolina State Historic Preservation Office (SHPO), it was determined that sites 31NH800 and 31NH804 are not eligible for listing on the NRHP, while site 31NH801 is eligible for listing.

3.4 Visual and Scenic Resources

Visual impacts occur when contrasts are introduced into the existing environment. Consideration when determining visual or scenic effects from a project are its proximity to viewing locations and the number of people expected to view the project. The proposed GLE Facility site is within the boundaries of GE's existing Wilmington Site. The existing GE facilities (GNF-A FMO and GE AE/SCO) are most visible from the east and southeast near the I-140/Castle Hayne Road interchange. Figure 3-2 shows one of the two entrances to the Wilmington Site (North Entrance) from Castle Hayne Road just north of the I-140 interchange. The tallest existing site feature is a water tower that is 39.6 meters (130 feet) tall (Figures 3-2

Figure 3-2 South Entrance from Castle Hayne Road to the Wilmington Site (GLE, 2008)

and 3-3). The closest residences are located northeast of the site and back to Sledge Road, which forms the northeastern boundary of the Wilmington Site (Figure 2-1). Existing vegetation largely blocks the view to Sledge Road from these locations (Figure 3-4). At the closest visible point, features of the site that are perceivable can only be seen from the rear of the residences. The GE facilities are not visible from Dekker Road. A stand of pine trees lies between Sledge Road and the main portion of the existing Wilmington Site and largely screens the existing facilities from these residences.

The proposed GLE Facility would be located to the west-northwest of the existing Wilmington Site. The facility would be visible from the residences along the south side of Dekker Road and from I-140 to the south. The entrance to the facility would be visible along Castle Hayne Road. However, the bulk of the proposed GLE Facility would be blocked from view by existing site structures.

The topography of the Wilmington Site is relatively flat. The area gently slopes down toward the Cape Fear River. The existing site is visually screened on the north and west by a pine plantation. Since the trees are evergreens, there is no seasonal variation in the visual screen surrounding the site. However, the understory does change in the winter months.

To the west of the Wilmington Site lies the Northeast Cape Fear River. The L.V. Sutton Steam Electric Plant is on the western bank of the Northeast Cape Fear River across from the site. Portions of the power plant are visible from the river. The existing Wilmington Site is not visible from the Cape Fear River because of vegetation and the change in elevation.

Figure 3-3 Existing Site Water Tower Viewed from South of I-140 (GLE, 2008)

Figure 3-4 Closest Residence to the Proposed GLE Facility Site Viewed from the North Access Road (GLE, 2008)

The U.S. Department of the Interior's (DOI's) Bureau of Land Management (BLM) has developed a process for considering visual resources (BLM, 2009). While the BLM's Visual Resource Management system is officially only applicable to BLM land, it provides a useful framework for considering visual resources. The BLM process involves conducting an inventory of the visual landscape to determine the sensitivity of the location to visual intrusions, the scenic qualities of a location, and the distance from which the location would be viewed. Sensitivity refers to the public's concern or expectation for scenic quality. Sensitivity is based on the types of users that would view the location (e.g., recreational users, commuters, and workers), the amount of use, public interest, and adjacent land uses. Scenic quality is a subjective rating of the visual setting. The scenic quality criteria applied to a landscape are presented and described in Table 3-1. Examples of how to apply the criteria are presented in Table 3-2. Distance considerations are a factor primarily when considering large vistas. It is not expected that any portion of the proposed GLE Facility would be perceivable beyond 8 kilometers (5 miles) (BLM, 2009).

Sensitivity is the main factor to be considered, because it addresses the expectation for pristine environments. The Wilmington Site is located in an industrialized area and is adjacent to a power plant, existing manufacturing facilities, and quarries. The expectation for a pristine natural viewshed would be low for such an area. Most users of the area would be commuters and workers, neither of which would be very sensitive to alterations to the visual quality of the area. The closest recreational users would be those using the Northeast Cape Fear River. Because of the vegetation cover and sloping topography, the proposed GLE Facility site would not visible from the river. The users most affected would be homeowners along Dekker Road. While the changes would be most evident for these residential viewers, they represent a very small fraction of users. The sensitivity of the proposed GLE Facility site is low.

The scenic quality of the area is determined through application of the scenic quality rating criteria, which include landform, vegetation, water, color, adjacent scenery, scarcity, and cultural modification. These criteria are explained in Table 3-1. Table 3-2 explains how numerical ratings are assigned for each criterion. For the proposed GLE Facility site, the landform is gently sloping river floodplain that does not contain any dramatic elements (Rating = 1). The vegetation is uniformly pine trees with leafy understory (Rating = 1). The closest water to the proposed GLE Facility site is the Northeast Cape Fear River. However, the river is not visible from the proposed GLE Facility site because of slope and vegetation cover (Rating = 0). The color range in the proposed GLE Facility site is uniform and consists entirely of evergreen trees (Rating = 1). Adjacent scenery is similar to that found in the proposed GLE Facility site and does not influence the visual quality (Rating = 0). There are no rare features associated with the proposed GLE Facility site; it is consistent with much of the surrounding region (Rating = 1). Cultural modifications would alter the view but are consistent with what is found in the surrounding area (Rating = −2). The overall scenic quality rating (i.e., the sum of the ratings for each criterion) is 2, which would make the scenic quality a C or lower. This rating, which is the lowest relative scenic quality rating, indicates that the project area has little scenic quality compared to other locations in the region. The sum would need to be 12 or more for a scenic quality rating of B, and 19 or more for a scenic quality rating of A.

Table 3-1 Explanation of Scenic Quality Rating Criteria

Landform	Topography becomes more interesting as it gets steeper or more massive, or more severely or universally sculptured. Outstanding landforms may be monumental, as the Grand Canyon, the Sawtooth Mountain Range in Idaho, the Wrangell Mountain Range in Alaska, or they may be exceedingly artistic and subtle as certain badlands, pinnacles, arches, and other extraordinary formations.
Vegetation	Give primary consideration to the variety of patterns, forms, and textures created by plant life. Consider short-lived displays when they are known to be recurring or spectacular. Consider also smaller scale vegetational features which add striking and intriguing detail elements to the landscape (e.g., gnarled or windbeaten trees and joshua trees).
Water	That ingredient which adds movement or serenity to a scene. The degree to which water dominates the scene is the primary consideration in selecting the rating score.
Color	Consider the overall color(s) of the basic components of the landscape (e.g., soil, rock, vegetation, etc.) as they appear during seasons or periods of high use. Key factors to use when rating "color" are variety, contrast, and harmony.
Adjacent Scenery	Degree to which scenery outside the scenery unit being rated enhances the overall impression of the scenery within the rating unit. The distance which adjacent scenery will influence scenery within the rating unit will normally range from 0 to 8 kilometers (0 to 5 miles), depending upon the characteristics of the topography, the vegetative cover, and other such factors. This factor is generally applied to units which would normally rate very low in score, but the influence of the adjacent unit would enhance the visual quality and raise the score.
Scarcity	This factor provides an opportunity to give added importance to one or all of the scenic features that appear to be relatively unique or rare within one physiographic region. There may also be cases where a separate evaluation of each of the key factors does not give a true picture of the overall scenic quality of an area. Often it is a number of not so spectacular elements in the proper combination that produces the most pleasing and memorable scenery – the scarcity factor can be used to recognize this type of area and give it the added emphasis it needs.
Cultural Modifications	Cultural modifications in the landform/water, vegetation, and addition of structures should be considered and may detract from the scenery in the form of a negative intrusion or complement or improve the scenic quality of a unit. Rate accordingly.

Source: BLM, 2009.

Table 3-2 Scenic Quality Inventory and Evaluation Chart

Key Factors	Rating Criteria and Score		
Landform	High vertical relief as expressed in prominent cliffs, spires, or massive rock outcrops, or severe surface variation or highly eroded formations including major badlands or dune systems; or detail features dominant and exceptionally striking and intriguing such as glaciers. (5)	Steep canyons, mesas, buttes, cinder cones, and drumlins; or interesting erosional patterns or variety in size and shape of landforms; or detail features which are interesting though not dominant or exceptional. (3)	Low rolling hills, foothills, or flat valley bottoms; or few or no interesting landscape features. (1)
Vegetation	A variety of vegetative types as expressed in interesting forms, textures, and patterns. (5)	Some variety of vegetation, but only one or two major types. (3)	Little or no variety or contrast in vegetation. (1)
Water	Clear and clean appearing, still, or cascading white water, any of which are a dominant factor in the landscape. (5)	Flowing, or still, but not dominant in the landscape. (3)	Absent, or present, but not noticeable. (0)
Color	Rich color combinations, variety or vivid color; or pleasing contrasts in the soil, rock, vegetation, water or snow fields. (5)	Some intensity or variety in colors and contrast of the soil, rock and vegetation, but not a dominant scenic element. (3)	Subtle color variations, contrast, or interest; generally mute tones. (1)
Adjacent Scenery	Adjacent scenery greatly enhances visual quality. (5)	Adjacent scenery moderately enhances overall visual quality. (3)	Adjacent scenery has little or no influence on overall visual quality. (0)
Scarcity	One of a kind; or unusually memorable, or very rare within region. Consistent chance for exceptional wildlife or wildflower viewing, etc. (5+)	Distinctive, though somewhat similar to others within the region. (3)	Interesting within its setting, but fairly common within the region. (1)
Cultural Modification	Modifications add favorably to visual variety while promoting visual harmony. (2)	Modifications add little or no visual variety to the area, and introduce no discordant elements. (0)	Modifications add variety but are very discordant and promote strong disharmony. (-4)

Source: BLM, 2009.

3.5 Climatology, Meteorology, and Air Quality

This section describes the climatology, meteorology, and air quality in the area surrounding the proposed GLE Facility in Wilmington, North Carolina. This information provides general background conditions and would be used as baseline conditions for the potential impact analysis under various alternatives in Chapter 4.

3.5.1 Regional Climatology

With its nearly 2042-meter (6700-foot) range in elevation and 483-kilometer (300-mile) range in distance from the ocean, North Carolina experiences one of the most diverse climates of any eastern State (NCDC, 2009a). The climate of North Carolina varies from the Atlantic Coast in the east to the Appalachian Range in the west. The mountain range in the west often blocks cold temperatures and storms from the Midwest and Canada. Most of the State has a humid subtropical climate (Cfa) by Koppen climate classification, except higher elevations in the west (University of Idaho, 2009).

Warm and humid maritime tropical air from the Gulf of Mexico flows into North Carolina during all seasons, while cold and dry continental polar air masses from Canada penetrate into the area but rarely in summer (Robinson, 2005). These air masses, the jet stream and its accompanying polar front, and the Bermuda High pressure system influence the weather system in North Carolina, depending on their relative positions and intensities. In the summer, the jet stream is situated near the United States–Canadian border, while the Bermuda High is mostly centered over Bermuda. Accordingly, North Carolina is more affected by the Bermuda High than the polar front. In some summers, the Bermuda High expands or moves westward and sits on the Coastal Plain, causing drought there. In the winter, the Bermuda High weakens as it shrinks south and east. This allows the jet stream to push far south well into the east-central United States, which causes the polar front to move into a position to directly influence weather in the Carolinas with deep lows and extensive frontal systems. In addition, the warm Gulf Stream and cold Labrador Current play a pivotal role in the weather of coastal North Carolina (NCDC, 2009a). The confluence of two opposite currents at the north of the Outer Banks of North Carolina produces a wide variety of weather, including the development of major storms, which cause rains along the coast and inland areas as well. At the Outer Banks, the Labrador Current passes between the Gulf Stream lying 80 kilometers (50 miles) offshore and the coast, which offsets most of the general warming effect that the Gulf Stream might otherwise have on coastal temperatures.

The proposed GLE Facility would be located in the tidewater section of southeastern North Carolina, near the Atlantic Ocean, which is located about 16 kilometers (10 miles) to the southeast. Because of its proximity to the Atlantic Ocean, the area experiences an unusually mild climate and small diurnal and seasonal temperature ranges, compared with a continental type of climate at a comparable latitude. In general, the summers are quite warm and humid with rare excessive heat. During the winter, numerous polar air masses can penetrate the Atlantic Coast and result in abrupt drops in temperatures (NCDC, 2009b). However, these cold outbreaks are considerably moderated by long trajectories from the source regions, the effects of passing over the Appalachian Range, and the moderating effects of the ocean air in the area. Accordingly, most winters in the area are short and quite mild.

3.5.2 Site and Regional Meteorology

Real-time meteorological data (e.g., wind speed and direction, barometric pressure) are collected by GNF-A at a level of 6.1 meters (20 feet) for emergency response purposes, but these data are not recorded. In view of the longer period of record available at the Wilmington/New Hanover County Airport, the NRC staff used that data to assess the meteorological and climatological conditions representative of the general region surrounding the proposed GLE Facility. The airport is located approximately 8 kilometers (5 miles) southeast of the proposed GLE Facility. The general topography of the Wilmington area is flat, with little to no change in elevation.

3.5.2.1 Temperature

Table 3-3 presents monthly average and daily extreme temperatures at the Wilmington/New Hanover County Airport, North Carolina. Compared with farther inland stations, temperatures around the proposed GLE Facility are moderate because of proximity to the Atlantic Ocean. For the 1971 to 2000 period, the annual average temperature was 17.7° Celsius (63.8° Fahrenheit), ranging from 11.9 to 23.3° Celsius (53.5° Fahrenheit to 74.0° Fahrenheit) (NCDC, 2009b).

Table 3-3 Monthly Average and Daily Extreme Temperatures at the Wilmington/New Hanover County Airport, North Carolina

	Monthly Averages[a]			Daily Extremes[b]			
	Mean	Minimum	Maximum	Lowest Minimum		Highest Maximum	
Month	° Celsius (° Fahrenheit)	° Celsius (° Fahrenheit)	° Celsius (° Fahrenheit)	° Celsius (° Fahrenheit)	Year	° Celsius (° Fahrenheit)	Year
Jan.	7.8 (46.1)	2.1 (35.8)	13.5 (56.3)	-15.0 (5)	1985	27.8 (82)	1975
Feb.	9.2 (48.5)	3.1 (37.5)	15.3 (59.5)	-11.7 (11)	1996	29.4 (85)	1962
Mar.	12.8 (55.0)	6.5 (43.7)	19.0 (66.2)	-12.8 (9)	1980	31.7 (89)	1974
Apr.	17.1 (62.7)	10.7 (51.2)	23.4 (74.1)	-1.7 (29)	2007	35.0 (95)	1967
May	21.2 (70.2)	15.4 (59.8)	27.0 (80.6)	3.3 (38)	1989	36.7 (98)	1953
June	25.0 (77.0)	19.8 (67.6)	30.2 (86.4)	8.9 (48)	1983	40.0 (104)	1952
July	27.3 (81.1)	22.4 (72.3)	32.2 (89.9)	12.8 (55)	1988	38.9 (102)	1977
Aug.	26.5 (79.7)	21.7 (71.0)	31.3 (88.3)	12.8 (55)	2004	39.4 (103)	1999
Sept.	23.9 (75.0)	18.8 (65.9)	28.9 (84.1)	6.7 (44)	1981	36.7 (98)	1975
Oct.	18.2 (64.8)	12.2 (53.9)	24.2 (75.6)	-2.8 (27)	1962	35.0 (95)	1986
Nov.	13.6 (56.5)	7.3 (45.1)	19.9 (67.8)	-6.7 (20)	1970	30.6 (87)	1974
Dec.	9.4 (48.9)	3.4 (38.1)	15.3 (59.6)	-17.8 (0)	1989	27.8 (82)	1998
Annual	17.7 (63.8)	11.9 (53.5)	23.3 (74.0)	-17.8 (0)	Dec. 1989	40.0 (104)	June 1952

[a] 1971 to 2000 climate normals.
[b] Period of record is 57 years (1952 to 2008).
Source: NCDC, 2009b.

January is the coldest month, averaging 7.8° Celsius (46.1° Fahrenheit) with temperature ranging from 2.1° Celsius to 13.5° Celsius (35.8° Fahrenheit to 56.3° Fahrenheit), and July is the warmest month, averaging 27.3° Celsius (81.1° Fahrenheit) with temperature ranging from 22.4° Celsius to 32.2° Celsius (72.3° Fahrenheit to 89.9° Fahrenheit). During the last 57 years, the lowest temperature, −17.8° Celsius (0° Fahrenheit), was reached in December 1989, and the highest, 40.0° Celsius (104° Fahrenheit), in June 1952. About 46.3 days have a maximum temperature greater than or equal to 32.2° Celsius (90° Fahrenheit), while 39.3 days have a minimum temperature less than or equal to 0° Celsius (32° Fahrenheit).

3.5.2.2 Precipitation and Relative Humidity

Generally, precipitation in North Carolina is relatively ample in most parts of the State (greater than 102 centimeters [40 inches]). The mean annual precipitation is heaviest in the southeastern corner of the State, which includes the proposed GLE Facility, and gradually decreases toward the north and west. Table 3-4 presents summaries of monthly mean and extreme precipitation and snowfall at the Wilmington/New Hanover County Airport. Annual precipitation averages about 145.0 centimeters (57.07 inches) (NCDC, 2009b). Precipitation in the area is well distributed throughout the year; it is driest in April and wettest in July. By season, precipitation is the highest in summer, accounting for about 36 percent of the annual total, and precipitation is comparable in other seasons. Summer rainfall is associated primarily with thunderstorms, and is therefore usually of a short duration, but often heavy and unevenly distributed. Minimum and maximum monthly precipitations are 0.4 centimeters (0.16 inches) and 59.5 centimeters (23.41 inches), respectively. The highest 24-hour precipitation was 37.7 centimeters (14.84 inches) in September 1999. Measurable precipitation of 0.025 centimeters (0.01 inches) or more occurred about one-third of the time (118.1 days per year).

Appreciable wintry precipitation, such as snow, sleet, or freezing rain, is a rarity and, when it occurs, remains on the ground for a short time. Light snow typically occurs from December through March, and the annual average snowfall in the area is about 5.3 centimeters (2.1 inches). The greatest amounts of snow reported in a single month and in a 24-hour period were 38.9 centimeters (15.3 inches) in December 1989, and 29.7 centimeters (11.7 inches) in February 1973, respectively (NCDC, 2009b).

Because of the proximity to the Atlantic Ocean, Wilmington experiences higher relative humidity and smaller monthly variations than farther-inland locations at a comparable latitude. The annual average relative humidity is about 74 percent, with the lowest monthly average of 68 percent in April and the highest monthly average of 80 percent in August (NCDC, 2009b). During the day, the lowest annual-average relative humidity of 57 percent occurs in the early afternoon and the highest of 85 percent in the early morning and the middle of the night.

3.5.2.3 Winds, Atmospheric Stability, and Temperature Inversions

Figure 3-5 presents a wind rose at the 10-meter (33-foot) level of Wilmington/New Hanover County Airport based on 2004 to 2008 wind data. The average annual wind speed is about 3.4 meters per second (7.6 miles per hour), and calm winds are recorded about 18 percent of the time (NCDC, 2009c). Albeit not prominent, the prevailing wind direction is from the southwest (about 9.7 percent of the time) and secondarily from the north-northeast (9.0 percent)

Table 3-4 Monthly Mean and Extreme Precipitation and Snowfall at the Wilmington/New Hanover County Airport, North Carolina

	Precipitation							Snowfall				
	Mean[a]	Minimum[b]		Maximum[b]		Maximum 24-hour[b]		Mean[a]	Maximum[b]		Maximum 24-hour[b]	
Month	cm (in.)	cm (in.)	Year	cm (in.)	Year	cm (in.)	Year	cm (in.)	cm (in.)	Year	cm (in.)	Year
Jan.	11.5 (4.52)	1.7 (0.68)	2001	26.0 (10.22)	1991	7.8 (3.08)	1982	1.5 (0.6)	15.5 (6.1)	2000	12.7 (5.0)	1988
Feb.	9.3 (3.66)	2.6 (1.01)	1976	28.5 (11.22)	1998	12.7 (5.00)	1998	1.3 (0.5)	31.8 (12.5)	1973	29.7 (11.7)	1973
Mar.	10.7 (4.22)	2.4 (0.93)	1967	21.0 (8.27)	1994	12.2 (4.81)	1994	1.0 (0.4)	16.8 (6.6)	1980	14.5 (5.7)	1980
Apr.	7.5 (2.94)	0.4 (0.16)	1995	20.9 (8.21)	1961	8.9 (3.52)	1961	0.0	Trace	1996	Trace	1996
May	11.2 (4.40)	2.4 (0.95)	1987	23.2 (9.12)	1956	12.8 (5.02)	1999	0.0	Trace	1998	Trace	1998
June	13.6 (5.36)	2.3 (0.89)	1984	32.7 (12.87)	1962	19.6 (7.73)	1966	0.0	Trace	1995	Trace	1995
July	19.4 (7.62)	4.2 (1.65)	1961	38.4 (15.12)	1966	16.7 (6.58)	1988	0.0	0.0	NA[c]	Trace	1996
Aug.	18.6 (7.31)	4.2 (1.66)	1968	47.8 (18.83)	2006	24.3 (9.56)	2006	0.0	0.0	NA	0.0	NA
Sept.	17.2 (6.79)	1.8 (0.70)	1986	59.5 (23.41)	1999	37.7 (14.84)	1999	0.0	0.0	NA	0.0	NA
Oct.	8.2 (3.21)	0.4 (0.17)	1953	38.3 (15.07)	2005	20.7 (8.15)	2005	0.0	0.0	NA	0.0	NA
Nov.	8.3 (3.26)	1.2 (0.49)	1973	20.0 (7.87)	1972	12.2 (4.82)	1969	0.0	Trace	1976	Trace	1976
Dec.	9.6 (3.78)	1.2 (0.48)	1955	17.9 (7.06)	1989	9.9 (3.88)	1980	1.5 (0.6)	38.9 (15.3)	1989	24.6 (9.7)	1989
Annual	145.0 (57.07)	0.4 (0.16)	Apr. 1995	59.5 (23.41)	Sep. 1999	37.7 (14.84)	Sep. 1999	5.3 (2.1)	38.9 (15.3)	Dec. 1989	29.7 (11.7)	Feb. 1973

[a] 1971 to 2000 climate normals.
[b] Period of record is 57 years (1952 to 2008).
[c] NA = not applicable.
Source: NCDC, 2009b.

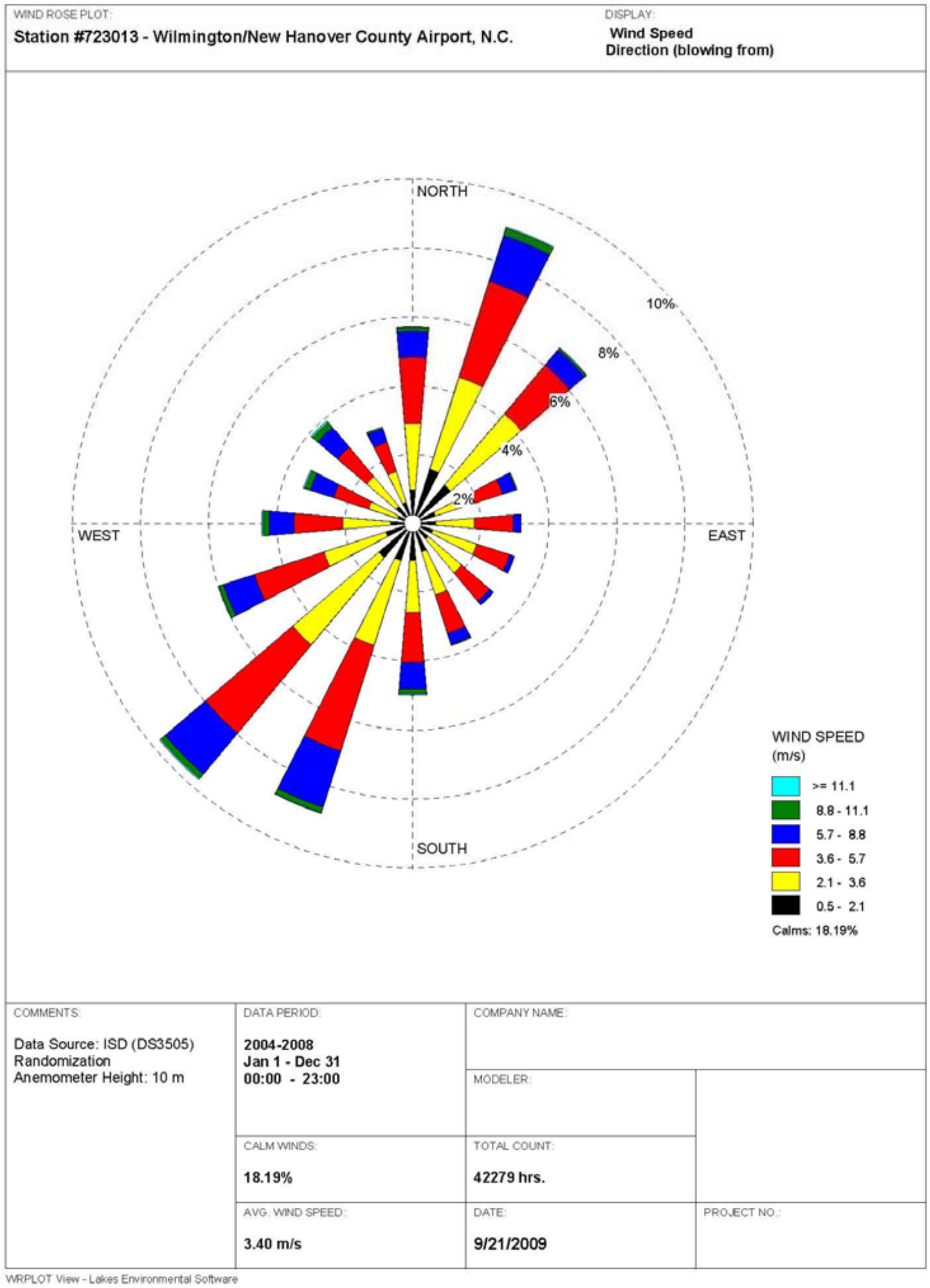

Figure 3-5 Wind Rose (10-meter [33-foot] level) for the Wilmington/New Hanover County Airport, 2004 to 2008 (NCDC, 2009c)

and south-southwest (8.8 percent). Wind speed tends to be relatively higher in spring and lower in summer and fall (NCDC, 2009b). The reverse is true for calm winds. In general, southwesterly winds prevail in spring and summer, while northerly winds prevail in fall and winter. The southwesterly winds are strongly influenced by general synoptic-scale[1] wind patterns of the Bermuda High. In contrast, northerly winds reflect the influences of penetrating polar air masses and changes in global circulation (Robinson, 2005).

Atmospheric stability affects the extent to which gases or particulates are dispersed. Vertical motions and pollution dispersion are enhanced in an unstable atmosphere, while suppressed in a stable atmosphere. Stability is usually classified by Pasquill stability, ranging from Class A through F (Turner and Schulze, 2007), which depends on solar insolation (the amount of solar radiation energy received by a given area in a given time), wind speed, and cloud cover. Class A stability (most unstable) conditions occur in low winds with high incoming levels of solar radiation typically during the daytime. Class E stability (slightly stable) and Class F stability (moderately stable) conditions arise on clear nights with little wind. Class D stability (neutral) conditions occur with higher wind speeds and/or greater cloud cover, irrespective of day or night. Figure 3-6 presents the frequency distribution of stability classes for a nine-year period (1984 to 1992) at the Wilmington/New Hanover County Airport (EPA, 2009a). The neutral (Class D) condition is most prevalent, which accounts for about 43.2 percent of the time. The unstable conditions (Class A to Class C) occur approximately 20.1 percent of the time, while the stable conditions (Class E and Class F) occur about 36.7 percent of the time.

Normally, the temperature in the atmosphere decreases with height above the ground. A temperature inversion occurs when there is an increase in temperature with height above the ground. An inversion suppresses convection, which can lead to air pollutants being trapped close to the ground, thereby causing possible adverse health effects. The length of time an inversion lasts (its persistence) is an important factor for determining its impact on air dispersion. One type of inversion is "surface inversion," which is due primarily to a loss of long-wave radiation near the surface and common over land prior to sunrise and in winter. On the basis of Class E and Class F stability,[2] surface inversion occurs frequently in the Wilmington area, about 36.7 percent of the time. After sunrise, the temperature surface inversion breaks up due to the sun's heating the ground on a time scale of hours.

Another type of inversion is the "subsidence inversion," which can develop aloft as a result of air gradually sinking over a wide area and being warmed by adiabatic compression, usually associated with subtropical high-pressure systems. Subsidence inversions are principal causes of air stagnation, which is characterized by poor ventilation due to persistent light and calm winds, and by the presence of inversions. Stagnant air could accumulate air pollutants and cause poor air quality over a wide area for a prolonged period, resulting in what is called an "air

[1] The synoptic scale is the scale of high- or low-pressure systems in the lower atmosphere as seen on weather maps; typically with a horizontal scale on the order of 1000 kilometers (620 miles) or more.

[2] The Pasquill stability classes presented here are based on solar insolation, wind speed, and cloud cover, not temperature gradients at two different heights. Temperature gradients are −0.5 to 1.5° Celsius (−0.9 to 2.7° Fahrenheit) per 100 meters (328 feet) for Class E and >1.5° Celsius (2.7° Fahrenheit) per 100 meters (328 feet) for Class F. Accordingly, the frequency of surface inversion presented here, defined as temperature increase with height (i.e., >0° Celsius (0° Fahrenheit) per 100 meters [328 feet]), might be overestimated.

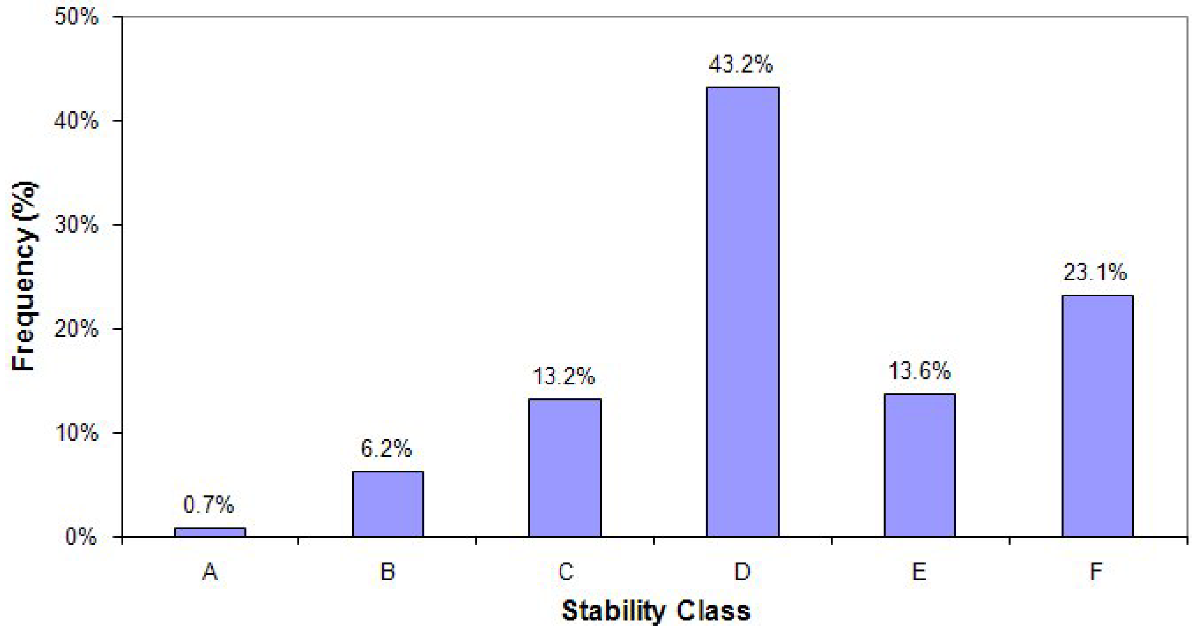

Figure 3-6 Distribution of Stability Classes for the Wilmington/New Hanover County Airport, 1984 to 1992 (EPA, 2009a)

pollution episode." An air pollution episode may adversely affect the health of individuals at higher risk (e.g., the young, elderly, or those with respiratory or cardiovascular diseases). The Wilmington area has a mean of 10 to 20 air stagnation days per year and of 2 to 4 air stagnation episodes per year (Wang and Angell, 1999). On average, stagnation episodes last about five days.

3.5.2.4 Mixing Heights

The mixing height is defined as the height above the ground surface through which relatively vigorous vertical mixing occurs, primarily through the action of atmospheric turbulence. All other parameters being equal, ground-level (at the surface) concentrations of emitted pollutants under low mixing height will be relatively high because pollutants are prevented from dispersing upward. Mixing heights commonly go through large diurnal variations because of solar heating and surface cooling. Mixing heights are generally lowest late at night or early morning and highest during mid to late afternoon. At the locations near large water bodies (e.g., Wilmington), diurnal and seasonal mixing heights show little difference, compared with considerable differences at inland stations because of the moderating effects of the large water bodies. Seasonal variations of morning mixing heights are generally not large. However, afternoon mixing heights display a large seasonal variation, and mixing heights in summer are typically higher than those in winter.

Mixing heights are not measured directly but calculated approximately from routine surface and upper air observations. Holzworth (1972) developed mean seasonal and annual mixing heights throughout the contiguous United States by using 1960 to 1964 observation data. No site-specific mixing height data are available for the Wilmington Site. Thus, mean seasonal and annual data were taken from the isopleths of mixing heights in Holzworth (1972). As shown in Figure 3-7, the mean annual morning and afternoon mixing heights for the Wilmington Site are approximately 540 meters (1770 feet) and 1160 meters (3810 feet), respectively. As mentioned previously, because of the moderating effects of the Atlantic Ocean, seasonal variations in mixing heights are small, and differences between morning and afternoon mixing heights are not considerable compared with farther inland stations.

3.5.2.5 Severe Weather Conditions

In common with most Atlantic coastal localities, the area is subject to the effects of coastal tropical storms and occasional hurricanes causing high winds, above-normal tides, heavy rains, and even tornadoes (NCDC, 2009b). In addition, thunderstorms in the area are associated with large-scale synoptic fronts approaching from the north and west. Thunderstorms are the most active during the summer months, occurring about one out of three days from June through August. The Wilmington area experiences about four days per year of damaging severe thunderstorms with straight winds greater than 50 knots (NSSL, 2009). Another hazard of thunderstorms is lightning, which can strike up to 16 kilometers (10 miles) away from the rain of a thunderstorm. Some lightning strikes have caused either numerous injuries, including fatalities, or property damage such as disruption of electric circuits and wildfires. From 1996 through 2005, the Wilmington area experienced about four to eight lightning flashes per square kilometer per year (NOAA, 2009).

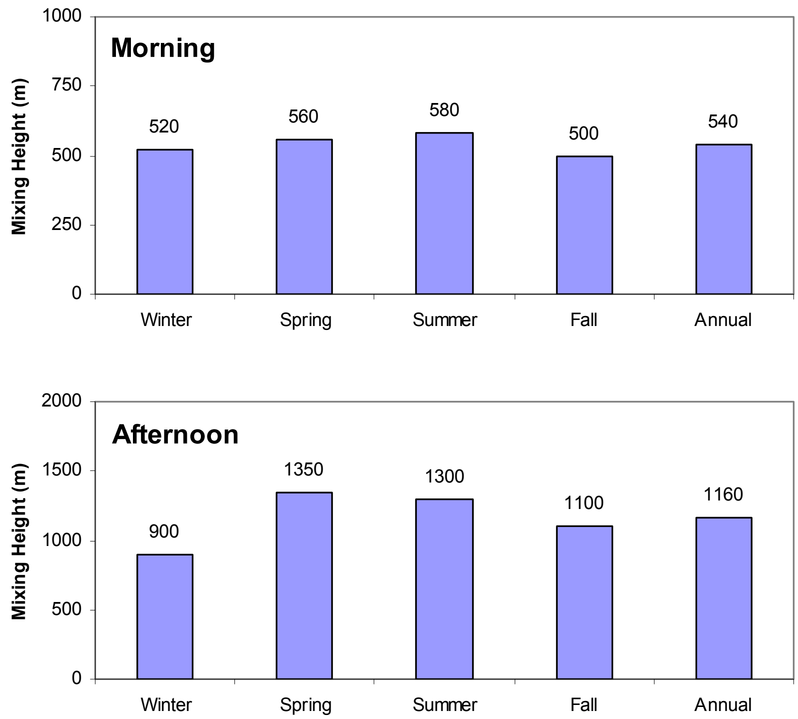

Figure 3-7 Mean Morning and Afternoon Mixing Heights for the Wilmington Site, North Carolina (Holzworth, 1972)

Tornadoes are rare in the area surrounding the proposed GLE Facility, and are less frequent and destructive than those in the “tornado alley” of the central United States. For the period 1950 to 2008, 1126 tornadoes were reported in North Carolina, with an average of 19.1 tornadoes per year (NCDC, 2009d). For the same period, a total of 16 tornadoes with an average of 0.3 tornadoes per year were reported in New Hanover County. Six of the 16 tornadoes that hit New Hanover County occurred during a two-year period (1998 to 1999). However, most tornadoes occurring in New Hanover County between 1950 and 2008 were relatively weak; that is, all F0 or F1, except one F2 on the Fujita tornado scale,[1] and caused five injuries and no fatalities in total.

Most hurricanes form over warm ocean waters near the equator and usually travel west and slightly north while strengthening. Many storms curve to the northeast near the Florida peninsula. Hurricanes are sustained and strengthened by energy from warm waters (water temperature higher than 27° Celsius [80° Fahrenheit]). Because of the proximity of New Hanover County to the Gulf Stream, this area has a high potential for hurricanes advancing from the tropics to sustain or intensify their strengths. Hurricanes come close enough to affect North Carolina about twice in an average year (NCDC, 2009a). Most storms that hit most or part of the State do little damage, but some storms are powerful enough to cause extreme damage and loss of life. Coastal properties occasionally suffer severe damage from associated high tides. The area of New Hanover County could expect the following return periods for each category of hurricanes passing within 75 nautical miles (139 kilometers [86 miles]): Category 1,[2] 10 years; Category 2, 24 years; Category 3, 43 years; Category 4, 96 years; and Category 5, 250 years (NHC, 2009). Between 1950 and 2007, many tropical storms have passed within 75 nautical miles of the proposed GLE Facility and 15 of them were classified as hurricanes (CSC, 2009). Ten hurricanes made landfall along the stretch of the coastline within 75 nautical miles (139 kilometers [86 miles]) of the proposed GLE Facility. The strongest of the 10 hurricanes recorded since 1950 were Category 3 storms Hazel (1954) and Fran (1996), which caused mass destruction along the coast. Category 4 Hurricane Helene (1958) was within 75 nautical miles (139 kilometers [86 miles]) but did not make landfall and moved northeastward along the Atlantic Coast. Hurricane Diana (1984) approached offshore of New Hanover County as a Category 4 hurricane but made landfall as a Category 1 hurricane after making one full turn offshore; it was then downgraded to a tropical storm while advancing inland. The southern coastline in North Carolina was affected by more hurricanes than any other State bordering the Atlantic Ocean and the Gulf of Mexico between 1996 and 1999.

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[1] The Fujita tornado scale is classified with the fastest 0.40-km (0.25-mi) wind speeds: 18–32 m/s (40–72 mph) for F0 (gale); 33–50 m/s (73–112 mph) for F1 (moderate); 51–70 m/s (113–157 mph) for F2 (significant); 71–92 m/s (158–207 mph) for F3 (severe); 93–116 m/s (208–260 mph) for F4 (devastating); and 117–142 m/s (261–318 mph) for F5 (incredible). The new Enhanced Fujita (EF) scale based on 3-second wind gusts was implemented on February 1, 2007. Since that date, all tornadoes in the United States have been rated by using EF categories. Similar to the original Fujita scale, the ratings are from EF0 to EF5. However, historical tornadoes recorded on or before January 31, 2007, are still categorized with the original Fujita scale.

[2] Maximum sustained surface (10-m [33 ft]-level) wind speeds are 33–42 m/s (74–95 mph) for Category 1, 43–49 m/s (96–110 mph) for Category 2, 50–58 m/s (111–130 mph) for Category 3, 59–69 m/s (131–155 mph) for Category 4, and greater than 69 m/s (155 mph) for Category 5.

3.5.3 Air Quality

Regulations governing air pollution sources at the Wilmington Site have been promulgated by the U.S. Environmental Protection Agency (EPA) per the Federal *Clean Air Act* (CAA). These regulations are implemented through several EPA programs. The North Carolina Division of Air Quality (NCDAQ) under the North Carolina Department of Environment and Natural Resources (NCDENR) has authority, as delegated by the EPA, to administer these regulatory programs in the State. The major programs are summarized below.

The EPA has set National Ambient Air Quality Standards (NAAQS) for six criteria pollutants: sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone (O_3), particulate matter (PM; PM_{10} and $PM_{2.5}$),[3] and lead (Pb), as shown in Table 3-5 (EPA, 2010). Primary NAAQS specify maximum ambient (outdoor air) concentration levels of the criteria pollutants with the aim of protecting public health with an adequate margin of safety. Secondary NAAQS specify maximum concentration levels with the aim of protecting public welfare, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. The NAAQS specify different averaging times as well as maximum concentrations. Some of the NAAQS for averaging times of 24 hours or less allow the standard values to be exceeded a limited number of times per year; others specify other procedures for determining compliance.

North Carolina has its own State Ambient Air Quality Standards (SAAQS) (Title 15A, Chapter 2, Subchapter D of the *North Carolina Administrative Code* [15A North Carolina (NC) Administrative Code 02D.0401-410]), which are almost the same as the NAAQS, as shown in Table 3-5. Currently, the State has the standard for total suspended particulates (TSP), which used to be one of the criteria pollutants but was replaced by PM_{10} in 1987. If a State has no standard corresponding to one of the NAAQS, the NAAQS apply.

An area where air quality is above NAAQS levels is called a nonattainment area. Previously, nonattainment areas where air quality has improved to meet the NAAQS were redesignated maintenance areas, subject to an air quality maintenance plan. None of the coastal counties in North Carolina, including New Hanover County (where the proposed GLE Facility will be located) and two neighboring counties, are nonattainment or maintenance areas for criteria pollutants (EPA, 2009b). Several inland counties are nonattainment areas for 8-hour O_3 and $PM_{2.5}$, and maintenance areas for CO.

In areas with pollutant levels below the NAAQS (i.e., attainment areas), the Federal Prevention of Significant Deterioration (PSD) program places limits on the total increase in ambient pollutant levels above established baseline levels for SO_2, NO_2, and PM_{10} (40 CFR 51.166.). This prohibits "polluting up to the limits" specified in the NAAQS for these pollutants. Under these regulations, the allowable increases are smallest in Class I areas (e.g., national parks and wilderness areas). The rest of the country is subject to larger Class II increments. Most areas,

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[3] Particulate matter (PM) is dust, smoke, and other solid particles and liquid droplets in the air. The size of the particulate is important and is measured in micrometers (μm). A micrometer is 1 millionth of a meter (0.000039 in.). PM_{10} is PM with an aerodynamic diameter less than or equal to 10 μm and can reach the lower sections of the respiratory system. $PM_{2.5}$ is PM with an aerodynamic diameter less than or equal to 2.5 μm and is small enough to penetrate deep into the lower, most sensitive parts of the lung.

Table 3-5 National Ambient Air Quality Standards (NAAQS) and North Carolina State Ambient Air Quality Standards (SAAQS) for Criteria Pollutants

Pollutant[a]	Averaging Time	NAAQS[b] Value	NAAQS[b] Type[c]	North Carolina SAAQS
SO_2	3-hour	0.5 ppm (1,300 $\mu g/m^3$)	S	1300 $\mu g/m^3$ (0.5 ppm)
	24-hour	0.14 ppm	P	365 $\mu g/m^3$ (0.14 ppm)
	Annual	0.03 ppm	P	80 $\mu g/m^3$ (0.03 ppm)
NO_2	1-hour	0.100 ppm[d]	P	NS[e]
	Annual	0.053 ppm (100 $\mu g/m^3$)	P, S	0.053 ppm (100 $\mu g/m^3$)
CO	1-hour	35 ppm (40 mg/m^3)	P	35 ppm (40 mg/m^3)
	8-hour	9 ppm (10 mg/m^3)	P	9 ppm (10 mg/m^3)
O_3	1-hour	0.12 ppm[f]	P, S	NS
	8-hour	0.075 ppm (2008 standard)	P, S	0.075 ppm
	8-hour	0.08 ppm (1997 standard)[g]	P, S	NS
TSP	24-hour	NS	NS	150 $\mu g/m^3$
	Annual (geometric)	NS	NS	75 $\mu g/m^3$
PM_{10}	24-hour	150 $\mu g/m^3$	P, S	150 $\mu g/m^3$
$PM_{2.5}$	24-hour	35 $\mu g/m^3$	P, S	35 $\mu g/m^3$
	Annual	15.0 $\mu g/m^3$	P, S	15.0 $\mu g/m^3$
Lead	Rolling 3-month	0.15 $\mu g/m^3$ [h]	P, S	0.15 $\mu g/m^3$
	Calendar quarter	1.5 $\mu g/m^3$	P, S	NS

[a] CO = carbon monoxide, NO_2 = nitrogen dioxide, O_3 = ozone, $PM_{2.5}$ = particulate matter ≤ 2.5 μm, PM_{10} = particulate matter ≤ 10 μm, SO_2 = sulfur dioxide, and TSP = total suspended particulates.
[b] NAAQS, other than those for NO_2, O_3, PM_{10}, and $PM_{2.5}$ and those based on annual averages, are not to be exceeded more than once per year. The 1-hour NO_2 standard is attained when the 3-year average of the 98th percentile of the daily maximum 1-hour average at any monitor within an area must not exceed 0.100 ppm The 1 hour O_3 standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above the standard is <1. The 8-hour O_3 standard is attained when the 3-year average of the fourth-highest daily maximum 8-hour average concentrations measured at each monitor within an area over each year does not exceed the standard. The 24-hour PM_{10} standard is not to be exceeded more than once per year on average over 3 years. The 24-hour $PM_{2.5}$ standard is attained when the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area does not exceed the standard. The annual $PM_{2.5}$ standard is attained when the 3-year average of the weighted annual mean concentrations from single or multiple community-oriented monitors does not exceed the standard. Refer to Title 40, Part 50 of the *Code of Federal Regulations* (40 CFR Part 50) for detailed information on attainment determination and reference method for monitoring.
[c] P = primary standard whose limits were set to protect public health; S = secondary standard whose limits were set to protect public welfare.
[d] Effective January 22, 2010.
[e] NS = no standard exists.
[f] As of June 15, 2005, the EPA revoked the 1-hour O_3 standard in all areas except 8-hour O_3 nonattainment Early Action Compact (EAC) areas.
[g] The 1997 standard – and the implementation rules for that standard – will remain in place for implementation purposes as the EPA undertakes rulemaking to address the transition from the 1997 O_3 standard to the 2008 O_3 standard.
[h] Final rule signed October 15, 2008.
Sources: EPA, 2010a; 15A NC Administrative Code 02D.0401-410.

including the proposed GLE Facility and its vicinity, are classified as Class II areas. EPA typically recommends that the permitting authority notify the Federal Land Managers (FLMs) when a proposed PSD source would locate within 100 kilometers (62 miles) of a Class I area (EPA, 2010b). If the source's emissions are considerably large (subjective), EPA recommends that sources beyond 100 kilometers (62 miles) be brought to the attention of the FLMs. The FLMs then become responsible for demonstrating that the source's emissions could have an adverse effect on air quality-related values (AQRVs), such as scenic, cultural, biological, and recreational resources (EPA, 2010b). The nearest Class I areas are the Swanquarter Wilderness Area in North Carolina and Cape Romain Wilderness Area in South Carolina, both of which are beyond 177 kilometers (110 miles) from the proposed facility (40 CFR 81.422 and 40 CFR 81.426) (FWS, 1998).

Section 112 of the CAA specified a list of hazardous air pollutants (HAPs), also called air toxics. Unlike criteria air pollutants, no Federal ambient air quality standards have been established for air toxics. Rather, the EPA has issued National Emission Standards for Hazardous Air Pollutants (NESHAPs) requiring control of sources of these pollutants. These standards are based on a technology, rather than a health-based approach, but still require an assessment of the residual health risk remaining after the controls are in place.

North Carolina has its own "risk-based" regulatory program, independent of the Federal program, designed to protect the public health by limiting emissions of toxic air pollutants (TAPs). Many chemicals on the State TAPs list overlap with those on the Federal hazardous air pollutants (HAPs) list, but the State includes additional substances not on the Federal list. As part of its program, North Carolina has also developed Acceptable Ambient Levels (AALs) for 97 TAPs, "above which the substance may be considered to have an adverse effect on human health" (15A NC Administrative Code 02D.1104). In contrast to the NAAQS, which are applied to outdoor air throughout the country, the AALs are applied on a much smaller scale. North Carolina's AALs are used in air permitting to ensure that TAPs from new or modified facilities do not cause or contribute beyond the premises (adjacent property boundaries) to any significant concentration levels that may adversely affect human health, on a case-by-case basis. Generally, monitoring for TAPs is limited to specific areas and specific pollutants.

3.5.3.1 Current Emissions at the Wilmington Site

Air quality permits are legally binding documents that include enforceable conditions with which the source owner/operator must comply. As discussed in Section 3.5.3, depending on the air regulatory program, the State has both independent authority and authority delegated from the EPA to issue these permits. The NCDAQ issues the permits to source owners/operators for the construction and operation of air emission sources in the State. Construction permits ensure that proposed projects can meet air pollution standards before construction. Operating permits set emission limits and establish monitoring, record-keeping, and reporting requirements. For air permitting purposes, a source is classified as one of three categories: "major," "synthetic minor," and "small." A facility that has the potential to emit 91 metric tons (100 tons) or more per year for one or more of the criteria pollutants, or 9.1 metric tons (10 tons) or more per year of any of the listed HAPs, or 23 metric tons (25 tons) or more per year of an aggregate total of HAPs is defined as a "major" source. Major sources are subject to Title V of the *Clean Air Act* (42 U.S.C. 7401 et seq.), which standardizes air quality permits and the permitting process across the United States. A "synthetic minor" (or "conditional major") source has the potential for exceeding major source emission thresholds but is the one that avoids major source requirements by accepting permit conditions that limit emissions below major source thresholds. The "small" (or "minor") source has no potential for exceeding major source emission thresholds.

Currently, the Wilmington Site has two active "synthetic minor" operating permits. Permit 1161R19 was issued to GE to operate air emission sources associated with the AE operations and one air emission source related to the SCO (NCDAQ, 2004a). The primary emission is PM_{10} from metal cleaning systems. Permit 1756R17 was issued to GNF-A to operate air emission sources associated with the FMO facility and the FCO (NCDAQ, 2004b). Primary emission sources include a natural gas-fired chambered incinerator for combustible LLRW, three natural gas or No. 2 fuel oil-fired boilers, and one emergency and two load-shedding generators burning diesel fuel.

Table 3-6 presents annual point source emissions of criteria pollutants and volatile organic compounds (VOCs) for New Hanover County, neighboring Brunswick and Pender Counties, and for the Wilmington Site (NCDAQ, 2009a). Annual point source emissions for New Hanover County are the highest among the three counties, about 2 to 7 times higher than for Brunswick County. Pender County, with the lowest population among the three counties and no major industries, has negligible point source emissions. Point source emissions from current operations at the Wilmington Site are well below the major source threshold of 91 metric tons (100 tons) per year for one or more of the criteria pollutants, and are insignificant compared with the annual total emissions in New Hanover County and the three counties combined.

Table 3-6 Annual Point Source Emissions of Criteria Pollutants and VOCs in New Hanover County, Neighboring Brunswick and Pender Counties for 2007, and at the Wilmington Site for 2004

Pollutant	Annual Emission Rates (tons/yr)[a]			
	Brunswick County	New Hanover County	Pender County	Wilmington Site[b]
SO_2	7407	26,055	NA[c]	0.2
NO_x	2612	7170	NA	7
CO	6299	12,156	NA	3.5
VOC	1426	2371	NA	0.4
TSP	292	1790	6.4	0.4
PM_{10}	201	1328	2.6	0.4
$PM_{2.5}$	134	782	NA	0.1

[a] To convert tons to metric tons, multiply by 0.9072.
[b] Point source emissions reported to and accepted by NCDAQ for compliance with current site permits.
[c] NA = not available.
Source: NCDAQ, 2009a.

Annual emissions in 2007 for large point sources with any one of the criteria pollutants and/or VOCs of greater than 91 metric tons (100 tons) per year in New Hanover County and neighboring Brunswick and Pender Counties are presented in Table 3-7. Many large point source emitters are in operation in Wilmington, New Hanover County, while no large emitters exist in Pender County. A coal-fired electric plant owned by Carolina Power and Light Company in Wilmington, New Hanover County, accounts for more than half of the three-county total point source emissions of SO_2, NO_x, and all PMs (TSP, PM_{10}, and $PM_{2.5}$). Invista, S.a.r.l., a manufacturer of industrial organic chemicals, is a primary contributor to emissions of CO and VOCs and a secondary contributor to emissions of all PMs. Invista, S.a.r.l. is also a secondary contributor to SO_2, along with a coal-fired cogeneration plant in Southport, Brunswick County, owned by EPCOR USA. DAK Americas LLC, a manufacturer of organic fibers in Leland, Brunswick County, is a secondary contributor to NO_x, CO, and VOC emissions.

As shown in Table 3-8, nitric acid, at 178 kilograms (393 pounds), was the highest among the air toxics emitted from the Wilmington Site in 2004, followed by ammonia at 108 kilograms (237 pounds). The Wilmington Site also emitted about 27 kilograms (60 pounds) of total fluorides and 15 kilograms (32 pounds) of hydrogen fluoride. Total air toxic emissions from the Wilmington Site in 2004 were about 546 kilograms (1203 pounds). Accordingly, toxic emissions from the Wilmington Site are well below the major source thresholds of 9.1 metric tons per year (10 tons per year) for a single HAP and 23 metric tons (25 tons per year) for any combination of listed HAPs.

No total greenhouse gas (GHG) emissions data are available at the county level in North Carolina. Greenhouse gas emissions and sinks in North Carolina are presented in Section 4.2.18.4.

Facilities in North Carolina are encouraged by the NCDAQ to report their GHG emissions voluntarily. No facilities in New Hanover County have voluntarily reported their GHG emissions to date. On October 30, 2009, the EPA promulgated the *Mandatory Greenhouse Gases (GHGs) Reporting Rule* (74 FR 56260). This rule mandates the reporting of annual GHG emissions for over 10,000 facilities that account for 85 percent of the national GHG emissions. The rule, which became effective on December 29, 2009, focuses on large emitters of GHGs, including power generation facilities, and other industrial entities. Facilities that emit GHGs from certain sources – such as the production of cement, aluminum, and lime – are required to comply with the rule regardless of emission rate. Other GHG sources must be reported only if the facility's GHG emissions exceed 25,000 metric tons (MT) of carbon dioxide equivalent (CO_2e). Combustion units are included in the sources which must report if aggregate emissions exceed this level. At this time, no action other than reporting must be taken.

3.5.3.2 Current Air Quality Conditions

Currently, three State monitoring sites as part of the North Carolina Ambient Monitoring Program are operating in New Hanover County; no monitoring sites are in operation in neighboring Brunswick and Pender Counties. Three criteria pollutants (O_3, PM_{10},[4] and $PM_{2.5}$)

[4] The NCDAQ began manual one-in-six-day PM_{10} monitoring at the Castle Hayne site in February 2008 to provide the necessary PM_{10} data for PSD modeling associated with industrial expansion in the coastal area, because it shut down the PM_{10} monitoring site in Jacksonville, Onslow County, on December 31, 2007.

Table 3-7 Annual Emissions for Large Point Sources in New Hanover County and Neighboring Brunswick and Pender Counties for 2007 (tons)[a,b,c]

Facility Name	County	City	SO_2	NO_x	CO	VOC	TSP	PM_{10}	$PM_{2.5}$	Industry Type (SIC)
DAK Americas LLC	Brunswick	Leland	3254	1409	5955	1112	121	76	49.4	2824 – Organic fibers, noncellulosic
EPCOR USA North Carolina LLC – Southport Plant	Brunswick	Southport	4113	1144	266	15.2	73.5	72.7	50.7	4911 – Electric services
Technical Coating International, Inc.	Brunswick	Leland	NR[d]	0.3	0	170	0	0	0	3089 – Plastics products, NEC[e]
Carolina Power and Light Company	New Hanover	Wilmington	20,393	5358	343	40.5	1161	827	445	4911 – Electric services
Corning Incorporated	New Hanover	Wilmington	0.1	213	3.7	62.8	16.7	9.1	NR	3229 – Pressed and blown glass, NEC
Elementis Chromium	New Hanover	Castle Hayne	534	414	14.6	55.1	140	103	75.4	2819 – Industrial inorganic chemicals
Invista, S.a.r.l.	New Hanover	Wilmington	4107	924	11,701	1151	326	285	196	2869 – Industrial organic chemicals, NEC
MeadWestvaco Packaging Systems, LLC	New Hanover	Wilmington	NR	1	0.8	664	0.2	0.2	0.2	2671 – Paper coated and laminated packaging

[a] Presented large point sources with any one of the criteria pollutants and/or VOCs of greater than 100 tons per year.
[b] None of the point sources in Pender County generate emissions of any one of the criteria pollutants and/or VOCs of greater than 100 tons per year.
[c] To convert tons to metric tons, multiply by 0.9072.
[d] NR = not reported.
[e] NEC = not elsewhere classified.
Source: NCDAQ, 2009a.

Table 3-8 Annual Toxic Air Pollutant Emissions at the Wilmington Site in 2004

Pollutant[a]	CAS[b] Code	Annual Emissions kg	Annual Emissions lb
Acetaldehyde	75-07-0	0.5	1.1
Acrolein	107-02-8	0.05	0.1
Ammonia (as NH_3)	7664-41-7	108	237
Benzene	71-43-2	0.7	1.5
Butadiene, 1,3-	106-99-0	0.05	0.1
Chromic acid (VI) (component of SolCR6 and CRC)	7738-94-5	0.001	0.002
Chromium (VI) soluble chromate compounds (component of CRC)	SolCR6	0.001	0.002
Chromium — all/total (includes chromium (VI) categories, metal and others)	CRC	0	0
Fluorides (sum of all fluoride compounds as mass of F ion)	16984-48-8	27	60
Formaldehyde	50-00-0	3.2	7
Hydrogen chloride (hydrochloric acid)	7647-01-0	2.7	6
Hydrogen fluoride (hydrofluoric acid as mass of HF) (component of 16984488/fluorides)	7664-39-3	15	32
MEK (methyl ethyl ketone, 2-butanone)	78-93-3	0.5	1
Methylene diphenyl diisocyanate (MDI) (component of 83329/POMTV)	101-68-8	0.05	0.1
Nitric acid	7697-37-2	178	393
Polycyclic organic matter (includes PAH, dioxins, etc., NC & AP 42 historic)	POM	0.1	0.3
Polycyclic organic matter (specific compounds from OAQPS for Title V)	83329/POMTV	0.05	0.1
Sulfuric acid	7664-93-9	1.8	4
Toluene	108-88-3	1.4	3
Trichloroethane, 1,1,2-	79-00-5	29	63
Xylene (mixed isomers)	1330-20-7	0.2	0.4
Total		546 (0.60 tons)	1,203

[a] SolCR6 = soluble chromium (VI) compounds; CRC = total chromium compounds; POMTV = polycyclic organic matter for Title V; PAH = polycyclic aromatic hydrocarbon; AP 42 = EPA emission factor database; QAQPS = EPA Office of Air Quality Planning and Standards.
[b] Chemical Abstract Service.
Source: NCDAQ, 2009a.

are currently measured at Castle Hayne station located about 10 kilometers (6 miles) northeast of the Wilmington Site, while only SO_2 is measured at the New Hanover County monitoring station located about 10 kilometers (6 miles) south of the Wilmington Site. The Battleship monitoring station, located about 10 kilometers (6 miles) south of the Wilmington Site, began collecting HAPs/TAPs in 2004. The Oleander & College monitoring station, located about 13 kilometers (8 miles) south–southeast of the Wilmington Site, was shut down in 2005 because consistently low CO concentrations (well below the NAAQS) had been collected. Currently, the NCDAQ is monitoring NO_2 at two urban centers in North Carolina (Charlotte and Winston-Salem), but is not monitoring lead in the statewide compliance monitoring network because of consistently low readings Statewide.

Table 3-9 gives the highest background concentrations for SO_2, CO, O_3, PM_{10}, and $PM_{2.5}$ collected at monitoring stations in New Hanover County, along with ambient air quality standards (EPA, 2009c). Because New Hanover County is in attainment for criteria pollutants (see Section 3.5.3), ambient air quality is considered relatively good. Monitoring data for SO_2, CO, and PM_{10} are well below the applicable standards (less than or equal to 30 percent of the standard), while data for 1-hour O_3 and $PM_{2.5}$ levels are around 70 percent of their respective standards.[7] However, monitoring data for 8-hour O_3, which is of regional concern, has ranged from 84 to 100 percent of the standard.

3.6 Geology, Minerals, and Soil

This section describes regional and local geology and soils, seismicity, geologic hazards, and mineral resources. Detailed safety analyses relative to seismicity are not presented here, but rather, are part of the NRC staff's Safety Evaluation Report (SER).

3.6.1 Regional Geology, Structure, and Seismicity

The Wilmington Site is located in the Atlantic Coastal Plain physiographic province. Generally, this low-relief province has a subsurface that is composed of unconsolidated sediments (layers of sand, silt, marl, and clay) and limestone that rest on a crystalline basement. The sediments dip and thicken toward the east.

Site stratigraphy comprises Quaternary sediments over Cretaceous sediments over crystalline basement rock (Table 3-10). Detailed surficial mapping is not available, but examples of the types of uppermost Quaternary deposits include beach, sand dune, tidal marsh, swamp, and alluvium. Because of nearshore depositional environments and changing sea level, the unconsolidated sediments are variable areally and vertically. The Cretaceous formations at the site are considered to include the Peedee, Black Creek, and Cape Fear formations. The Peedee is a silty, fine to very fine-grained sand with traces of oyster shells and pyrite (Lautier, 1998). It overlies the Black Creek formation, which is approximately 300 feet of

7 The highest 24-hour $PM_{2.5}$ concentration recorded in 2008 was 41.6 $\mu g/m^3$, primarily due to a forest fire. PM monitors were removed in April 2008 and never started back (NCDAQ, 2009b). Only 16 measurements were made in 2008, and thus, this value falls in the 98th percentile concentration. This reading, considered to be an exceptional event, is not a representative 98th percentile concentration for 2008. The second-highest concentration recorded in 2008 was 15.2 $\mu g/m^3$, which is well below the standard of 35 $\mu g/m^3$.

Table 3-9 Highest Background Concentrations at Monitoring Stations in New Hanover County, North Carolina, during the Period 2004 to 2008

Pollutant	Averaging Time	NAAQS/ SAAQS	Monitored Background Concentrations[a]					
			Data Format	2004	2005	2006	2007	2008
SO_2	3-hour	0.5 ppm	2nd maximum	0.072 (14%)[b]	0.061 (12%)	0.065 (13%)	0.082 (16%)	0.069 (14%)
	24-hour	0.14 ppm	2nd maximum	0.022 (16%)	0.022 (16%)	0.030 (21%)	0.027 (19%)	0.028 (20%)
	Annual	0.03 ppm	Annual average	0.005 (17%)	0.003 (10%)	0.005 (17%)	0.006 (20%)	0.006 (20%)
CO	1-hour	35 ppm	2nd maximum	3.3[c] (9.4%)	NA[d]	NA	NA	NA
	8-hour	9 ppm	2nd maximum	2.3[c] (26%)	NA	NA	NA	NA
O_3	1-hour	0.12 ppm	2nd maximum	0.081 (68%)	0.088 (73%)	0.085 (71%)	0.083 (69%)	0.082 (68%)
	8-hour	0.075 ppm	4th highest daily maximum	0.070 (93%)	0.075 (100%)	0.072 (96%)	0.071 (95%)	0.063 (84%)
PM_{10}	24-hour	150 $\mu g/m^3$	2nd maximum	NA	NA	NA	NA	20[e] (13%)
$PM_{2.5}$	24-hour	35 $\mu g/m^3$	98th percentile	22.8 (65%)	25.0 (71%)	25.8 (74%)	25.4 (73%)	41.6[e,f] (119%)
	Annual	15.0 $\mu g/m^3$	Annual average	10.5 (70%)	10.3 (69%)	9.8 (65%)	9.0 (60%)	10.4[e] (69%)

[a] The NCDAQ monitors NO_2 at two urban centers (Charlotte and Winston-Salem), for which the highest annual average concentration is 0.015 ppm, about 28 percent of the NAAQS of 0.053 ppm. However, the NCDAQ does not monitor Pb in the State of North Carolina because statewide attainment with applicable ambient air quality standards has been demonstrated.
[b] Values in parentheses are monitored concentrations as a percentage of NAAQS or SAAQS.
[c] CO monitoring was discontinued from 2005 due to consistently low CO concentrations.
[d] NA = no measurement data are available.
[e] Because of a prolonged fire, the PM monitors were removed in April 2008 and never started back (NCDAQ, 2009b). On the basis of monitoring data in Wilmington for the 1998 to 2002 period, the highest background 24-hour and annual average concentrations were 45 and 20 $\mu g/m^3$, respectively.
[f] This concentration is the highest (also falls in the 98th percentile) out of only 16 measurements recorded in 2008. This reading, which was primarily caused by a forest fire and considered to be an exceptional event, is not the representative 98th percentile in 2008. The second highest in 2008 was 15.2 $\mu g/m^3$.
Source: EPA, 2009c.

Table 3-10 Geologic Units at the North–Central Sector of the Wilmington Site

Formation	Geologic Age	Description	Approx. Thickness (ft)[a]	Approx. Depth to Top (ft)
Surficial sediments	Quaternary	Beach, sand dune, tidal marsh, swamp, and alluvial deposits	10–30	0
Peedee	Cretaceous	Mainly silty fine-grained sand	330	10–30
Black Creek	Cretaceous	Mainly alternating fine-grained sand and clay, clay lenses, variable sands	300	350
Cape Fear	Cretaceous	Clay interbedded with clayey sand and sandy clay	400	650
Crystalline basement	Pre-Mesozoic	Igneous and metamorphic rocks	Large	1050

[a] To convert feet to meters, multiply by 0.305.
Sources: Lautier, 1998; Harden et al., 2003.

alternating beds of fine-grained sands and clays with organic matter (Harden et al., 2003). Clayey sand lenses are present that contain shells, glauconite, and organic material. In the lower portion of the formation, kaolinitic clay and cross-bedded sand, silty clay, channel sands, and laminated beds of sand and clay of a nonmarine river-delta environment are present. The Cape Fear formation comprises about 400 feet of clays interbedded with clayey sand to sandy clay. These materials were deposited in shallow seas and in deltaic and estuarine settings. The basement rock elevation is approximately 1050 feet below ground surface (bgs) (Harden et al., 2003).

3.6.1.1 Regional Earthquakes

Most North Carolina earthquakes have taken place in the western portion of the State. The site vicinity does not have a significant seismic hazard. Crone and Wheeler (2000) assessed the Cape Fear Arch, a regional structural feature, approximately located along the Cape Fear River, and noted the lack of evidence for Quaternary faulting. The peak acceleration at the site is 3 to 4 percent of gravity (Frankel, 2005), which is relatively low.

Because of the geologic and seismic setting of the site and its low relief, natural hazards such as volcanism, tsunamis, and landslides are not considered to be relevant.

3.6.1.2 Mineral Resources

Regional mineral resources include sand and gravel, clay, limestone, phosphate, and peat. The U.S. Geological Survey (USGS) notes the location of several active or former sandpits, a clay pit, and a quarry for crushed stone within 10 miles of the site (USGS, 2005). Fluorine and titanium operations occur outside of northern New Hanover County. At the site area, mineral resources have not been extracted, and significant economic value is not likely.

3.6.2 Site Geology

Across the Wilmington Site, Quaternary sediments blanket the surface. These deposits vary in texture and include silty fine sands, silty fine clayey sands, fine sandy silts, and fine sandy clays. The Peedee clay is present in the eastern portion of the proposed GLE site, while the underlying Peedee sands are present across the Wilmington Site. A total of ten soil borings were drilled in 1980 and 2007 at or near the North–Central Site Sector to provide preliminary geotechnical information for a proposed landfill and for foundation design, respectively (GLE, 2008). The depths of the borings were roughly 35 to 60 feet. These drilling data indicate that the Peedee Clay has been eroded (GLE, 2008). Here, the Peedee Formation's sandy material is found at a depth of roughly 10 to 30 ft. Farther to the west, at the Northwest Site Sector, a drilling program showed that no clay is present to a depth of at least 60 feet (RTI, 1997).

Carbonate bedrock is present elsewhere in New Hanover County and in adjoining Pender and Brunswick Counties (NCGS, 2007). In a karst terrain, dissolution of carbonate bedrock such as limestone leads to sinkholes and ground collapse. The site, however, is not underlain by the limestone formations that are susceptible to karst (NCGS, 2007; Lautier, 1998; GLE, 2008).

3.6.3 Site Soils

Soils in the region have developed on the recent Quaternary sediments. The North-Central Site Sector, as well as most of the Wilmington Site, has soils of the Meggett-Johnston-Dorovan association. Typical characteristics are very poorly drained, very little slope, high flooding frequency due to poor drainage, and moderate permeability (GLE, 2008). Most of the North-Central Site Sector is mapped as the Murville fine sand and the Leon sand soil types. The Murville is formed in sandy marine and fluvial sediments on broad interstream uplands or in interstream areas. Slopes are less than two percent, drainage is very poor, and permeability is high in the surface layer and moderately high in the subsoils. The seasonal high water table is at or near the surface. The soil is strongly to extremely acidic. The Leon sand is found in various settings, including uplands and stream terraces. It is deep, with high permeability at the surface, moderate to moderately high permeability in the subsoil, and very high permeability at depth. The seasonal high water table is at or near the surface.

Differential settlement of foundations occurs in clayey soils with particular properties. The potential for differential settlement at the proposed construction site is not a concern because of the sandy soils.

Section 3.7.4.3 provides information on historical releases to site groundwater at various facilities at the Wilmington Site. These have included historical VOCs, calcium fluoride, uranium, nitrate, and metals. Remediation has been conducted or is being conducted in response to these contaminants. Residual contaminants are presumably present in the unsaturated or saturated site soils.

3.7 Water Resources

This section discusses both surface water and groundwater, including descriptions of the resources, their use, and natural and anthropogenic quality issues.

3.7.1 Surface Water Features and Quality

The Wilmington Site is in the Northeast Cape Fear River subbasin of the Cape Fear River basin. The Northeast Cape Fear River is the nearest named surface water body to the Wilmington Site. It forms the southwestern border of the Wilmington property, where it is 600 to 1300 feet wide. The river is tidally influenced (Weaver and Pope, 2001). Flow measurements of the river in the immediate vicinity of the Wilmington Site are unavailable. The nearest flow monitoring stations for the Northeast Cape Fear River are upstream from the Wilmington Site. At Burgaw (approximately 18 miles north of the site), limited data provide an average flow of 620 cubic feet per second in 2005 (USGS, 2010a). Farther upstream at Chinquapin (approximately 34 miles north of the site), data from 1941 to 2009 indicate an annual average flow of 712 cubic feet per second (USGS, 2010b). The 2005 average, for comparison with the Burgaw data, was 423 cubic feet per second. The Northeast Cape Fear River basin comprises more than 1740 square miles, while the overall Cape Fear River basin covers 9090 square miles and is the largest watershed in North Carolina (Weaver and Pope, 2001). There are no dams (other than the site dam on the effluent channel), reservoirs, or surface water intakes within the Northeast Cape Fear watershed.

Surface water is used in the region for various purposes; the predominant use is nonconsumptive cooling water for thermoelectric power generation. In New Hanover, Pender, and Brunswick Counties, there are no public supply intakes; however, the Wilmington area is served by an intake on the Cape Fear River in Bladen County. In New Hanover, Pender, and Brunswick Counties, the dominant surface water uses are irrigation and industry (USGS, 2009). Groundwater is the water source for domestic, municipal, and industrial users.

The site is drained by several small streams and an effluent channel (Figure 3-8). The effluent channel begins in the Eastern Site Sector and flows to the site dam west and then connects to an unnamed perennial tributary to the Northeast Cape Fear River. Another tributary to the same river drains portions of the western and northwestern site sectors. Two unnamed streams flow north from the property to Prince George Creek, a tributary to the Northeast Cape Fear River. One of these originates in the Eastern Site Sector and receives site stormwater; the other has headwaters just north of the Northwestern Site Sector.

The effluent channel receives treated process wastewater effluent subject to NPDES water quality standards. It also receives stormwater runoff from the developed Eastern Site Sector.

Other onsite natural surface water bodies include three ephemeral woodland ponds. Created features include two active final process lagoons, their associated aeration basin, four inactive wastewater treatment facility lagoons, one firewater pond, and two stormwater wet detention basins.

The process lagoons and aeration basin are for the treatment of process wastewater from the FMO facility. Adjustment of wastewater pH causes precipitation of chemicals and the resulting floc is disposed of as low-level waste. The lagoons are periodically dredged and inspected. The water discharged from the lagoons is cooled to ambient air temperature prior to discharge to Outfall 001 (Figure 3-20).

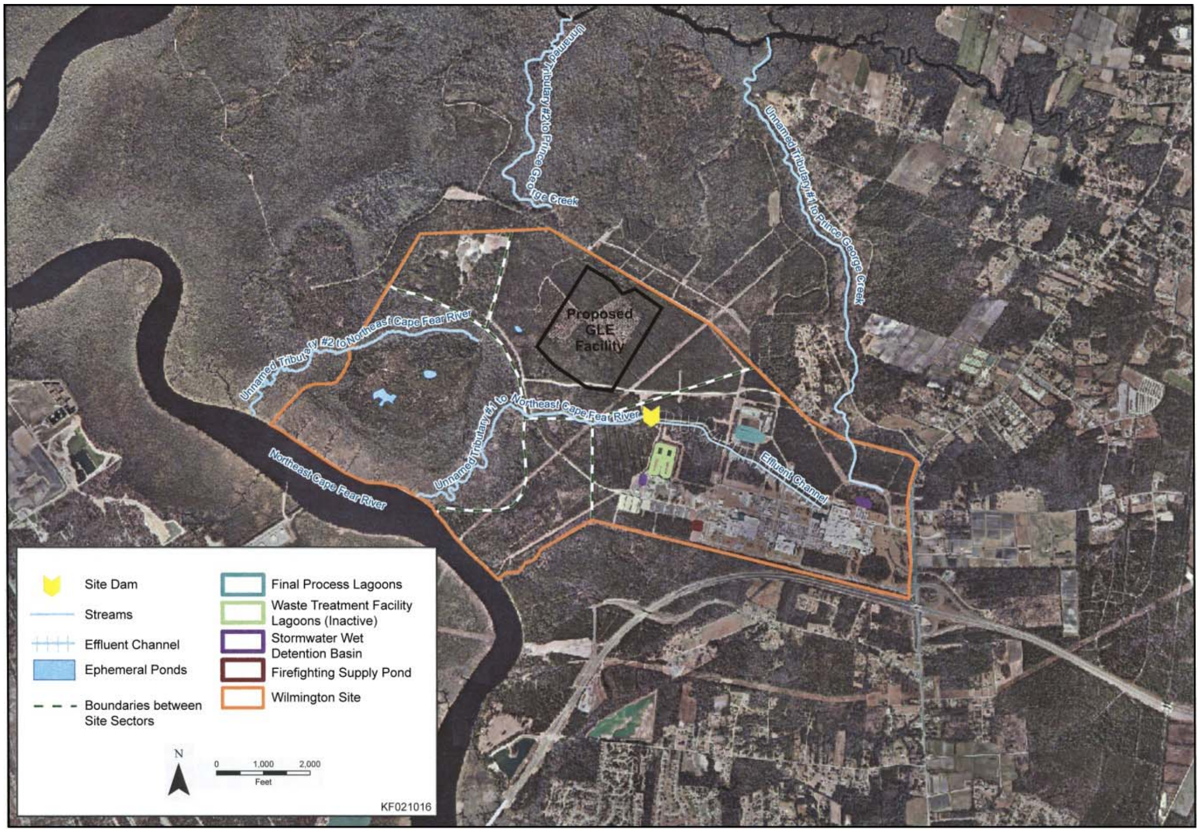

Figure 3-8 Surface Water Features at the Wilmington Site (Modified from GLE, 2008)

Dredging of stormwater ponds and the effluent channel are not covered under the *Clean Water Act* (CWA) because they are created features for industrial purposes. Large trees along the banks of the effluent channel suggest that dredging is not frequent and has not taken place for many years.

The wastewater lagoons are being decommissioned because wastewater is being reused at the facility, as described later in this section.

The State classifies surface waters and wetlands to specify the required types of protection (15A NC Administrative Code 2B.0101). The Northeast Cape Fear River near the Wilmington Site is State-designated as Class C swamp water. A Class C designation means that the water is protected for secondary recreation (boating, but not swimming), fishing, and wildlife. The supplemental classification “swamp water” describes water of low velocity, low pH, and low dissolved oxygen. The tributaries draining the site are also considered Class C swamp water. The lower portions of these tributaries, as well as the Northeast Cape Fear River near the site, are tidally influenced and therefore contain some saltwater. The balance of fresh and saltwater is dynamic and dependent on the tide and the flow of freshwater from upstream.

The North Carolina Division of Water Quality (NCDWQ) maintains two monitoring stations along the Northeast Cape Fear River. One station is about 17 miles upstream of the Wilmington Site; another is 6 miles downstream. The GLE Environmental Report (GLE, 2008; Table 3.4-6) contains tabulated summaries of water quality monitoring results from these stations. Results include the chloride mean and maximum values exceeding the evaluation limit at the downstream location, the copper and zinc maximum values exceeding the evaluation limit at both the upstream and downstream locations, the iron maximum value exceeding the evaluation limit at the upstream location, the minimum pH below the evaluation limit at the downstream location, and the minimum dissolved oxygen below the evaluation limit at both the upstream and downstream locations. A third station is located at the GE dock near the Wilmington Site's south border, less than 2500 feet downstream of the tributary fed by the effluent channel. This station is monitored by the Lower Cape Fear River Program, a collaborative effort among academia, government, industry, and the public. The GLE Environmental Report (GLE, 2008; Table 3.4-7) contains a tabulated summary of water quality monitoring results from this station. Of the water quality parameters listed, the minimum dissolved oxygen is the only one outside the evaluation limit.

GE-Hitachi Nuclear Energy (GEH) monitors water quality, gross alpha, gross beta, and uranium concentrations in the effluent channel at the site dam, the Northeast Cape Fear River significantly upstream of the Wilmington Site (at a location consistent with the upstream NCDWQ station), and the Northeast Cape Fear River at the GE dock. These three surface water stations are also monitored by the North Carolina Radiation Protection Section (NCRPS) through monthly sampling. Summary data from 1997 to 2006 are presented for water quality parameters, total uranium, gross alpha, and gross beta (GLE, 2008; Tables 3.4-8 and 3.4-9).

Non-radiological results include the copper mean and maximum values exceeding the evaluation limit at both the upstream location and the GE dock, the fecal coliform maximum exceeding the evaluation limit at the upstream location, and the dissolved oxygen minimum value below the evaluation limit at both the upstream location and the GE dock. Evaluation limits are not applied to the site dam data because it is an industrial waterway not subject to 15A NC Administrative Code 02B.0211. Although a segment of the Northeast Cape Fear River (ending approximately 8.5 miles upstream of the Wilmington Site) is listed by the State as mercury-impaired, the segment of the river contiguous to and immediately downstream of the Site is not listed as mercury-impaired. GEH does not monitor the effluent channel or the Northeast Cape Fear River for mercury.

Radiological results at the site dam include mean total uranium concentration of 0.024 milligrams per liter, maximum total uranium concentration of 0.13 milligrams per liter, mean gross alpha of 49.9 picocuries per liter, maximum gross alpha of 329 picocuries per liter, mean gross beta of 58.7 picocuries per liter, and maximum gross beta of 330 picocuries per liter. State standards are annual averages of 15 picocuries per liter for gross alpha and 50 picocuries per liter for gross beta (15A NC Administrative Code 02B.0211); however, these standards do not apply to an industrial waterway such as the effluent channel. Results on the upstream and downstream river stations are significantly lower and often below detection limits, and the annual averages are below the standards for gross alpha and gross beta. NCRPS data with detailed monthly summary tables for 2000, 2002, and 2006 were obtained for comparison with GE and NCRPS results for gross alpha and gross beta (NCDENR, 2009b). These comparisons showed NCRPS results to be generally higher than the GE results, and the difference in many cases was significant. No NCRPS data were available for total uranium. North Carolina does not have a water quality standard for uranium in 15A NC Administrative Code 02B.0211.

The Wilmington Site has two National Pollutant Discharge Elimination System (NPDES) permits: one for wastewaters (process and sanitary) and another for stormwater.

The process and sanitary wastewater permit (Klimek, 2004) expired February 28, 2009. The Wilmington Site operates under a renewal draft permit (NCDENR, 2009d), which allows the Site to continue operating under the conditions of the previous permit. A renewal draft permit is an interim permit issued by the State that allows a permittee to operate under the previous permit (the terms of which may be modified by the State) until the final draft permit is issued. The permit addresses two outfalls. Outfall 001 (Figure 3-20) is for process wastewater. It is monitored prior to discharge to the effluent channel for various parameters and has limitations on total suspended solids (TSS), total nitrogen, fluoride, cyanide, pH, metals (total cadmium, lead, chromium, copper, nickel, silver, zinc), oil and grease, and total toxic organics. The permit lists a number of equipment systems that contribute flow to the outfall, including treatment tanks, lime slurry system, hydrofluoric acid equipment, etc. The permitted maximum flow at the outfall is 1.8 million gallons per day. Outfall 002 (Figure 3-20) was used for treated domestic (sanitary) wastewater until April 2008. Permit limitations included biochemical oxygen demand (BOD), TSS, and fecal coliform, and a maximum allowed flow of 75,000 gallons per day (Klimek, 2004).

The current sanitary wastewater treatment facility is a new system that does not release effluent. The Wilmington Site obtained a permit for the construction and operation of a 75,000-gallons-per-day reverse osmosis water treatment facility to treat the wastewater prior to reuse (Klimek, 2007a). This system's treated sanitary effluent is routed to the FMO facility for industrial process use and to Wilmington Site cooling towers (for the SCO heating, ventilation and air-conditioning, the FCO facility, and the FMO facility). Effluent limits for both monthly average and daily maximum values include turbidity, nitrogen, BOD, TSS, and fecal coliform.

The NCDWQ web site does not list NPDES-related Notices of Violation (NOVs) at facilities. At the site audit, representatives described the history of NOVs for discharges. From approximately 1995 to 1997, the site received several NOVs for BOD. GLE had two reporting violations (one for weekly ammonia, one for weekly coliform) but could not provide written documentation from the State regarding these occurrences (GLE, 2009a). None of the NOVs have recurred.

The effluent channel receives effluent from the final process lagoons, which receive alkaline water from the alkaline cleaners used in processing at the FCO facility (GLE, 2009a). The optimum pH of the lagoons is 8 to 10 to facilitate the settling of solids. The permit for the process wastewater limits pH to a minimum of 6.0 and a maximum of 9.0 at Outfall 001 upstream of the site dam (Klimek, 2004). The adjustment is made using sulfuric acid prior to release at the outfall (GLE, 2009a). The site dam has a monitoring station for pH. A gate can be closed to stop flow through the dam if there is an alarm caused by pH outside the range of 6 to 9. GE data for 1997 to 2006 include statistics for 874 pH samples: a minimum pH of 6.10, a maximum pH of 12.50, and an average pH of 7.31 determined by using the hydrogen ion concentrations (GLE, 2008). In the last 10 years, the dam has had no reportable pH excursions (GLE, 2009a). The pH may exceed the range of 6 to 9 for 60 minutes in one event or 7.2 hours in a month (Klimak, 2004). If the pH alarm at the dam sounds, GLE implements a procedure to investigate (GLE, 2009a). An operator closes the dam within five minutes and manually checks the pH at the outfall with pH paper and a handheld pH meter. If the pH is not within the allowable range, the operator closes the final process lagoons and the pH is retested within 60 minutes. If the pH were still not within the allowable range, the cause would be investigated and a remediation plan would be developed to adjust the pH. The pH alarms have been attributed to an error with the probe at the dam or the system has recovered within 60 minutes.

Overflow at a closed dam could occur if the effluent channel receives more than 8.6 million gallons of water, which would be expected with a 25-year storm event (GLE, 2009b). During dry conditions, the retention capacity at the dam would allow time for pH adjustments. Dilution of out-of-specification pH would occur during large rainfall events.

The NPDES stormwater permit (Klimek, 2007b) requires a stormwater pollution prevention plan, with components that include a description of site operations such as storage and waste disposal, a list of spills or leaks in the prior three years, secondary containment information, a description of best management practices with regard to controlling pollutants in stormwater discharge, and a spill prevention and response plan. The Wilmington Site has three stormwater outfalls: two discharge to the Northeast Cape Fear River (Figure 3-20), and one discharges to the Prince George Creek. Semiannual sampling is required during a storm event, with analysis for lead, oil and grease, pH, and TSS. The 2007 results were within the allowable ranges, with the exception of a TSS value that was driven high because of construction activities. Quarterly stormwater sampling took place during 2003 and included analyses for ammonia, combined nitrite and nitrate, fluoride, uranium (up to 9.9 picocuries per liter), dichloroethylene (DCE), trichloroethylene (TCE), and vinyl chloride (VC) (GLE, 2008). The VOCs were at very low or nondetectable levels. In the current stormwater permit (Klimek, 2007b), uranium has been dropped as a monitoring requirement.

3.7.2 Floodplains

The North-Central Site Sector, the location of the proposed GLE Facility, is above the 100-year and 500-year floodplains of the Northeast Cape Fear River. Employees at the Wilmington Site did not observe flooding in 1999 during Hurricane Floyd (GLE, 2008).

3.7.3 Wetlands

Several small wetlands have been identified (GLE, 2008) and were visited during the site audit. Section 3.8.2 describes these features in detail.

3.7.4 Groundwater

3.7.4.1 Site and Regional Hydrogeology

The geologic units discussed in Section 3.6 comprise the aquifers and aquitards of the site vicinity. Table 3-10 gives the thicknesses and approximate contact elevations. The discussion below focuses on the Quaternary sediments and the Peedee and Black Creek aquifers because they represent the near-surface flow system and because fresh water is present in the Quaternary and portions of the Peedee.

The unconfined surficial aquifer consists of the Quaternary sediments, which vary greatly in texture and permeability over short lateral or vertical distances. Well yields are limited and usually are sufficient only for domestic wells. The aquifer's groundwater is generally fresh, away from coastal barrier islands (Lautier, 1998). Regional hydraulic conductivity measurements range between 18.2 and 607 feet per day, with an average of 130 feet per day (Lautier, 1998).

The Peedee aquifer is an important regional water source and is the water source for the Wilmington Site (see Section 3.7.4.2). Its hydraulic conductivity varies spatially but is generally high. Regional hydraulic conductivity measurements range between 1.02 and 243 feet per day with an average of 38.26 feet per day (Lautier, 1998). Its groundwater is generally transitional between freshwater and saltwater, though at the Wilmington Site, the shallow Peedee groundwater is fresh. Recharge may occur from the surficial aquifer and as upward leakage from the Black Creek aquifer (Harden et al., 2003). In the eastern GLE property, the overlying Peedee clay is of variable thickness and functions as a semiconfining unit, but it thins to the west. Site drilling logs (GLE, 2008) indicate that the Peedee clay is not present at the proposed GLE site.

The underlying Black Creek aquifer at the site is nonpotable because of saltwater content, and is therefore not relied on as a water resource in the Wilmington Site vicinity. A confining unit of clay, silt, and thin sand beds separates the Black Creek aquifer from the overlying Peedee aquifer. Below the Black Creek formation is the Cape Fear formation, which contains upper and lower aquifers. Both are nonpotable due to salt content.

At the proposed GLE Facility site, the surficial aquifer discharges to surface water bodies, including streams, drainage canals, and swamps. It also leaks groundwater into the underlying upper Peedee aquifer. Potentiometric mapping of the surficial aquifer (GLE, 2008) indicates a water table mound centered on the north-central site sector, with shallow groundwater discharging directly toward the surrounding low areas in all directions. Flow to the east eventually diverts to the north or south. Water levels generally fluctuate over a range of several feet in response to seasonal changes or precipitation events.

Water level data from the upper portion of the Peedee sand at the proposed GLE site support flow patterns similar to those of the surficial aquifer. A mound is present at the north-central site sector, with flow toward the surface water bodies on the north, west, and south. To the east, however, flow is captured by remediation/containment wells and process water wells in the central GLE property (GLE, 2008).

3.7.4.2 Groundwater Use

Much of the regional groundwater withdrawal for public systems and private users is from the Peedee aquifer.

For potable water supply, the Wilmington Site has three production wells completed in the Peedee aquifer. They are located east of the site and NC 133 (Castle Hayne Road) on a separate GE property. The average pumping rate from this system is approximately 47,000 gallons per day (GLE, 2008). In comparison, the rate of groundwater usage for public supply in New Hanover County in 2000 was nearly 8 million gallons per day, while the overall groundwater withdrawal was about 17 million gallons per day, with the main categories of public supply, domestic wells, industrial wells, and irrigation (USGS, 2009). Much of the regional groundwater withdrawal is from the Peedee aquifer.

Approximately 15 extraction wells and two sumps are at the site. They are located within the eastern site sector and are used for remediation, specifically hydraulic containment. Extracted groundwater is treated and used as the process water at Wilmington facilities, with an average pumping rate of approximately 565,000 gallons per day (GLE, 2008).
Together, the potable and remedial/process pumping systems withdraw a combined 612,000 gallons per day of groundwater. Nonagricultural users of more than 100,000 gallons per day of groundwater are required to register with the North Carolina Environmental Management Commission, and to update their registrations every five years thereafter, under *North Carolina General Statutes* 143-215.22H. GE operations have been registered under this program (GLE, 2008).

3.7.4.3 Groundwater Quality

Natural groundwater quality varies with location and depth. While the surficial and Peedee aquifers are generally of good quality in the Wilmington region, the lower portion of the Peedee in eastern areas has a high chloride concentration because of saltwater intrusion and is consequently nonpotable (Lautier, 1998). The deeper Black Creek aquifer and underlying units are generally nonpotable due to saltwater intrusion.

Groundwater monitoring takes place at the Wilmington Site to assess groundwater contamination, which may be any combination of organic, inorganic, radiological, or water quality parameters. Figure 3-9 shows the locations of monitoring areas and wells. The GLE Environmental Report gives a tabular summary of monitoring results based on historical site databases and identifies exceedances, which have included chromium, fluoride, nitrate, nitrite, various organic compounds, gross alpha, and high pH (GLE, 2008; Tables 3.4-3, 3.4-4, and 3.4-5). The impacted groundwater does not flow offsite, given proper functioning of the groundwater extraction systems that provide hydraulic containment and route the extracted water to site industrial uses.

Groundwater impacts are present at several distinct areas of the Wilmington Site, as described below. These areas are shown in Figure 3-9. The Northwest Site Area is located in the Northwest Site Sector, adjacent to the northwestern edge of the current proposed GLE site. It was a lubricant disposal area, and its groundwater contains TCE and its breakdown products, cis-1,2 dichloroethylene (cDCE), and VC. Calcium fluoride, which typically contains traces of uranium, was stored here. Excavation of contaminated soil took place in 1996 (RTI, 2006). A corrective action plan for the groundwater proposed monitored natural attenuation (MNA) on the basis of a lack of downgradient receptors, sampling results, and model calculations (RTI, 1999a). Fluoride and uranium are included in the MNA assessment. Concentrations were stable or decreasing for TCE, cDCE, VC, uranium, and fluoride as of 2005 (RTI, 2006).

The other monitored locations are in the Eastern Site Sector (Figure 2-1). The Waste Treatment Area has nitrate impacts in the surficial and Peedee aquifers (RTI, 1999b). The facility is no longer used for storing nitrate-containing liquids. Monitoring has not indicated impact from fluoride or uranium. MNA is taking place, and the nitrate plume is stable in extent.

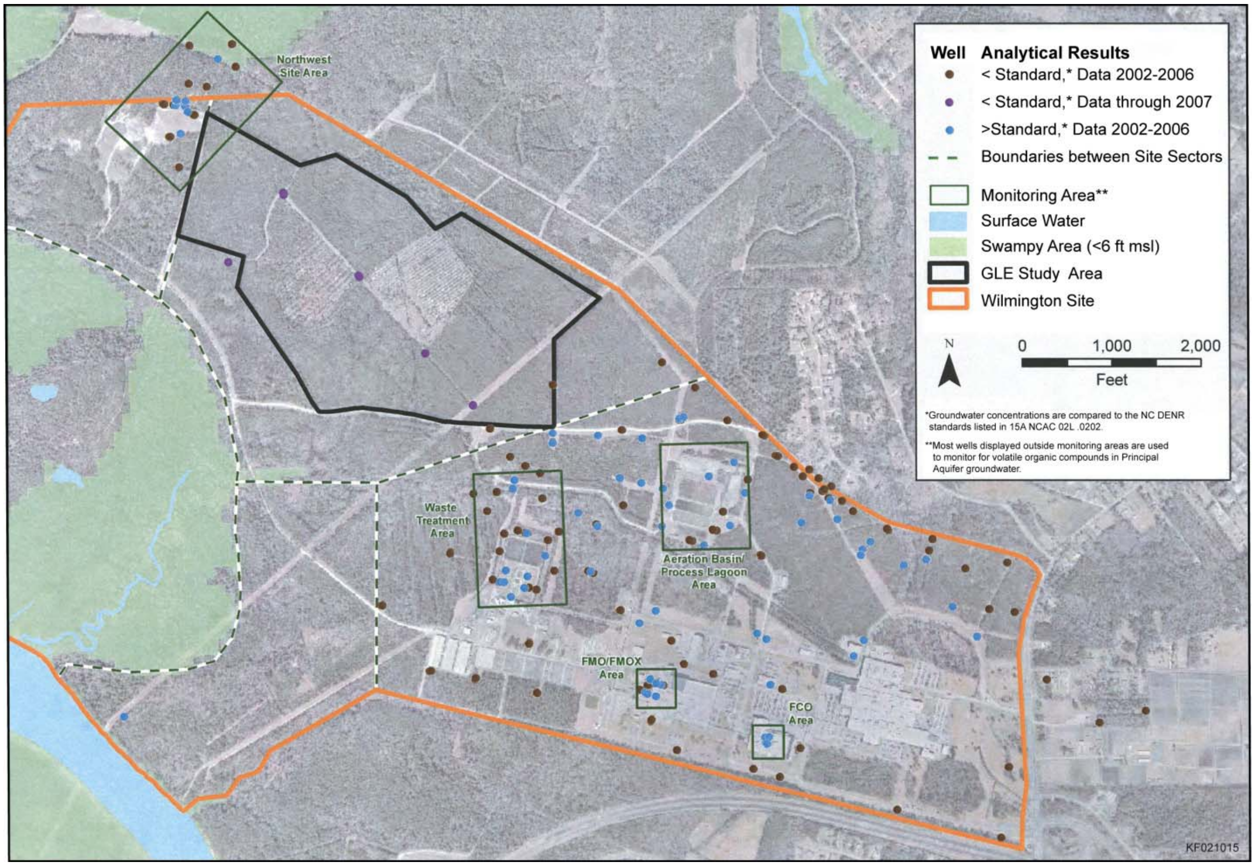

Figure 3-9 Groundwater Monitoring at the Wilmington Site (Modified from GLE, 2008)

The FCO Cleanroom Area is monitored to address a release of acid process solutions. A breach in an acid tank containment was identified and repaired in September 1996 (RTI, 1998b). Shallow wells were installed and monitored from January to May 1997, and, following a dry period, monitoring continued in January 1998. Excavation and offsite disposal of 72 cubic feet of soil took place in 1999 (GLE, 2009b). The affected area is beneath the active FCO building, and monitoring is focused on pH, fluoride, nitrate, and five indicator metals (chromium, zirconium, tin, nickel, and copper).

The Aeration Basin/Process Lagoon Area is an active treatment facility for process wastewater. Shallow groundwater in this area has occasionally shown shallow inorganic and radiological impacts. GNF-A performs groundwater monitoring in this area as a condition of NRC Materials License SNM-1097 (GLE, 2008).

The FMO/FMOX Facility Area has been affected by a 1991 release of process liquid. Well installation and groundwater sampling took place immediately, and the fluoride and nitrate values were above the standard in all wells (NCDEHNR, 1991b). Uranium was also detected, with a maximum of 387 parts per million. Soil excavation took place, and a sump system (the Horizontal Collection System) was installed to remove groundwater from the shallow surficial aquifer. Another sump (SD-1SW) was installed in a former storm drain to collect shallow groundwater. Groundwater monitoring has taken place since 1992 in the shallow surficial aquifer, deep surficial aquifer, and Peedee sand aquifer. Exceedances have included fluoride, nitrate, and uranium in the upper surficial aquifer beyond the perimeter of the FMOX building (RTI, 1998a).

In 1991, the State issued an NOV regarding TCE and other organic compounds present in site water wells at levels above the standard (NCDEHNR, 1991a). The wells included five process-water extraction wells and nine monitoring wells. In the NOV, the North Carolina Department of Environment, Health, and Natural Resources (NCDEHNR) required determination and elimination of the source of contamination, assessment of the extent of contamination, and submission of a remedial action plan. In 2009, the State transferred the GE site to its Inactive Hazardous Waste Sites Priority List, a list of sites where uncontrolled disposal, spills, or releases of hazardous substances have been identified. Listed sites are required to take action to control the contaminated discharge and mitigate hazards. Many other monitoring wells are located in or near the eastern site sector and are used to monitor VOC concentrations from various historic releases of solvents (RTI, 1992; RTI, 1994; RTI, 1996). VOCs across the entire Wilmington Site are addressed in comprehensive annual reports updating the ongoing site investigation (e.g., RTI, 2008). In general, the concentrations of VOCs have been stable or decreasing; this is attributed to natural attenuation (RTI, 2008).

3.8 Ecological Resources

This section describes the terrestrial, wetland, and aquatic ecological resources in the area of the proposed GLE Facility, with emphasis on the components that could be affected by the construction and operation of the facility, ancillary facilities, and the onsite access road to the facility. Particular attention is given to species protected by the Federal government under the *Endangered Species Act* (ESA), as well as species and habitats of special concern listed by the State of North Carolina. Unless otherwise cited, the information presented in this section has been adapted from the GLE Environmental Report (GLE, 2008), with additional information supplied by GLE (GLE, 2009b; GLE, 2009c). To the extent practicable, the information was verified independently by the NRC staff through a review of references provided by GLE; a site visit to observe habitats at the Wilmington Site; discussions with GLE and their consultants; and use of geographic information tools. Ecological field surveys were conducted during six days in July 2007, four days in September 2007, and from September 1 through September 30, 2009, to identify biotic communities and characterize the natural and anthropogenic communities on the Wilmington Site. The emphasis of the field surveys was on the area that encompasses the proposed GLE Facility and the area for the revised entrance and roadway (GLE, 2008, 2009c).

3.8.1 Vegetation

Ecoregions are designed to provide a spatial framework for the research, assessment, management, and monitoring of ecosystems and ecosystem components (EPA, 2007a). An ecoregion is an area having a general similarity in ecosystems and is characterized by the spatial patterning and composition of biotic and abiotic features, including vegetation, wildlife, geology, physiography (patterns of terrain or land forms), climate, soils, land use, and hydrology, such that within an ecoregion, there is a similarity in the type, quality, and quantity of environmental resources present (EPA, 2007b). The Wilmington Site is located within the Middle Atlantic Coastal Plain Level III Ecoregion. This ecoregion is characterized by low-level flat plains with many swamps, marshes, and estuaries. The ecoregion's forest cover was once dominated by longleaf pine (*Pinus palustris*), but is now dominated by loblolly pine (*P. taeda*) and some shortleaf pine (*P. echinata*), with patches of oaks (*Quercus* spp.), sweetgum (*Liquidamber styraciflora*), and cypress (*Taxodium* spp.) near major streams. Pine plantations are common, and there are some areas of cropland.

The Wilmington Site is located within the border of two Level IV ecoregions.[8] The eastern portion of the Wilmington Site, including most of the existing facilities, is located within the Carolina Flatwoods Level IV Ecoregion; while the western portion of the site, including the proposed GLE Facility, is located within the Mid-Atlantic Floodplains and Low Terraces Level IV Ecoregion (Figure 3-10). Table 3-11 summarizes the vegetation and the land use and land cover within these Level IV ecoregions.

Three general vegetation cover types dominate the Wilmington Site: (1) upland forested vegetation (mostly in sandy, well-drained to excessively well-drained soils that are never or rarely flooded for any significant period of time); (2) wetland vegetation (mostly in soils saturated at all times or for a significantly long period of time throughout the year); and (3) anthropogenic vegetation (occurring under various hydrologic regimes and soils with the type of vegetation cover primarily resulting from human occupation or intervention) (DuMond, 1984). The anthropogenic vegetation cover type occurs within the operations area, utility corridors, along roadsides, and also includes pine plantations.

Plant community mapping of the Wilmington Site was conducted on the basis of true-color orthophotography and field surveys conducted in July and September 2007 (GLE, 2008). Thirteen plant communities, including eight natural and five anthropogenically influenced communities, were identified on the Wilmington Site (Figure 3-11). Table 3-12 summarizes information on these communities. The proposed GLE Facility would be located within areas now occupied by pine forest, pine-hardwood forest, and pine plantation communities. These communities are described in more detail below. The ages of these pine-dominated plant communities are shown in Figure 3-12.

3.8.1.1 Pine Forest

Pine forest communities primarily occur within the north-central portion of the Wilmington Site, and within the upland area surrounded by the old oxbow of the Northeast Cape Fear River in the western portion of the site. Several small stands of pine forest are also scattered throughout the rest of the Wilmington Site. Most pine forest stands on the Wilmington Site, including those within and immediately adjacent to the proposed GLE Facility site, vary from less than 20 years old to 20 to 29 years old (Figure 3-12). A total of 123 hectares (304 acres) of pine forest occur on the Wilmington Site. Canopy species include loblolly, longleaf, and/or pond pines (*Pinus serotina*). Subcanopy species can include sweetgum, white oak (*Quercus alba*), southern red oak (*Q. falcata*), water oak (*Q. nigra*), red maple (*Acer rubrum*), loblolly bay (*Gordonia lasianthus*), flowering dogwood (*Cornus florida*), and tulip tree (*Liriodendron tulipifera*). Shrub species include coast pepper-bush (*Clethra alnifolia*), red bay (*Persea borbonia*), sweetbay magnolia (*Magnolia virginiana*), southern bayberry (*Morella cerifera*), sassafras (*Sassafras albidum*), horsesugar (*Symplocos tinctoria*), farkleberry (*Vaccinium arboreum*), and southern

[8] Level IV ecoregions are further subdivisions of a Level III ecoregion. Level IV ecoregions are based on physiography, geology, soils, climate, potential natural vegetation, land use, and land cover differences within a Level III ecoregion (Omernik et al., 2000).

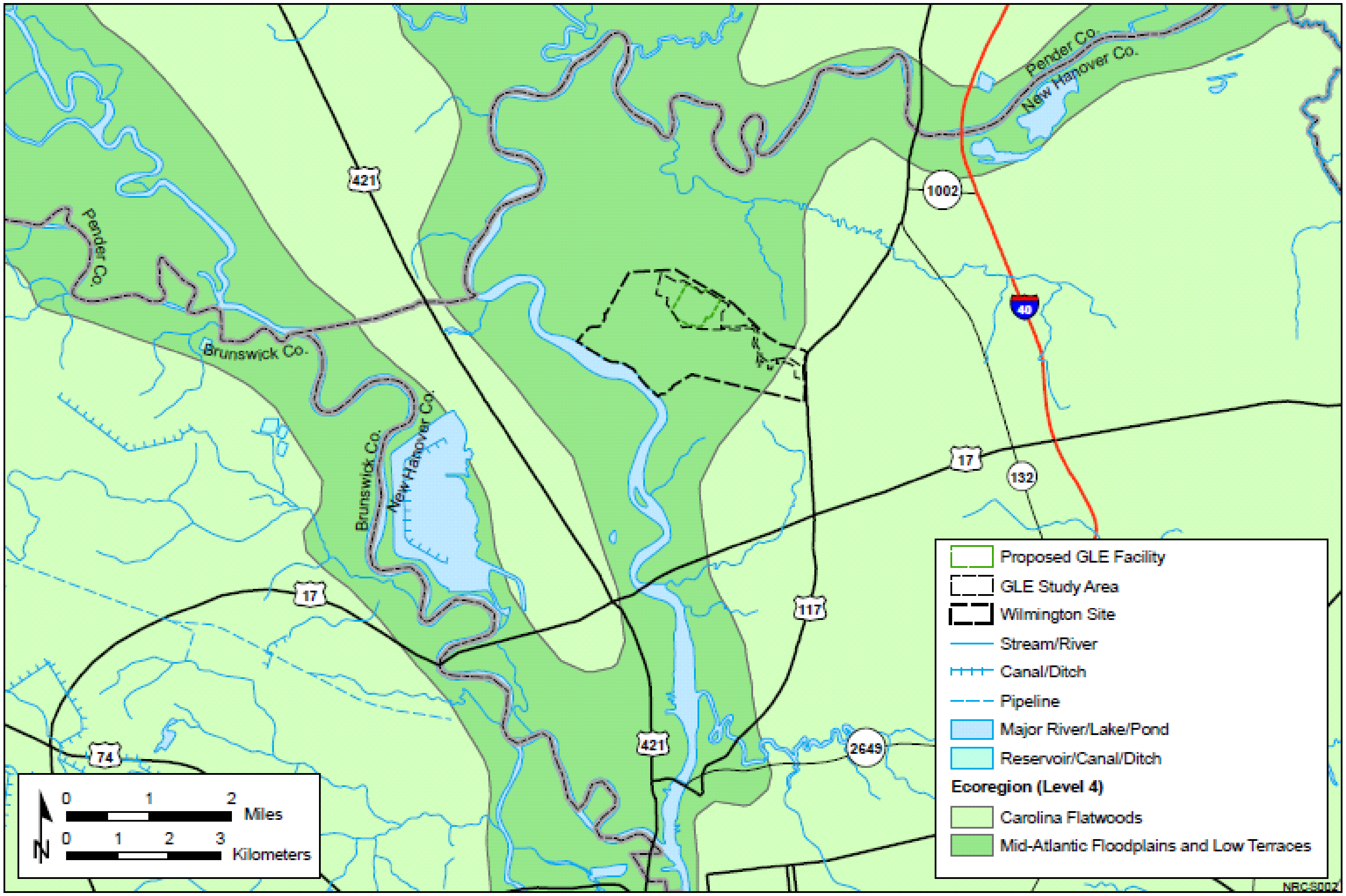

Figure 3-10 Level IV Ecoregions Located within the Wilmington Site Area (Griffith et al., 2002)

Table 3-11 Level IV Ecoregions within the Wilmington Site

Level IV Ecoregion	Potential Natural Vegetation	Land Use and Land Cover
Carolina Flatwoods	Longleaf pine (*Pinus palustris*) and Carolina wiregrass (*Aristida stricta*); xeric sandhill scrub (longleaf pine, turkey oak [*Quercus laevis*], and Carolina wiregrass); pond pine (*P. serotina*) forest and woodland; some oak-hickory and mixed forest.	Pine plantations, mixed forest; forested wetlands; cropland (cotton, corn, soybeans, wheat, peanuts, tobacco, and blueberries); production of hogs, broiler chickens, and turkeys; some public lands; and wildlife habitat.
Mid-Atlantic Floodplains and Low Terraces	Southern floodplain forests, including cypress-gum swamps (water-tupelo [*Nyssa aquatica*], swamp tupelo [*N. biflora*], bald cypress [*Taxodium distichum*], and pond cypress [*T. ascendens*]) and bottomland hardwood forests (bottomland oaks, red maple [*Acer rubrum*], sweetgum [*Liquidambar styraciflua*], green ash [*Fraxinus pensylvanica*], and bitternut hickory [*Carya cordiformis*]).	Forested wetlands, deciduous forests, and some croplands on larger terraces.

Source: Griffith et al., 2002.

highbush blueberry (*V. formosum*). A number of vines also occur within the pine forest. These include Virginia creeper (*Parthenocissus quinquefolia*) and eastern poison-ivy (*Toxicodendron radicans*). The herbaceous layer includes slender spikegrass (*Chasmanthium laxum*), ebony spleenwort (*Asplenium platyneuron*), cinnamon fern (*Osmunda cinnamomea*), bracken fern (*Pteridium aquilinum*), and narrowleaf silk grass (*Pityopsis graminifolia* var. *graminifolia*).

3.8.1.2 Pine-Hardwood Forest

The pine-hardwood forest community is similar to the pine forest community except that hardwood trees tend to co-dominate. Pine-hardwood forests occur in the north-central and south-central portions of the Wilmington Site. Scattered stands also occur in the eastern portion of the site. The pine-hardwood forest stands located within and immediately adjacent to the proposed GLE Facility site are approximately 20 to 29 years of age (Figure 3-12). The age of the other pine-hardwood forest stands on the Wilmington Site (e.g., in the south-central portion of the site) are not known (GLE, 2009b). A total of 93 hectares (231 acres) of pine-hardwood forests occur on the Wilmington Site. Sweet-gum, tulip tree, water oak, post oak (*Quercus stellata*), white oak, red maple, blackgum (*Nyssa sylvatica*), and southern red oak are gradually replacing many of the pines within the forest canopy. Vine and herbaceous species are similar to those found in the pine forest communities.

3.8.1.3 Pine Plantation

Pine plantations on the Wilmington Site consist of loblolly or longleaf pines that are planted in rows. These plant communities are maintained by manual thinning and prescribed burns to clear understory plants. The 126 hectares (312 acres) of pine plantations occur in large stands

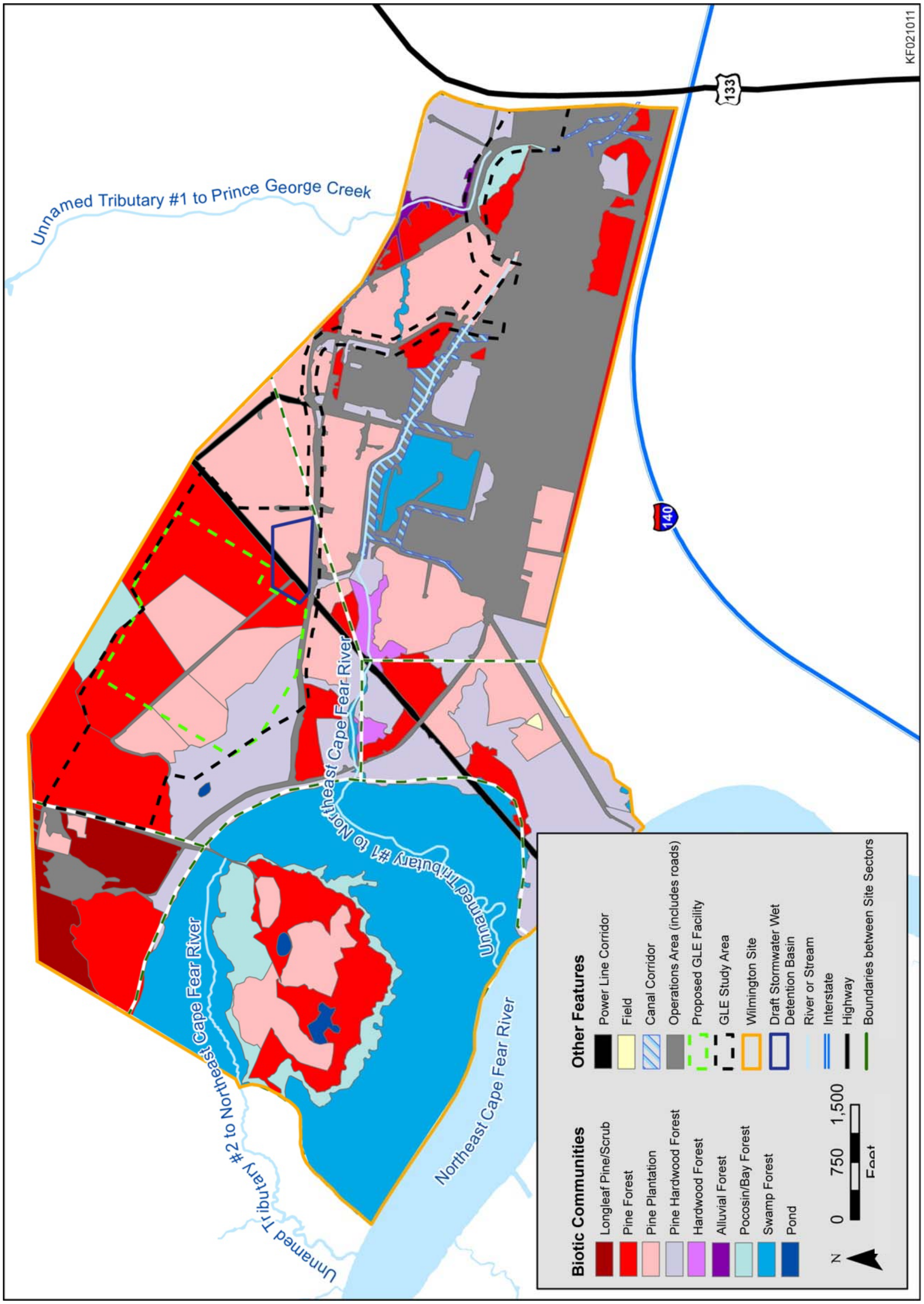

Figure 3-11 Plant Communities Located within the Wilmington Site (GLE, 2008)

Table 3-12 Plant Communities That Occur on the Wilmington Site

Plant Community	Acres[a] (% of Site)	Characteristic Plant Species
Natural Communities		
Longleaf pine/scrub forest	39 (2.4)	Longleaf pine (*Pinus palustris*)
Pine forest	304 (18.7)	Loblolly pine (*P. taeda*), longleaf pine, and pond pine (*P. serotina*)
Pine-hardwood forest	231 (14.3)	Pines: loblolly pine, longleaf pine, and pond pine Hardwoods: sweetgum (*Liquidambar styraciflua*), tulip tree (*Liriodendron tulipifera*), water oak (*Quercus nigra*), post oak (*Q. stellata*), white oak (*Q. alba*), red maple (*Acer rubrum*), blackgum (*Nyssa sylvatica*), and southern red oak (*Q. falcata*)
Hardwood forest	10 (0.6)	Sweetgum, water oak (*Q. nigra*), and southern red oak
Alluvial forest	4 (0.2)	Red maple and sweetgum
Pocosin/bay forest	52 (3.2)	Loblolly pine and scattered pond pine intermixed with red bay (*Persea borbonia*), loblolly bay (*Gordonia lasianthus*), blackgum sand, pond cypress (*Taxodium ascendens*), and laurel oak (*Q. hemisphaerica*), with an isolated stand of Atlantic white cedar (*Chamaecyparis thyoides*)
Swamp forest	325 (20.0)	Loblolly pine, tulip tree, blackgum, pumpkin ash (*Fraxinus profunda*), red maple, sweetgum, and pond cypress
Ephemeral pond	4 (0.3)	New Jersey blueberry (*Vaccinium caesariense*), swamp titi (*Cyrilla racemiflora*), red bay, red maple, and blackgum among other species
Anthropogenically Influenced Communities		
Pine plantation	312 (19.2)	Loblolly pine and longleaf pine
Field	2 (0.1)	Bahia grass (*Paspalum notatum*)
Canal corridor	19 (1.2)	Various woody and herbaceous species, including Bahia grass, prickly Florida blackberry (*Rubus argutus*), Chinese bushclover (*Lespedeza cuneata*), northern dewberry (*R. flagellaris*), winged sumac (*Rhus copallinum*), broom-sedge (*Andropogon virginicus*), small dog-fennel thoroughwort (*Eupatorium capillifolium*), black willow (*Salix nigra*), Carolina willow (*S. caroliniana*), broadleaf cattail (*Typha latifolia*), common reed (*Phragmites australis*), and loblolly pine
Power line corridor	16 (1.0)	Primarily shrub and herbaceous species that occur in adjacent plant communities

Table 3-12 Plant Communities That Occur on the Wilmington Site (Cont.)

Plant Community	Acres[a] (% of Site)	Characteristic Plant Species
Operations area	303 (18.6)	Mowed areas of Bahia grass and centipede grass (*Eremochloa ophiuroides*) with ornamental and planted trees and shrubs
Total:	1621 (100.0)	

[a] To convert acres to hectares, multiply by 0.4047.
Source: GLE, 2008.

throughout the Wilmington Site. Most pine plantation stands on the Wilmington Site, including those within and immediately adjacent to the proposed GLE Facility site, vary from less than 20 years old to 20 to 29 years old (Figure 3-12). Sweetgum, red maple, water oak, red bay, loblolly bay, and sweetbay magnolia can also be present in the early stages of development of the pine plantation stands. These species become components of the understory as the plantation ages. Common shrub species include inkberry (*Ilex glabra*), American French mulberry (*Callicarpa americana*), fetterbush (*Leucothoe racemosa*), southern bayberry, and switch cane (*Arundinaria gigantea* ssp. *tecta*). Herbaceous species include broomsedge (*Andropogon virginicus*), American burnweed (*Erechtites hieracifolia* var. *hieracifolia*), small dog-fennel thoroughwort (*Eupatorium capillifolium*), flat-top fragrant goldenrod (*Euthamia graminifolia* var. *graminifolia*), and eastern milkpea (*Galactia regularis*).

3.8.2 Wetlands

Wetlands on the Wilmington Site are extremely varied and include a number of wetland types such as marshes, pocosins, and forested wetlands (swamps). Wetland areas are typically inundated or have saturated soils for a portion of the growing season and support plant communities that are adapted to saturated soil conditions. Streambeds and mudflats are among the wetland areas that may not be vegetated (Cowardin et al., 1979). While surface flows provide the water source for some wetlands, others, such as springs and seeps, are supported by groundwater discharge. Wetlands are often associated with perennial water sources, such as springs, perennial segments of streams, or lakes and ponds. However, some wetlands have seasonal or intermittent sources of water.

> ***Wetlands***
>
> *Wetlands are areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation adapted for life in saturated soil conditions (EPA, 2009f).*

Wetlands can perform one or more of the following functions: groundwater recharge and discharge, flood storage and desynchronization, shoreline anchoring and dissipation of erosive forces, sediment trapping, nutrient retention and removal, food chain support, and fish and wildlife habitat (Whigham and Brinson, 1990).

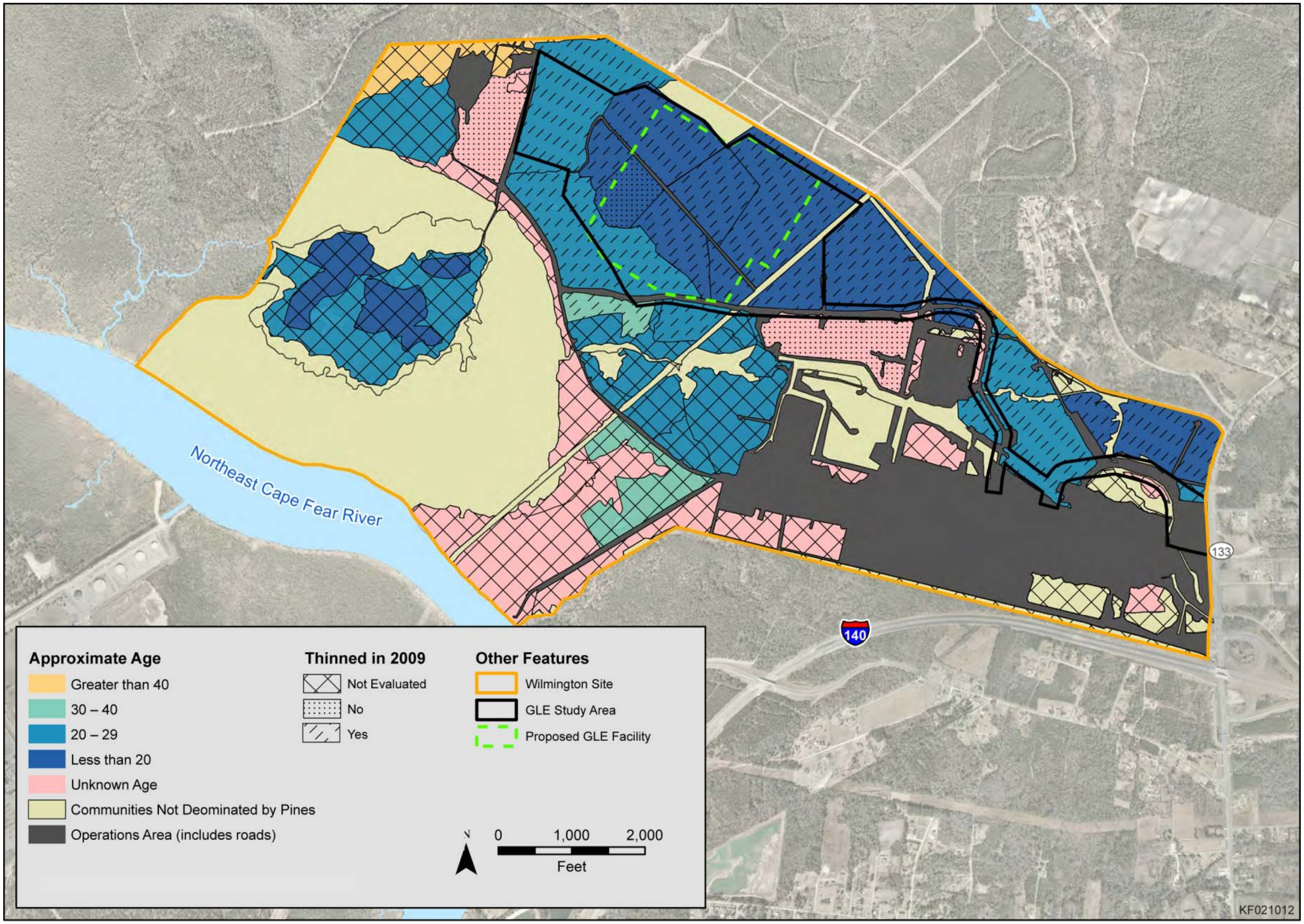

Figure 3-12 Age and Management of Pine-Dominated Plant Communities on the Wilmington Site (GLE, 2009b)

Figure 3-13 shows the wetlands that occur on the Wilmington Site; Table 3-13 provides the acreages and descriptions of these wetlands. Nearly 308 hectares (760 acres) of wetlands occur within the Wilmington Site. More than 121 hectares (298 acres) of the forested wetlands within the North-Central and Eastern Site Sectors (where the proposed GLE Facility, ancillary facilities, and north access road would be located) were drained prior to 1963 (GLE, 2008). This area (shown as "PFO4Bd" in Figure 3-13) no longer meets the conditions necessary to be classified for regulatory purposes as a wetland (i.e., hydric soils, hydrophytic vegetation, and hydrological conditions that provide a temporary to permanent source of water to cause soil saturation) (EPA, 2009d).

Several jusridictional and isolated wetlands (wetlands with and without connections to surface waters, respectively) occur within the corridor for the proposed access road to the proposed GLE Facility (Figure 3-14). These would include jurisdictional wetlands WD, WF, and WG and isolated wetland WA. Wetland WD is a forested wetland that abuts Unnamed Tributary #1 to Prince George Creek. Only 0.0008 hectare (0.002 acre) of wetland WD occurs within the proposed access road corridor (GLE, 2009c). Wetland WF is an herbaceous wetland located in the upstream reach of Unnamed Tributary #1 to Prince George Creek. About 0.012 hectare (0.03 acre) of this wetland occurs within the access road corridor (GLE, 2009c). Wetland WG is a forested wetland that occurs along Jurisdictional Channel #2. About 0.08 hectare (0.02 acre) of this wetland occurs within the access road corridor (GLE, 2009c). Isolated wetland WA is a forested wetland that is contained entirely within the proposed access road corridor. The area of the wetland is 0.02 hectare (0.06 acre) (GLE, 2008).

3.8.3 Environmentally Sensitive Areas

Environmentally sensitive areas[9] include conservation areas or other areas of ecological importance. Areas of outstanding natural significance in New Hanover County have been inventoried by LeBlond and Grant (2003). These are areas within the county that contain the best examples of natural habitats and/or are locations where rare biota or rare natural communities occur.

The southwestern portion of the Wilmington Site, which does not include the proposed GLE Facility site, occurs within the Northeast Cape Fear River Floodplain. The Northeast Cape Fear River Floodplain is considered to be a natural area of national significance. This means that the area is considered to contain examples of natural communities, rare plant or animal populations, or other significant ecological features that are among the highest quality or best examples of their kind in the nation (LeBlond and Grant, 2003). The Northeast Cape Fear River Floodplain natural area is located along the Northeast Cape Fear River from its confluence with Smith Creek in New Hanover County to its confluence with Holly Shelter Creek in Pender County. It encompasses 10,392 hectares (25,679 acres), 3572 hectares (8827 acres) of which

[9] While environmentally sensitive areas do not have an official definition, they can be defined basically as natural features such as habitats or rare species that may be protected by government regulation. Jennings and Reganold (1989) defined environmentally sensitive areas as landscape elements or places that are crucial to the long-term maintenance of biological diversity, soil, water, and other natural resources, especially as they relate to human health, safety, and welfare, both at a local and regional context.

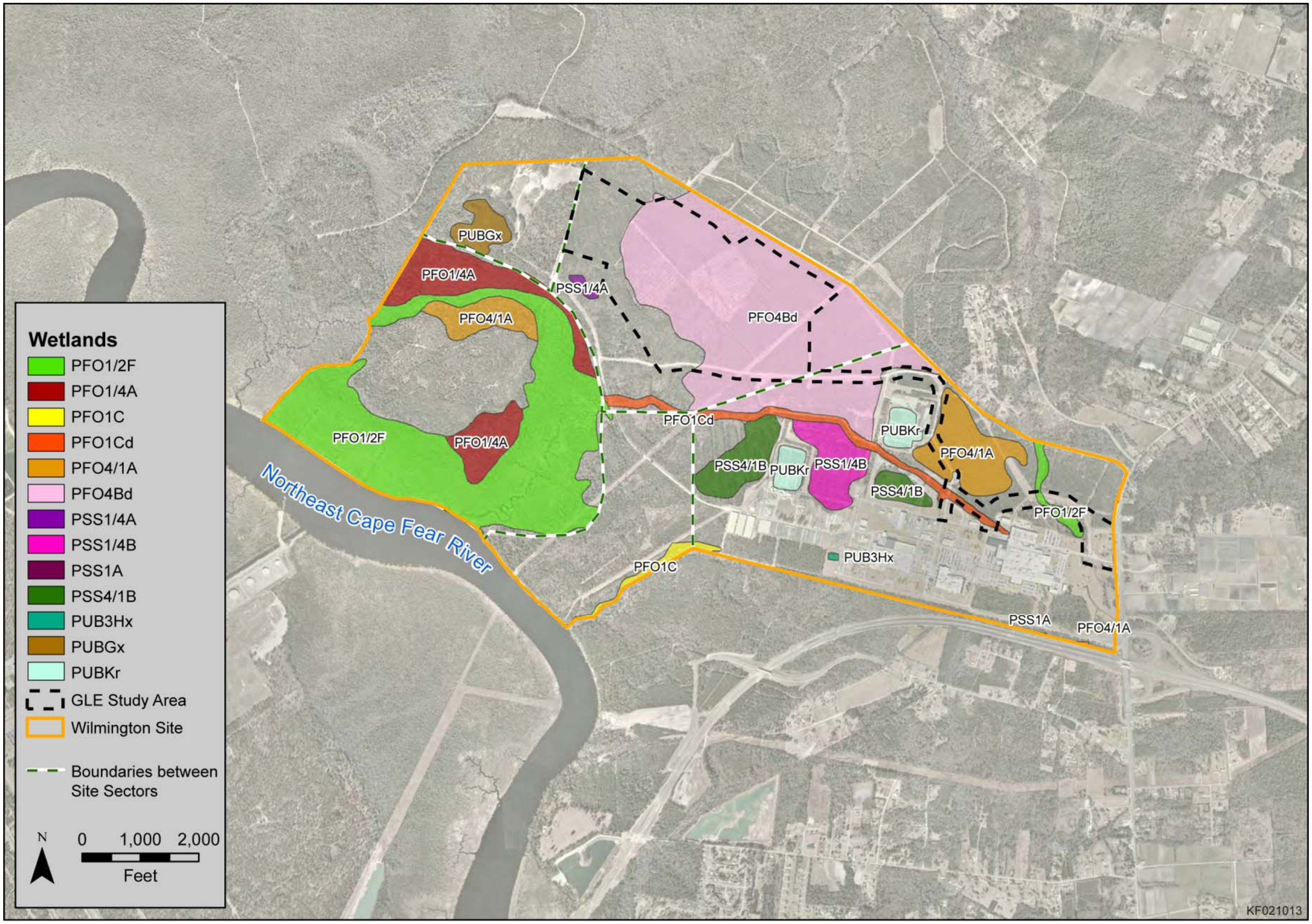

Figure 3-13 Wetlands Located within the Wilmington Site (GLE, 2008)

Table 3-13 Wetlands That Occur on the Wilmington Site

Wetland Type[a]	Area (acres)[b]	Wetland Characteristics
PFO1/2F	235.3	Palustrine, forested, broad-leaved deciduous/needle-leaved deciduous, semipermanently flooded
PFO1/4A	64.8	Palustrine, forested, broad-leaved deciduous/needle-leaved evergreen, temporarily flooded
PFO1C	7.4	Palustrine, forested, broad-leaved deciduous, seasonally flooded
PFO1Cd[c]	24.0	Palustrine, forested, broad-leaved deciduous, seasonally flooded, partially drained/ditched
PFO4/1A	61.4	Palustrine, forested, needle-leaved evergreen/broad-leaved deciduous, temporarily flooded
PFO4Bd[c]	274.4	Palustrine, forested, needle-leaved evergreen, saturated, partially drained/ditched
PSS1/4A	1.9	Palustrine, scrub-shrub, broad-leaved deciduous/needle-leaved evergreen, temporarily flooded
PSS1/4B	26.9	Palustrine, scrub-shrub, broad-leaved deciduous/needle-leaved evergreen, saturated
PSS1A	0.1	Palustrine, scrub-shrub, broad-leaved deciduous, temporarily flooded
PSS4/1B	32.9	Palustrine, scrub-shrub, needle-leaved evergreen/broad-leaved deciduous, saturated
PUB3Hx	0.5	Palustrine, unconsolidated bottom, mixohaline, permanently flooded, excavated
PUBGx[c]	13.3	Palustrine, unconsolidated bottom, intermittently flooded, excavated
PUBKr	15.4	Palustrine, unconsolidated bottom, artificially flooded, artificial substrate
Total:	758.3	

[a] Refer to Figure 3-13 for wetland locations.
[b] To convert acres to hectares, multiply by 0.4047.
[c] Limited wetland hydrology remains in the area.
Sources: GLE, 2008; FWS, 1990.

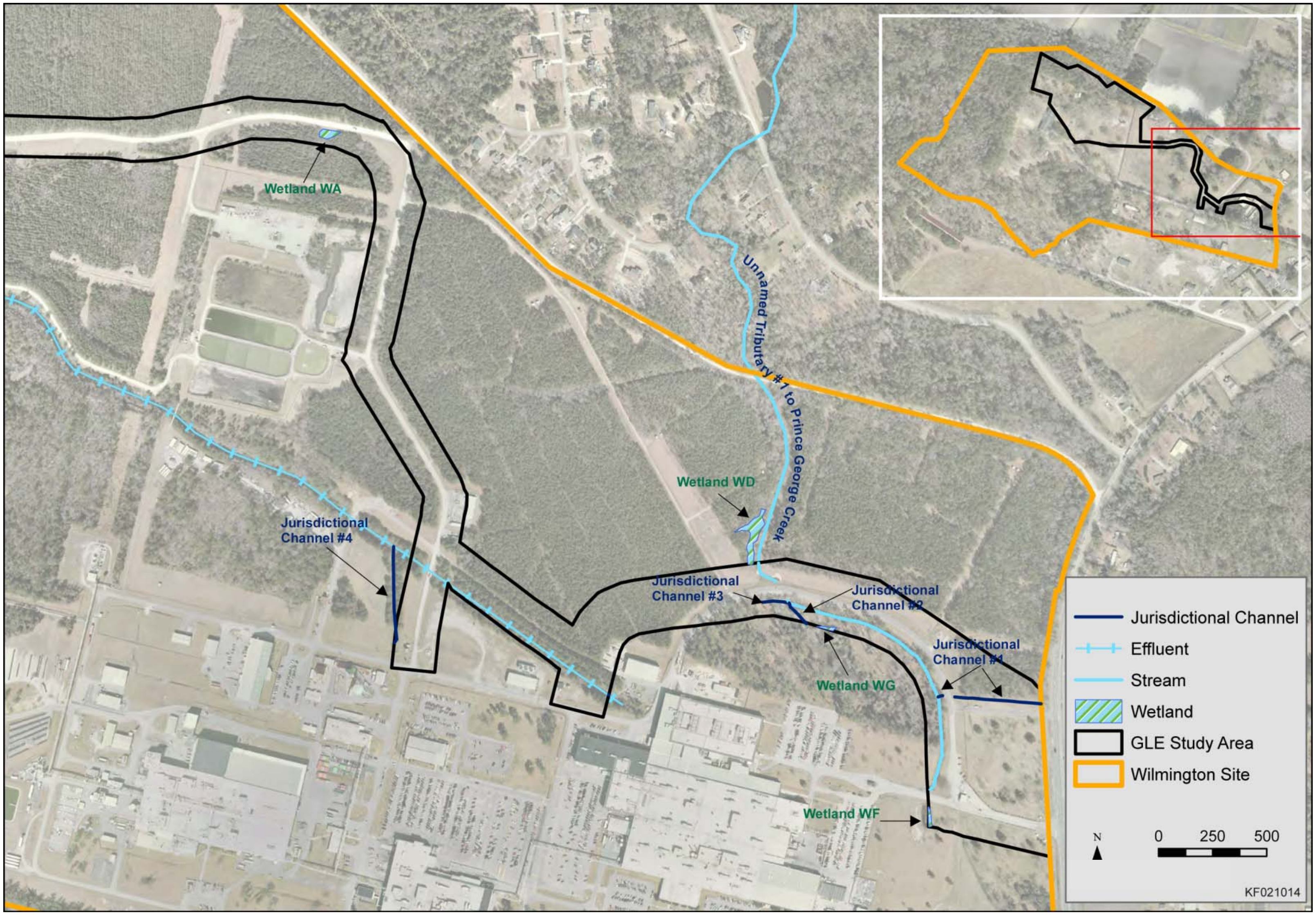

Figure 3-14 Wetlands Located within the Corridor for the Proposed Access Road to the Proposed GLE Facility (GLE, 2009c)

are within New Hanover County. It is one of the nation's best examples of a tidal cypress-gum swamp community (LeBlond and Grant, 2003).

Most of the Northeast Cape Fear River, including the reach along the southwestern portion of the Wilmington Site, is considered a primary nursery area for shellfish and fish (NCDMF, 2006). Primary nursery areas are located in the upper portions of creeks and bays and are usually shallow with soft muddy substrates and are surrounded by marshes and other wetlands. The low salinity and abundance of food items make these areas ideal for young fish and shellfish. Many commercial fishing activities (e.g., use of trawl nets, seine nets, dredges, or any mechanical means used to collect clams and oyster) are prohibited in primary nursery areas (NCDMF, 2009). Areas designated as primary nursery areas by the North Carolina Division of Marine Fisheries would also be considered to be essential fish habitat. Essential fish habitat are defined as those waters and substrate necessary for Federally managed marine and anadromous fish species and Federally managed shellfish species for spawning, breeding, feeding, or growth to maturity (*Magnuson-Stevens Fishery Conservation and Management Act*, 16 U.S.C. 1801 Section 3).

On a more localized scale, environmentally sensitive area features can include floodplains, wetlands, unstable soils, and steep slopes. The 100-year floodplain within the Wilmington Site occurs along the Northeast Cape Fear River, while the 500-year floodplain occurs within the forested wetland areas in the western portion of the Wilmington Site (GLE, 2008). Wetlands on the Wilmington Site are discussed in Section 3.8.2. About 30 hectares (74 acres) of unstable soils occur on the Wilmington Site, all at or within the vicinity of four former borrow pits. One of the areas of unstable soils occurs in the northwestern portion of the Wilmington Site, while the other three areas are located within the south–central and southern portion of the site (GLE, 2008). Gradients greater than 10 percent are considered steep slopes. Most areas of steep slopes on the Wilmington Site are contained along the remnant oxbow of the Northeast Cape Fear River and along the banks of existing stream banks and the effluent channel. Some steep slopes also occur in the area of the former borrow pits.

Except for drained forested wetlands, none of these sensitive area features occur within the proposed GLE Facility area. Small wetland areas that occur within the corridor for the access road were discussed in Section 3.8.2.

3.8.4 Wildlife

Although the Wilmington Site has been subjected to varying degrees of environmental disturbances from silviculture, agriculture, industrial operations, residential developments, and roads, the habitats within the Wilmington Site and surrounding areas support a relatively high diversity of wildlife species. Nearly 370 species of mammals, birds, reptiles, and amphibians potentially occur on the Wilmington Site. Wildlife species that could occur within the proposed GLE Facility area are primarily those that inhabit forested habitats.

About 40 mammal species could occur in the area. These include white-tailed deer (*Odocoileus virginianus*), American black bear (*Ursus americanus*), bobcat (*Lynx rufus*), gray fox (*Urocyon cinereoargenteus*), raccoon (*Procyon lotor*), eastern cottontail (*Sylvilagus floridanus*), marsh rabbit (*S. palustris*), eastern gray squirrel (*Sciurus carolinensis*), and striped skunk (*Mephitis mephitis*). In addition, a number of bat, shrew, and small rodent (e.g., mice and voles) species are likely to occur in the proposed GLE Facility area. These would include the short-tailed shrew (*Blarina brevicauda*), eastern red bat (*Lasiurus borealis*), hoary bat (*L. cinereus*), golden mouse (*Ochrotomys nuttallii*), and woodland vole (*Microtus pinetorum*).

More than 100 bird species could occur within the proposed GLE Facility area. Widespread and common species include wild turkey (*Meleagris gallopavo*), northern bobwhite (*Colinus virginianus*), mourning dove (*Zenaida macroura*), red-eyed vireo (Vireo olivaceus), northern cardinal (*Cardinalis cardinalis*), tufted titmouse (*Baeolophus bicolor*), eastern towhee (*Pipilo erythrophthalmus*), wood thrush (*Hylocichla mustelina*), summer tanager (*Piranga rubra*), blue-gray gnatcatcher (*Polioptila caerulea*), hooded warbler (*Wilsonia citrina*), and Carolina wren (*Thryothorus ludovicianus*). No sites on or near the Wilmington Site are recognized as Important Bird Areas (National Audubon Society, 2009a).[10]

Nearly 40 reptile species could occur within the habitat types found in the proposed GLE Facility area. Included among these would be the eastern box turtle (*Terrapene carolina*), green anole (*Anolis carolinensis*), ground skink (*Scincella lateralis*), six-lined racerunner (*Aspidoscelis sexlineata*), eastern kingsnake (*Lampropeltis getula getula*), racer (*Coluber constrictor*), and red-bellied snake (*Storeria occipitomaculata*). Several species of rattlesnakes (*Crotalus* spp.) and the copperhead (*Agkistrodon contortrix*) could also occur within the upland forested habitats of the proposed GLE Facility area. Fewer than 10 amphibian species would be expected to occur within the proposed GLE Facility area. These could include the redback salamander (*Plethodon cinereus*), Fowler's toad (*Bufo fowleri*), southern toad (*B. terrestris*), and several species of treefrogs (*Hyla* spp.). These reptile and amphibian species could occur within suitable habitat types throughout the Wilmington Site.

The developed portions (operations area) of the Wilmington Site include buildings, parking lots, infrastructure, and landscaped areas. Nevertheless, a number of wildlife species occur in these areas. However, the densities of most wildlife species are higher in undeveloped areas than in developed areas. Exceptions include species such as house sparrow (*Passer domesticus*), house finch (*Carpodacus mexicanus*), rock pigeon (*Columba livia*), house mouse (*Mus musculus*), and Norway rat (*Rattus norvegicus*). Other common bird species within the operations area include the killdeer (*Charadrius vociferus*), American crow (*Corvus brachyrhynchos*), northern mockingbird (*Mimus polyglottos*), American robin (*Turdus migratorius*), and European starling (*Sturnus vulgaris*). Other mammal species include Virginia opossum (*Didelphis virginiana*), eastern cottontail, striped skunk, and raccoon. Generally, it would be expected that wildlife use of the operational areas would primarily be for foraging, while the least frequent type of use would be for reproductive activities.

3.8.5 Aquatic Biota

The Northeast Cape Fear River (at River Mile 6.1 to 6.7 [river kilometer 9.8 to 10.7]) borders the southwestern portion of the Wilmington Site. Aquatic habitats within the Wilmington Site include

[10] Important Bird Areas are sites that provide essential habitat for one or more species of birds that are species of conservation concern, species with restricted ranges, species that are vulnerable because their populations are concentrated in one general habitat type or biome, or species (or groups of similar species) that are vulnerable because they occur at high densities because of congregatory behavior (National Audubon Society, 2009b).

Unnamed Tributary #1 to the Northeast Cape Fear River, an industrial effluent channel that flows into Unnamed Tributary #1, Unnamed Tributary #2 to the Northeast Cape Fear River, several other smaller tributaries to the Northeast Cape Fear River, and an Unnamed Tributary #1 to Prince George Creek. An Unnamed Tributary #2 to Prince George Creek occurs just north of the Wilmington Site and receives drainage from the northern portion of the site. The lower portions of the tributaries to the Northeast Cape Fear River, as well as the Northeast Cape Fear River in the area of the Wilmington Site, are tidally influenced. Water quality characteristics of these water bodies are discussed in Section 3.7.1.

In addition to the onsite streams, several impoundments and ponds on the Wilmington Site provide aquatic habitat. These include two active final process lagoons and their associated aeration basin (which are part of the Wilmington Site's treatment system for process wastewater), four inactive wastewater treatment facility lagoons, one firefighting water supply pond, two stormwater wet detention basins, and three ephemeral woodland ponds. These impoundments and ponds would provide habitat for aquatic invertebrates, waterfowl and shorebirds, and amphibians. No aquatic habitats occur within the area proposed for the GLE Facility. More detailed information on the surface waters of the Wilmington Site were presented in Section 3.7.

Nearly 110 species of freshwater, marine, and migratory fish are reported from the Northeast Cape Fear River. About 40 fish species plus sunfish hybrids have been collected from the Northeast Cape Fear River near the Wilmington Site (NCWRC, 2007). About 50 of the species from the Northeast Cape Fear River are considered freshwater species. These include gars, suckers, minnows, catfish, sunfish, bass, crappie, perch, and darters. The anadromous species (species that migrate to freshwaters to spawn) include the blueback herring (*Alosa aestivalis*), hickory shad (*A. mediocris*), alewife (*A. pseudoharengus*), American shad (*A. sapidissima*), striped bass (*Morone saxatilis*), and shortnose sturgeon (*Acipenser brevirostrum*); the American eel (*Anguilla rostrata*) is the only catadromous species (species that migrate to marine waters to spawn). The Federally endangered shortnose sturgeon is discussed in more detail in Section 3.8.6.1. The blueback herring spawns in Prince George Creek, while the American shad and striped bass use the creek as nursery grounds. Atlantic sturgeon (*Acipenser oxyrhynchus*) and American eel are also present in the area of Prince George Creek (NOAA, 2002).

During periods of drought and elevated salinities, the fish community in the Northeast Cape Fear River near the Wilmington Site could shift to more estuarine species (NCWRC, 2007). About 50 marine and estuarine fish species ascend into the Northeast Cape Fear River. These include the bay anchovy (*Anchoa mitchilli*), gobies, striped mullet (*Mugil cephalus*), and pipefish. Marine and estuarine gamefish include the tarpon (*Megalops atlanticus*), crevalle jack (*Caranx hippos*), common snook (*Centropomus undecimalis*), spotted seatrout (*Cynoscion nebulosus*), black drum (*Pogonias cromis*), and red drum (*Sciaenops ocellatus*).

Commercial and recreational fishing occur in the Northeast Cape Fear River, although most commercial fishing occurs downstream of the Wilmington Site (e.g., in the Cape Fear River Estuary). Commercial fishing for American shad and striped bass occurs in the Northeast Cape Fear River near the Wilmington Site, while recreational fishing occurs for these species plus blueback herring, hickory shad, alewife, largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), redear sunfish (*L. microlophus*), redbreast sunfish (*L. auritus*), pumpkinseed (*L. gibbosus*), warmouth (*L. gulosus*), black crappie (*Pomoxis nigromaculatus*), channel catfish (*Ictalurus punctatus*), blue catfish (*I. furcatus*), chain pickerel (*Esox niger*), redfin pickerel (*E. americanus*), and yellow perch (*Perca flavescens*) (Ashley and Rachels, 2005). Sport fishing within the Cape Fear River Basin also occurs for the introduced spotted bass (*M. punctulatus*) and flathead catfish (*Pylodictis olivaris*) (Ashley and Rachels, 2005).

No major studies of fish species within the Wilmington Site have been conducted. During the onsite biological surveys for the Environmental Report, the eastern mosquitofish (*Gambusia halbrooki*) and a blue crab (*Callinectes sapidus*) were observed in the Unnamed Tributary #1 to the Northeast Cape Fear River (GLE, 2008). In addition to being an important nursery area for a number of fish species, the Northeast Cape Fear River is also used as a nursery area by shrimp, blue crabs, and other shellfish.

The Federally endangered West Indian manatee (*Trichechus manatus*), a marine mammal, may also occur within the Northeast Cape Fear River and the lower portions of its tributaries near the Wilmington Site. Information on the West Indian manatee is presented in Section 3.8.6.1.

The major factor limiting fisheries resources within the Cape Fear River Basin is the impedance to fish migrations by locks and dams. Additional factors include degraded water quality, sedimentation and turbidity, and loss of wetlands and riparian areas resulting from agricultural and forestry operations, increased development, unstable shorelines, and road construction (Ashley and Rachels, 2005).

3.8.6 Threatened, Endangered, and Other Special Status Species

Because of the diversity of species, habitats, and other influences (e.g., convergence of inland sandhill habitat with coastal areas), a large number of rare plants and animals are native to New Hanover County (LeBlond and Grant, 2003). The National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (FWS) are responsible for listing aquatic and terrestrial species as threatened and endangered at the Federal level, as delegated by the *Endangered Species Act* (ESA), as amended (16 U.S.C. 573, et seq.). NRC consultations with the FWS and NMFS have been conducted to comply with Section 7 of the ESA.[11] The State of North Carolina lists additional species that are regionally threatened, endangered, or rare. The North Carolina Wildlife Resource Commission within the Department of Environment and Natural Resources has regulatory authority over animals (except insects), while the Plant Conservation Program within the North Carolina Department of Agriculture has regulatory authority over plants and insects.

3.8.6.1 Federally Listed Species

Nine Federally threatened or endangered species known to occur in New Hanover County (FWS, 2009a). No critical habitat for any of the nine species occurs in the area of the Wilmington Site (FWS, 2009a). In addition to the threatened and endangered species, a number of Federal species of concern occur within New Hanover County. Table 3-14 lists the Federally threatened or endangered species and species of special concern that are known to occur or likely to occur within New Hanover County, along with their State status (as applicable).

[11] Letters of consultation can be found in Appendix B.

Table 3-14 Federally Threatened, Endangered, and Special Concern Species Reported from New Hanover County, North Carolina

Scientific Name	Common Name[a]	Status Federal/State[b]	Record Status[c]	Habitat	Potential Presence on or near WS/GLEF[d]
Plants					
Amaranthus pumilus	Seabeach amaranth	T/T	Current	Upper beaches, foredunes, overwash flats and sand/shell replenishments, and dredge spoils.	No/No
Amorpha georgiana var. *confusa*	Georgia indigobush	FSC/T	Historic	Dry savannas and riverbanks.	No/No
Astragalus michauxii	Sandhills milkvetch	FSC/T	Historic	Longleaf pine/scrub oak woodlands.	Yes/Yes
Dionaea muscipula	Venus' flytrap	FSC/SR-L	Current	Bogs and perennially wet areas.	Yes/No
Hypericum adpressum	Creeping St. John's-wort	FSC/NL	Historic	Shores, shallow waters of freshwater ponds.	No/No
Litsea aestivalis	Pondspice	FSC/SR-T	Current	Margins of swamps, cypress ponds, and sandhill depression ponds.	Yes/No
Ludwigia ravenii	Raven's seedbox	FSC/SR-T	Historic	Swamps, bogs, ponds.	Yes/Yes
Lysimachia asperulaefolia	Roughleaf loosestrife	E/E	Current	Edges between longleaf pine uplands and pond pine pocosins on moist seasonally saturated sands or shallow organic soils overlying sands.	Yes/No
Pteroglossaspis ecristata	Giant orchid	FSC/SR-T	Historic	Pine savannas, scrub oaks.	No/No
Ptilimnium ahlesii	Carolina bishopweed	FSC/SR-L	Current	Tidal freshwater marshes.	Yes/No
Rhynchospora pleiantha	Brown beakrush	FSC/T	Current	Sands and peat of pond shores and moist pine savannas.	No/No
Sagittaria graminea var. *weatherbiana*	Grassleaf arrowhead	FSC/SR-T	Current	Swamps.	Yes/Yes

Table 3-14 Federally Threatened, Endangered, and Special Concern Species Reported from New Hanover County, North Carolina (Cont.)

Scientific Name	Common Name[a]	Status Federal/State[b]	Record Status[c]	Habitat	Potential Presence on or near WS/GLEF[d]
Sideroxylon tenax	Tough bumelia	FSC/SR-P	Historic	Maritime forests and scrub.	No/No
Solidago verna	Spring-flowering goldenrod	FSC/T	Current	Pine savannas, pocosins, pine barrens, open woods, fields, dry bogs, and disturbed roadsides.	Yes/Yes
Solidago villosicarpa	Coastal goldenrod	FSC/E	Historic	Mesic, hardwood forests with dense canopies and sparse understories and areas of disturbance.	Yes/Yes
Stylisma pickeringii var. *pickeringii*	Pickering's morning-glory	FSC/E	Current	Scrub habitats with sandy soils, minimal litter accumulation, sparse ground cover, and little canopy cover of scattered scrubby oaks and pines.	Yes/Yes
Thalictrum cooleyi	Cooley's meadowrue	E/E	Historic	Wet savannas.	No/No
Thalictrum macrostylum	Small-leaf meadowrue	FSC/SR-L	Current	Bogs, wet woods, and cliffs.	Yes/No
Trichostema sp. 1	Dune blue curls	FSC/SR-L	Current	Maritime grasslands behind foredunes, maritime scrub.	No/No
Invertebrates					
Agrotis buchholzi	Buchholz's dart moth	FSC/NL	Current	Pine plains.	No/No
Atrytone arogos arogos	Eastern arogos skipper	FSC/SR	Obscure	Savannas, open pinewoods, and other relatively undisturbed grasslands.	Yes/No
Atrytonopsis loammi	Loammi skipper	FSC/SR	Obscure	Barrier islands.	No/No
Helisoma eucosmium	Greenfield ramshorn snail	FSC/E	Historic	Shallow creek beds, marshes, and swamps.	Yes/No

Table 3-14 Federally Threatened, Endangered, and Special Concern Species Reported from New Hanover County, North Carolina (Cont.)

Scientific Name	Common Name[a]	Status Federal/State[b]	Record Status[c]	Habitat	Potential Presence on or near WS/GLEF[d]
Planorbella magnifica	Magnificent rams-horn	FSC/E	Historic	Ponds.	No/No
Problema bulenta	Rare skipper	FSC/SR	Current	Brackish water marshes, abandoned rice paddies.	Yes/No
Triodopsis soelneri	Cape Fear threetooth	FSC/T	Current	Savannas, flatwoods, and swamps.	Yes/No
Fishes					
Acipenser brevirostrum	Shortnose sturgeon	E/E	Current	Downstream reaches of large rivers and Atlantic coastal waters. It prefers deep water with soft substrate and vegetated bottoms.	Yes/No
Anguilla rostrata	American eel	FSC/NL	Current	Matures in fresh or brackish waters, spawns in the Sargasso Sea.	Yes/No
Amphibians					
Rana capito capito	Carolina gopher frog	FSC/T	Current	Sandhills, pine and turkey oak woodlands; breeds in wetlands and temporary ponds.	Yes/Yes
Reptiles					
Alligator mississippiensis	American alligator	T(S/A)/T	Current	Freshwater swamps and marshes, but can also be found in rivers, lakes, and other bodies of water.	Yes/No
Caretta caretta	Loggerhead	T/T	Current	Open seas.	No/No
Chelonia mydas	Green turtle	T/T	Current	Open seas.	No/No
Heterodon simus	Southern hog-nosed snake	FSC/SC	Current	Mature pine forests and sandhills.	Yes/Yes

Table 3-14 Federally Threatened, Endangered, and Special Concern Species Reported from New Hanover County, North Carolina (Cont.)

Scientific Name	Common Name[a]	Status Federal/State[b]	Record Status[c]	Habitat	Potential Presence on or near WS/GLEF[d]
Ophisaurus mimicus	Mimic glass lizard	FSC/SC	Historic	Sandhills, pine and turkey oak woodlands.	Yes/No
Pituophis melanoleucus melanoleucus	Northern pinesnake	FSC/SC	Current	Woodlands.	Yes/Yes
Birds					
Charadrius melodus	Piping plover	T/T	Current	Nests in barrier island beaches; sandy beach shoals used during migration and winter.	No/No
Passerina ciris ciris	Eastern painted bunting	FSC/SR	Current	Woodlands.	Yes/Yes
Picoides borealis	Red-cockaded woodpecker	E/E	Current	Open stands of mature pine trees >60 years old for nesting and roosting; pine and pine/hardwood stands >30 years old for foraging.	Yes/No
Mammals					
Corynorhinus rafinesquii	Rafinesque's big-eared bat	FSC/T	Current	Riparian woodlands, hardwood forests.	Yes/No
Myotis austroriparius	Southeastern myotis	FSC/SC	Current	Nests in snags and hollow trees in conifer and hardwood forests. Forages in riparian areas and uplands.	Yes/Yes
Trichechus manatus	West Indian manatee	E/E	Current	Shallow coastal bays, lagoons, estuaries, and inland rivers.	Yes/No

Footnotes on following page.

Table 3-14 Federally Threatened, Endangered, and Special Concern Species Reported from New Hanover County, North Carolina (Cont.)

[a] Common names follow those used in NatureServe, 2009.
[b] E = endangered; FSC = Federal species of concern; SC = special concern; SR = significantly rare; SR-L = significantly rare – limited; SR-P = significantly rare – peripheral; SR-T = significantly rare – throughout; T = threatened; T(S/A) = threatened due to similarity in appearance; NL = not listed.
[c] Current: the species has been observed in the county within the last 50 years; Historic: the species was last observed in the county more than 50 years ago; Obscure: the date and/or location of observation is uncertain.
[d] WS = Wilmington Site, GLEF = proposed GLE Facility site.
Sources: Buchanan and Finnegan, 2008; FWS, 2009a; Jordan, 1998; LeGrand et al., 2008; NatureServe, 2009; NCNHP, 2001; Patrick et al., 1995; GLE, 2008; FWS, 2008a; 2003a,b.

While several listed species exist or may exist in the Wilmington Site area, no listed species have been reported from the area proposed for the GLE Facility.

The following definitions are applicable to the species categories for listing under the ESA (FWS, 2008d):

- *Endangered*: any species that is in danger of extinction throughout all or a significant portion of its range.

- *Threatened*: any species that is likely to become endangered within the foreseeable future throughout all or a significant part of its range.

- *Threatened due to similarity of appearance*: a taxon that is threatened due to similarity of appearance with another listed species and is listed for its protection. Taxa listed as "threatened due to similarity of appearance" are not biologically endangered or threatened and are not subject to Section 7 consultation.

- *Proposed for listing*: species that have been formally proposed for listing by the FWS or NMFS by notice in the *Federal Register*.[12,]

- *Candidate*: species for which the FWS or NMFS has sufficient information on their biological status and threats to propose them as threatened or endangered under the ESA but for which development of a proposed listing regulation is precluded by other higher priority listing actions.

- *Federal species of concern*: species under consideration for listing, for which there is insufficient information to support listing at this time. These species may or may not be listed in the future, and many of these species were formally recognized as Category 2 (C2) candidate species.[13]

- *Critical habitat*: specific areas within the geographical area occupied by the species at the time it is listed, on which are found physical or biological features essential to the conservation of the species and which may require special management considerations or protection. Except when designated, critical habitat does not include the entire geographical area that can be occupied by the threatened, endangered, or other special status species.

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[12] Within one year of a listing proposal, the FWS or NMFS must take one of three possible courses of action: (1) finalize the listing rule (as proposed or revised); (2) withdraw the proposal if the biological information on hand does not support the listing; or (3) extend the proposal for up to an additional six months because, at the end of one year, there is substantial disagreement within the scientific community concerning the biological appropriateness of the listing. After the extension, the FWS or NMFS must decide whether to list the species on the basis of the best scientific information available.

[13] Category 2 (C2) species are species for which information in the possession of the FWS indicated that proposing to list the species as endangered or threatened was possibly appropriate, but for which persuasive evidence on biological vulnerability and threat was not available to support the listing. Thus, the FWS concluded that these species might be threatened or endangered, but more information was necessary before a final conclusion could be reached.

Among the Federally listed threatened or endangered species that occur within New Hanover County, the seabeach amaranth (*Amaranthus pumilus*), Cooley's meadowrue (*Thalictrum cooleyi*), green turtle (*Chelonia mydas*), loggerhead (*Caretta caretta*), and piping plover (*Charadrius melodus*) do not occur within the Wilmington Site area. The following paragraphs describe the Federally listed threatened or endangered species and Federal species of concern that exist or may exist in the Wilmington Site area. Unless otherwise referenced, the information on each species is adapted from NatureServe (2009), with species status provided by Buchanan and Finnegan (2008) for plants and LeGrand et al. (2008) for animals.

Plants

Carolina bishopweed (*Ptilimnium ahlesii*)

The Carolina bishopweed, an erect annual herb, is a Federal species of concern and is considered to be significantly rare – limited by the State[14]. The plant inhabits freshwater tidal marshes (Weakley, 2008). Threats to the Carolina bishopweed include invasion by common reed (*Phragmites australis*) and water pollution (NatureServe, 2009; Weakley, 2008). No occurrences of the Carolina bishopweed have been recorded within 3.2 kilometers (2 miles) of the Wilmington Site (NCNHP, 2009).

Coastal goldenrod (*Solidago villosicarpa*)

The coastal goldenrod, a perennial herb, is a Federal species of concern and is State listed as endangered. It occurs in a wide variety of wooded habitats, occurring in areas associated with natural or human-caused disturbance (CPC, 2008a). Canopy closure is a threat to the coastal goldenrod. Invasive species also present a minor threat to the species. An occurrence was recorded within 3.2 kilometers (2 miles) of the northern boundary of the Wilmington Site, but more than that distance from the proposed GLE Facility area (NCNHP, 2009). Habitat potentially suitable for the coastal goldenrod occurs in the pine-hardwood forests in the north-central and south-central portions of the Wilmington Site (GLE, 2008).

Grassleaf arrowhead (*Sagittaria graminea* var. *Weatherbiana*)

The grassleaf arrowhead is a Federal species of concern and is considered significantly rare – throughout by the State. It is a perennial herb that inhabits shallow water and wet shores of ponds, marshes, and ditches. Threats to the species include drainage and other habitat modification that causes excessive drying of wetland habitat (Burns and Cusick, 1983). No occurrences of the grassleaf arrowhead have been recorded within 3.2 kilometers (2 miles) of the Wilmington Site (NCNHP, 2009).

Pickering's morning-glory (*Stylisma pickeringii* var. *pickeringii*)

The Pickering's morning-glory (also known as Pickering's dawnflower) is a Federal species of concern and is State-listed as endangered. The species is a perennial, creeping vine that occurs in dry to extremely dry, nutrient-poor, well-drained, coarse sandy soils. Tree cover, ground cover, and litter accumulation are generally sparse (Patrick et al., 1995). It generally

[14] The North Carolina status definitions are provided at the end of Section 3.8.6.2.

forms large mats or clumps in dry, barren, deep sand areas such as the edge of Carolina bays and relic riverine dunes (CPC, 2008b; Weakley, 2008). Preferred locations include frequently burned or clear-cut areas with little or no competing vegetation (CPC, 2008b). Threats to the Pickering's morning-glory include habitat loss and modification and disruption of natural fire regimes. There is a 1958 occurrence record for the Pickering's morning-glory within 3.2 kilometers (2 miles) of the proposed GLE Facility area (NCNHP, 2009). The Operations Area in the northwestern portion of the Wilmington Site contains deep sands that are periodically disturbed and may provide suitable habitat for the Pickering's morning-glory (GLE, 2008).

Pondspice (*Litsea aestivalis*)

Pondspice is a Federal species of concern and is considered significantly rare – throughout by the State. It is a deciduous shrub that inhabits the margins of swamps; cypress ponds; low wet woodlands; and sandhill depressions on wet, sandy or peaty, acidic soils. It may form thickets and be locally abundant. Pondspice is threatened by hydrological alterations (e.g., ditching and draining of wetland habitat and lowering of the water table) and suppression of natural fire regimes. It may be potentially threatened by red bay (or laurel wilt) disease, an emerging fungal disease for which the pondspice is a documented host. There is a 1977 occurrence record for the pondspice within 3.2 kilometers (2 miles) of the proposed GLE Facility area around the perimeter of an ephemeral pond within the north-central portion of the Wilmington Site (GLE, 2008; NCNHP, 2009). However, hydrological conditions of this pond have been altered and do not appear to support recruitment of the species. During field surveys for the Environmental Report, the existing plants appeared stressed (GLE, 2008). The location of the proposed GLE Facility is more than 150 meters (500 feet) southeast of the ephemeral pond (GLE, 2008).

Raven's seedbox (*Ludwigia ravenii*)

Raven's seedbox, a perennial herb, is a Federal species of concern and is considered significantly rare – throughout by the State. It is an obligate wetland species that inhabits open, wet, peaty areas such as ditches and the margins of swamps, ponds, and bogs. Threats to the Raven's seedbox include excavation and deepening of ditches, road widening and paving, and herbicide use. The Raven's seedbox does not have any occurrence record within 3.2 kilometers (2 miles) of the Wilmington Site (NCNHP, 2009).

Roughleaf loosestrife (*Lysimachia asperulaefolia*)

The roughleaf loosestrife, an erect perennial herb, is both Federally and State-listed as endangered. It occurs in grass-shrub ecotones (transition areas between two habitats that can contain characteristic species from both) adjacent to longleaf pine/scrub oak, pine savanna, flatwoods, and pond pine pocosins (evergreen shrub bogs). It prefers full sunlight and is shade intolerant (CPC, 2008c; NCNHP, 2001). It grows on moist, seasonally saturated sands or shallow organic soils overlying sands. The roughleaf loosestrife has been found in roadside depressions, firebreaks, seeps, and power rights-of-way (ROWs) (NCNHP, 2001). The roughleaf loosestrife flowers from mid-May through June, with fruits present from July through October. Habitats within which the species occur are fire-maintained. Threats to the roughleaf loosestrife include drainage and development of habitat, land conversion, and suppression of natural fire regimes (CPC, 2008c). Suppression of naturally occurring fires within ecotones allows shrubs to increase in density and height, which eliminates the open edges required by the species (FWS, 2009a). No occurrences for the roughleaf loosestrife have been recorded within 3.2 kilometers (2 miles) of the Wilmington Site (NCNHP, 2009). Some areas of pocosin habitats that support the species have been drained from the Wilmington Site. Also, fire regimes necessary for maintaining the species habitat do not occur on the site (GLE, 2008).

Sandhills milkvetch (*Astragalus michauxii*)

The sandhills milkvetch, an erect perennial herb, is a Federal species of concern and is State-listed as threatened. It inhabits longleaf pine/scrub oak woodlands. It grows best in disturbed or fire-prone open understory areas (e.g., xeric to dry-mesic, nutrient poor soils, thickets, field edges, and road banks). Threats to the sandhills milkvetch include suppression of natural fire regimes, land conversion, and habitat fragmentation. There is a 1946 occurrence record for the sandhills milkvetch southwest of the Wilmington Site near the intersection of US 421 and I-140, which is within 3.2 kilometers (2 miles) of the proposed GLE Facility site (NCNHP, 2009; GLE, 2008). The longleaf pine/scrub forest in the northwestern portion of the Wilmington Site and the pine plantation in the north-central portion of the site could provide suitable habitat for the species.

Small-leaf meadowrue (*Thalictrum macrostylum*)

The small-leaf meadowrue, an erect herb, is a Federal species of concern and is considered significantly rare – limited by the State. Habitat for the species includes swampy woodlands, slopes, and limestone cliffs. Threats to the small-leaf meadowrue include land use alteration, habitat fragmentation, silviculture practices, and changes in hydrology. No occurrences of the small-leaf meadowrue have been recorded within 3.2 kilometers (2 miles) of the Wilmington Site (NCNHP, 2009).

Spring-flowering goldenrod (*Solidago verna*)

The spring-flowering goldenrod, an erect perennial herb, is a Federal species of concern and is State listed as threatened. It inhabits a wide variety of habitats such as pine savannas, pocosins, pine barrens, open woods, fields, dry bogs, and disturbed roadsides (CPC, 2008d). Threats to the spring-flowering goldenrod include alteration and destruction of habitat for development, pine plantations, and agriculture. No occurrences of the spring-flowering goldenrod have been recorded within 3.2 kilometers (2 miles) of the Wilmington Site (NCNHP, 2009). Pocosin/bay and pine forests potentially provide limited habitat for the spring-flowering goldenrod on the Wilmington Site (GLE, 2008).

Venus' flytrap (*Dionaea muscipula*)

The Venus' flytrap, an insectivorous herb, is a Federal species of concern and is considered significantly rare – limited by the State. It inhabits bogs and perennially wet areas, often located between longleaf pine savannas and pocosins (shrub bogs) on the coastal plains of the Carolinas (Floridata, 2003). Threats to the Venus' flytrap include habitat conversion and suppression of natural fire regimes. Some collecting from natural populations can also affect the species. Two occurrences of the Venus' flytrap have been recorded within 3.2 kilometers

(2 miles) of the Wilmington Site, one of which is also within 3.2 kilometers (2 miles) of the proposed GLE Facility area (NCNHP, 2009). Suitable habitat for the Venus' flytrap occurs within the western portion of the Wilmington Site, where pine forest and pocosin habitats are adjacent to each other.

Invertebrates

Cape Fear threetooth (*Triodopsis soelneri*)

The Cape Fear threetooth is a Federal species of concern and is listed as threatened by the State. It is a terrestrial snail that occurs on logs and under litter in swamps and under trash in pine woods (Hubricht, 1985). The main threat to the species is presumed to be habitat loss. No occurrences of the Cape Fear threetooth have been recorded within 3.2 kilometers (2 miles) of the Wilmington Site (NCNHP, 2009).

Eastern arogos skipper (*Atrytone arogos arogos*)

The eastern arogos skipper is a Federal species of concern, and the butterfly is considered significantly rare by the State. It inhabits native grasslands and savannas. Individuals are capable of dispersing several miles. The known North Carolina site for the species contains habitats that are mesic to boggy, sometimes ecotonal, pinebarrens reedgrass (*Calamovilfa brevipilis*) savanna. The pinebarrens reedgrass is a foodplant for eastern arogos skipper larvae. Adults obtain nectar from a variety of flowers. Threats to the eastern arogos skipper include habitat loss and fragmentation and fire (including prescribed burns). No occurrences of the eastern arogos skipper have been recorded within 3.2 kilometers (2 miles) of the Wilmington Site (NCNHP, 2009).

Greenfield ramshorn snail (*Helisoma eucosmium*)

The Greenfield ramshorn snail is a Federal species of concern and is listed as endangered by the State. Within New Hanover County, this freshwater snail is only known from Greenfield Lake in Wilmington. It is also known from Town Creek in Brunswick County and from the Wisconsin River in the northeastern portion of the State. Specimens from Town Creek inhabited densely vegetated areas in water less than 3 meters (10 feet) deep. Threats to the species include habitat degradation and, possibly, invasive plant species. No occurrences of the Greenfield ramshorn snail have been recorded within 3.2 kilometers (2 miles) of the Wilmington Site (NCNHP, 2009).

Rare skipper (*Problema bulenta*)

The rare skipper is a Federal species of concern and the butterfly is considered significantly rare by the State. Although nonmigratory, the rare skipper is a strong flier that can fly over forests or fly up to 0.5 kilometer (0.3 mile) to find nectar. They inhabit marshes along tidal rivers. Adults are usually viewed while feeding on the nectar of roadside flowers. Threats to the rare skipper include habitat loss and, probably, biocides used to control mosquitoes. No occurrences of the rare skipper have been recorded within 3.2 kilometers (2 miles) of the Wilmington Site (NCNHP, 2009).

Fishes

American eel (*Anguilla rostrata*)

The American eel is a Federal species of concern but has no State listing status. It spawns in the Sargasso Sea and matures in fresh or brackish waters (estuaries, rivers, streams, ponds, and lakes), spending 4 to 10 years in these habitats until they return to sea to spawn (FWS, 2009b). Upstream migration can occur from March through October, while downstream migration begins in summer or fall. Threats to the American eel include barriers to migration, habitat loss and alteration, turbine mortalities, overfishing, and pollution. No occurrences of the American eel have been recorded within 3.2 kilometers (2 miles) of the Wilmington Site (NCNHP, 2009). However, the American eel is expected to occur in the Northeast Cape Fear River near the Wilmington Site (NCDENR, 2008c). The river's tributaries on the site could also provide suitable habitat for the American eel.

Shortnose sturgeon (*Acipenser brevirostrum*)

The shortnose sturgeon is both Federally and State-listed as endangered. Federal protection of the species is under the jurisdiction of the NMFS. The shortnose sturgeon inhabits the lower reaches of large rivers and Atlantic coastal waters. It primarily occurs in brackish and salt waters of lower coastal river reaches and river estuaries. Shortnose sturgeon seldom venture into the Atlantic Ocean (Ozier et al., 1999). The shortnose sturgeon ascends into the freshwaters of larger coastal rivers to spawn. Spawning occurs from April through June in swift waters over gravel or coarse substrates such as submerged logs (NCNHP, 2001; Ozier et al., 1999). Juveniles may remain in rivers for up to 5 years before migrating to estuarine waters (NCNHP, 2001). Larvae and juveniles may prefer deep river channels. The shortnose sturgeon feeds upon invertebrates and aquatic plants (FWS, 2003a). It is very rare in the Cape Fear River drainage. The absence of juvenile shortnose sturgeon within the Cape Fear River drainage indicates that the species may not be spawning because of blockage of upstream migration by adults at Lock and Dam 1 at River Mile 60 (river kilometer 96). In other river systems, spawning takes place 100 to 300 kilometers (62 to 186 miles) upstream of the mouth of the river (Moser and Ross, 1995). Threats to the shortnose sturgeon include habitat alteration, barriers to upstream movement, pollution, and overfishing (including poaching) (NCNHP, 2001). They are also susceptible to gill nets set for striped bass and American shad (Moser and Ross, 1995). There is a 1993 occurrence record for the shortnose sturgeon within 3.2 kilometers (2 miles) of the Wilmington Site (NCNHP, 2009). It may occur in the Northeast Cape Fear River and the lower portions of its unnamed tributaries that occur on the Wilmington Site. It does not ascend into smaller tributaries such as the Prince George Creek (NOAA, 2002).

Amphibians

Carolina gopher frog (*Rana capito capito*)

The Carolina gopher frog is a Federal species of concern and is listed as threatened by the State. Adults inhabit primarily xeric uplands, especially longleaf pine-turkey oak sandhill associations. They also occur in xeric to mesic longleaf pine flatwoods, sand pine scrub, and xeric oak hammocks. Burrows of gopher tortoises (*Gopherus polyphemus*) and rodents are used for shelter. They will also hide in sewers, under logs, and in or under stumps. Breeding habitat includes ephemeral to semipermanent graminoid (grass or grass-like) dominated wetlands that lack large predatory fishes. Breeding generally occurs between mid-January and April. The larval period lasts about four months; individual adults spend less than four weeks in breeding ponds. Threats to Carolina gopher frogs include habitat loss and degradation caused by logging and fire suppression, introduction of predatory fishes into breeding ponds, and declines in gopher tortoises. No occurrences of the Carolina gopher frog have been recorded within 3.2 kilometers (2 miles) of the Wilmington Site (NCNHP, 2009).

Reptiles

American alligator (*Alligator mississippiensis*)

The American alligator is Federally listed as threatened because its appearance is similar to the American crocodile (*Crocodylus acutus*); it is State listed as threatened. From a Federal perspective, the American alligator is not biologically threatened and does not have protection under the ESA (FWS, 2009a). It inhabits slow-moving coastal rivers, canals, lakes, impoundments, marshes, cypress ponds, and estuaries. Its tolerance to salinity increases with age (NCNHP, 2001). The minimum home range averages 1255 hectares (3100 acres) for males and 8 hectares (21 acres) for females (NCNHP, 2001). Past threats to the American alligator included overharvest and habitat loss (FWS, 2008c). Current threats include loss and degradation of habitat due to recreational use and development. The American alligator has been recorded from various localities near the Wilmington Site, including the Prince George Creek at its confluence with its Unnamed Tributary #1; the Northeast Cape Fear River at its confluence with Prince George Creek upstream of the Wilmington Site in Turkey Creek, Morgan Creek, and Long Creek; and south of the Wilmington Site in Ness Creek (GLE, 2008). Occurrences of the American alligator have been reported within 3.2 kilometers (2 miles) of the proposed GLE Facility area (NCNHP, 2009). At the Wilmington Site, potential breeding habitat occurs along the Northeast Cape Fear River and its tributaries, and small alligators may occur within the streams and swamp forest habitats of the site.

Mimic glass lizard (*Ophisaurus mimicus*)

The mimic glass lizard, a legless lizard, is a Federal and a State species of concern. It inhabits longleaf pine savannas and conifer and mixed woodlands where it burrows in the soil or inhabits fallen logs and woody debris. Threats to the mimic glass lizard include habitat loss, conversion of preferred habitat to pine plantations, and road mortality. No occurrences of the mimic glass lizard have been reported within 3.2 kilometers (2 miles) of the Wilmington Site (NCNHP, 2009).

Northern pinesnake (*Pituophis melanoleucus melanoleucus*)

The northern pinesnake is a Federal and a State species of concern. It inhabits xeric pine forest uplands. Threats to the northern pinesnake include logging, habitat modification and fragmentation, and direct mortality by humans (e.g., deliberate killing and road mortality). A pre-1927 occurrence record exists for the northern pine snake within 3.2 kilometers (2 miles) of the proposed GLE Facility area (NCNHP, 2009).

Southern hog-nosed snake (*Heterodon simus*)

The southern hog-nosed snake is a Federal and a State species of concern. It inhabits mature pine forests and sandhill habitats (Jordan, 1998) and spends most of its time buried in soil. It primarily eats toads, but also preys on frogs, lizards, and small mammals. Habitat loss is the primary threat to the southern hog-nosed snake (Jordan, 1998). Sightings of the southern hog-nosed snake have been made southwest of the Wilmington Site between the Northeast Cape Fear River and the Cape Fear River (GLE, 2008). No occurrences of the southern hog-nosed snake have been recorded within 3.2 kilometers (2 miles) of the Wilmington Site (NCNHP, 2009). Within the Wilmington Site, the snake could occur within the pine forests, longleaf pine/scrub forests, hardwood forests, and fields. The xeric, sandy soils in the northwestern portion of the site may also be suitable habitat.

Birds

Eastern painted bunting (*Passerina ciris ciris*)

The eastern painted bunting is a Federal species of concern and is considered significantly rare by the State. Habitat includes partly opened areas with scattered trees and brush, riparian thickets and brush, weedy and shrubby areas, woodland edges, yards, and gardens. Salt marsh/forest edges are preferred over interior forests. Eggs are laid in March through July (mostly May through June) in bushes or vine tangles at heights of 1 to 2 meters (3 to 6 feet) or at greater heights in thick Spanish moss (*Tillandsia usneoides*) in trees. It winters in Mexico. The major threat to the eastern painted bunting is loss of breeding habitat. No occurrences of the eastern painted bunting have been recorded within 3.2 kilometers (2 miles) of the Wilmington Site (NCNHP, 2009).

Red-cockaded woodpecker (*Picoides borealis*)

The red-cockaded woodpecker is both Federally and State-listed as endangered. No critical habitat has been designated for the species (FWS, 2008b). Coastal Plain longleaf pine forests maintained by frequent fires probably supported the highest population levels (Ozier et al., 1999). It requires open stands of mature pine (more than 60 years old) for nesting and roosting habitat. Nesting and roosting occur in cavities of live trees that range in age from 63 to more than 300 years old for longleaf pine, or 62 to more than 200 years old for loblolly and other pines. An aggregate (cluster) of 1 to 20 cavity trees is used on an area of 1 to 24 hectares (3 to 60 acres) (FWS, 2003b; NatureServe, 2009). The red-cockaded woodpecker generally chooses trees that are infected with red heart disease, which is caused by a fungus (*Phellinus pini*) that attacks the heartwood (the older, nonliving central wood of a tree), thereby making it softer and pithy, which aids in the bird being able to excavate the cavity. Suitable habitat surrounding a cluster of cavity trees contains open, park-like conditions. Often, the breeding pair and up to nine “helpers” (usually four or less) form a family unit called a group. The helpers assist in incubating the eggs, feeding nestlings and fledglings, and defending territories. Each member of a group usually has an exclusive roost cavity. Egg-laying generally occurs between April and early May. A group may not nest every year. Incubation lasts 10 to 12 days, and nestlings remain in the nest for nearly a month.

The diet of red-cockaded woodpeckers primarily consists of invertebrates found on and within pine bark (Ozier et al., 1999). Stands of pine or mixed pines and hardwoods that are more than 30 years old are used for foraging. A group requires at least 32 to 51 hectares (80 to 125 acres) of foraging habitat. The territory for a group averages about 81 hectares (200 acres) but can range from 24 to 243 hectares (60 to more than 600 acres) (FWS, 2003b). Most suitable nesting habitat in the southeastern United States occurs on public lands. Threats to the red-cockaded woodpecker include habitat loss and fragmentation, short-term timber rotation (e.g., <45 years), fire suppression (and subsequent encroachment of hardwood midstory trees that reach the heights of the cavity entrance), and competition for cavity space. When foraging habitat is cleared, groups may have difficulty raising young. Juveniles dispersing from isolated clusters of cavity trees seldom encounter suitable habitat, and much less other individuals. Once a breeding female dies, it is highly unlikely that a replacement will immigrate to the group (Ozier et al., 1999).

An active red-cockaded woodpecker group occurs within 8 kilometers (5 miles) northeast of the Wilmington Site. It is located just north of the Northeast Cape Fear River along NC 117 in Pender County (GLE, 2008). Several occurrences of the red-cockaded woodpecker have been recorded within 3.2 kilometers (2 miles) of the western border of the Wilmington Site (NCNHP, 2009). No cavity trees were observed on the Wilmington Site during field surveys conducted in support of the Environmental Report (GLE, 2008). The forested habitats on the Wilmington Site meet the minimum area requirements needed for foraging habitat. However, the lack of mature forests would limit the value of the Wilmington Site as foraging habitat. Only the longleaf pine/scrub plant community located in the northwest corner of the Wilmington Site is estimated to be over 40 years of age (Figures 3-11 and 3-12). Thinning of forested areas has increased habitat potentially suitable for the red-cockaded woodpecker on the Wilmington Site (GLE, 2009c). The Sledge Forest, a property containing more than 1619 hectares (4000 acres) of high-quality forest directly adjacent to and north of the Wilmington Site, does contain loblolly and longleaf pine trees that are more than 300 years old. This area would be suitable as nesting and roosting habitat for the red-cockaded woodpecker. It is possible that woodpeckers that forage in the Sledge Forest could occasionally forage within the western forested portion of the Wilmington Site.

Mammals

Rafinesque's big-eared bat (*Corynorhinus rafinesquii*)

The Rafinesque's big-eared bat is a Federal and a State species of concern. The species occurs in forested areas. Summer roosts include hollow trees, loose bark, or abandoned buildings in or near wooded areas. Bridges are also used as day roosts and as maternity roosts. Foraging habitat is primarily among the canopies of mature upland and lowland forests (Ozier et al., 1999). While most bats become active before dark, the Rafinesque's big-eared bat does not emerge from its roost until it is completely dark (Ozier et al., 1999). In the Coastal Plain, they are assumed to use hollow trees during cold weather and possibly as winter roosts. It roosts singly, in small clusters, or in groups of more than 100 individuals. During the nursing season, males are generally solitary. The species is considered nonmigratory, having only short-distance movements between summer and winter roosting sites. Threats to the species include habitat loss (e.g., forest destruction, removal of hollow trees, removal of abandoned buildings, and vandalism or destruction of mines and caves), insecticide applications, and disturbance at roost sites. There is a pre-2006 occurrence record for the Rafinesque's big-eared bat within 3.2 kilometers (2 miles) of the proposed GLE Facility area (NCNHP, 2009).

Southeastern myotis (*Myotis austroriparius*)

The southeastern myotis bat is a Federal and a State species of concern. It nests in caves, buildings, and snags and hollow trees of pine and hardwood forests; and it primarily forages in riparian areas, but also in various upland habitats. Threats to the southeastern myotis include human disturbance and physical alteration of caves used for hibernacula and maternity sites. Clearing and draining of bottomland hardwood forest wetlands also have reduced summer roosting and foraging habitat. There is a 1986 occurrence record for the southeastern myotis within 3.2 kilometers (2 miles) of the proposed GLE Facility area from floodplains north of the Wilmington Site near the confluence of the Northeast Cape Fear River and Prince George Creek (NCNHP, 2009; GLE, 2008). The riparian habitats and pine and hardwood forests on the Wilmington Site provide suitable foraging and breeding habitat for the southeastern myotis. It may also forage in the Operations Area and transmission line ROWs.

West Indian manatee (*Trichechus manatus*)

The West Indian manatee is both Federally and State-listed as endangered. It inhabits shallow coastal bays, lagoons, estuaries, and rivers. The manatee usually inhabits waters with a depth of 1 to 6 meters (3.3 to 20 feet) (FWS, 2009a; NatureServe, 2009). Much of their time is spent submerged or partly submerged. Manatees feed on aquatic vegetation. It is a seasonal inhabitant of North Carolina, being present mainly from June through October. They migrate south (e.g., to Florida) when water temperatures fall below about 21° Celsius (70° Fahrenheit). Manatees often return to the same winter and summer habitats every year (Ozier et al., 1999). Threats to the West Indian manatee include collisions with boats, habitat loss and degradation, entrapment and/or crushing in water control structures, entanglement in fishing gear, hunting and fishing, red tide poisoning, and exposure to cold temperatures. No occurrences of the West Indian manatee have been recorded within 3.2 kilometers (2 miles) of the Wilmington Site (NCNHP, 2009). However, the Northeast Cape Fear River and some of its tributaries in the area of the Wilmington Site may provide suitable habitat for the manatee (FWS, 2009a).

3.8.6.2 State-Listed Species

In addition to the Federally threatened or endangered species and Federal species of concern identified in Table 3-14, there are additional State-rare species that are known to occur within New Hanover County (Buchanan and Finnegan, 2008; LeGrand et al., 2008). These are identified in Table 3-15.[15] Some of these species may occur on or near the Wilmington Site. Continued declines in some of these species could be expected in the future, which may lead to their becoming upgraded to State threatened or endangered or possibly as Federally listed species.

[15] County distributions for "watch list" animal species were not provided by LeGrand et al., 2008; therefore, these species are not included in Table 3-15. The State status of the Federally threatened or endangered species and Federal species of concern is provided in Table 3-15. These species are also discussed in Section 3.8.6.1.

Table 3-15 State Rare Species Reported from New Hanover County, North Carolina[a]

Scientific Name	Common Name	State Status[b]	Habitat	Potential Presence on or near WS/GLEF[c,d]
Lichens				
Cladonia evansii	Powder-puff lichen	W	Sandhills (primarily near the coast), usually associated with sand live oak.	No/No
Liverworts				
Cephalozia connivens var. *bifida*	A liverwort	SR-T*	Moist riverbanks.	Yes[†]/No
Metzgeria uncigera	A liverwort	W*	On bark in maritime forests or on rhododendron in mountain forests.	No/No
Mosses				
Fissidens elegans	A plume moss	W*	Sandy and clayey soils along roadsides and streams, on trees or stumps.	Yes/Yes
Weissia muehlenbergiana	A moss	W*	Soil among grasses, roadsides.	Yes/Yes
Vascular Plants				
Adiatium capillus-veneris	Venus hair fern	E	Coquina limestone (marl) outcrops, adventitious on mortar of old stone walls.	No/No
Agalinis aphylla	Scale-leaf gerardia	W*	Wet savannas and sandhills streambed pocosin ecotones.	No/No
Agalinis linifolia	Flaxleaf gerardia	W	Savannas, clay-based carolina bays, depression ponds, and other open habitats.	No/No
Agalinis virgata	Branched gerardia	SR-P	Savannas and depression pond shores.	No/No
Anthaenantia rufa	Purple silkyscale	W*	Savannas.	No/No
Aristida condensata	Big three-awn grass	SR-P	Bay rims with xeric pine-oak scrub.	Yes[†]/No

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Table 3-15 State Rare Species Reported from New Hanover County, North Carolina[a] (Cont.)

Scientific Name	Common Name	State Status[b]	Habitat	Potential Presence on or near WS/GLEF[c,d]
Asclepias pedicellata	Savanna milkweed	SR-P	Dry savannas and moist flatwoods.	Yes[†]/No
Baccharis angustifolia	Saltwater false-willow	W	Brackish marshes, sandhill seeps, and other open wet areas.	No/No
Bacopa caroliniana	Blue water-hyssop	SR-P*	Shallow ponds, marshes, natural lakes, and tidal creeks.	No/No
Bacopa innominata	Tropical water-hyssop	SR-P*	Tidal freshwater marshes.	No/No
Bartonia paniculata ssp. *paniculata*	Twining screwstem	W	Wet savannas, sandhill seeps, and other open wet areas.	No/No
Boltonia asteroides	White doll's-daisy	SR-O	Clay-based Carolina bays, marshes, and savannas.	Yes[†]/No
Burmannia biflora	Northern bluethreads	W	Limesinks, cypress savannas, and sandhill seeps.	No/No
Calamovifa brevipilis	Pinebarren sandreed	W	Savannas and sandhill seeps.	No/No
Cardamine longi	Long's bittercress	SR-T	Tidal marshes and tidal cypress-gum forests.	Yes/No
Carex chapmanii	Chapman's sedge	W*	Moist bottomlands and slopes, perhaps associated with marl.	No/No
Carex mitchelliana	Mitchell's sedge	W	Swampy woodlands and forests.	Yes/No
Carex decomposita	Cypress knee sedge	SR-T*	Beaver ponds and old millponds.	No/No
Carex vericosa	Warty sedge	SR-P*	Savannas and pinelands.	Yes/Yes
Cirsium lecontei	Le Conte's thistle	SR-P*	Savannas.	No/No
Cladium mariscoides	Twig-rush	SR-O	Bogs, fens, brackish marshes, and sandhill seepage bogs.	No/No
Chrysopogon pauciflorus	Goldenbeard	W*	Sandhills.	No/No

Table 3-15 State Rare Species Reported from New Hanover County, North Carolina[a] (Cont.)

Scientific Name	Common Name	State Status[b]	Habitat	Potential Presence on or near WS/GLEF[c,d]
Chrysopsis trichophylla	Naked golden-aster	W	Xeric sandhills and sandhill scrub.	No/No
Cleistes bifaria	Small spreading pogonia	W	Savannas, dry meadows.	No/No
Coelorachis rugosa	Wrinkled jointgrass	W	Limesink ponds, clay-based Carolina bays, and wet savannas.	No/No
Corallorhiza odontorhiza	Autumn coral-root	W*	Harwood forests.	No/No
Corallorhiza visteriana	Spring coral-root	SR-O	Nutrient-rich forests, especially over limestone, mafic rocks, or shell-rich sands.	No/No
Crinum americanum	Swamp-lily	SR-P*	Tidal swamp forests and tidal marshes.	Yes/No
Crocanthemum carolinianum	Carolina sunrose	SR-P	Sandhills, pinelands, and dry savannas.	Yes[†]/No
Crocanthemum georgianum	Georgia sunrose	SR-P	Maritime forests.	No/No
Crocanthemum nashii	Florida scrub frostweed	E	Coastal fringe sandhill.	No/No
Cyperus distans	A flatsedge	W*	Marshes.	No/No
Cyperus lecontei	Leconte's flatsedge	SR-P*	Limesink ponds.	No/No
Cyperus tetragonus	Four-angled flatsedge	SR-P+	Maritime forests and barrier island grasslands.	No/No
Dicanthelium aciculare spp. *neuranthum*	Nerved witch grass	SR-D	Maritime wet grasslands.	No/No
Dicanthelium sp. 9	A witch grass	SR-L*	Wet streamhead pocosin openings, including utility clearings.	Yes/No
Dichanthelium erectifolium	Erectleaf witch grass	W	Pond shores.	Yes/No
Dryopteris ludoviciana	Southern woodfern	W*	Acid swamps.	Yes/No
Eleocharis equisetoides	Horsetail spikerush	W*	Limesink ponds.	No/No

Table 3-15 State Rare Species Reported from New Hanover County, North Carolina[a] (Cont.)

Scientific Name	Common Name	State Status[b]	Habitat	Potential Presence on or near WS/GLEF[c,d]
Eleocharis melanocarpa	Blackfruit spikerush	W	Clay-based Carolina ponds.	No/No
Eleocharis robbinsii	Robbins' spikerush	SR-P	Limesink ponds, clay-based Carolina bays, peat-burn lakes, millponds, beaver ponds, and artificial lakes.	Yes[†]/No
Eleocharis tricostata	Three-angle spikerush	W	Bogs and savannas.	No/No
Epidendrum magnoliae	Green fly orchid	SR-P	Epiphytic on trees in blackwater river swamps.	Yes[†]/No
Erythrina herbacea	Coralbean	SR-P	Maritime forests.	No/No
Eupatorium leptophyllum	Limesink dog-fennel	SR-P	Limesink ponds and clay-based Carolina bays.	No/No
Gaylussacia nana	Confederate huckleberry	E	Coastal fringe sandhill.	No/No
Gelsemium rankinii	Swamp jessamine	SR-P	Floodplains of blackwater rivers and streams.	Yes/No
Habenaria repens	Water-spider orchid	W*	Stagnant blackwater pools and impoundments.	No/No
Helenium pinnatifidum	Dissected sneezeweed	SR-P*	Savannas and open, wet, and mucky sites.	No/No
Hibiscus aculeatus	Comfortroot	SR-P	Bay forests, sand ridges, and roadsides.	Yes/No
Hypericum fasciculatum	Peelbark St. John's-wort	SR-L*	Beaver ponds, low pinelands, and pools.	Yes/No
Ilex cassine var. *cassine*	Dahoon	W	Blackwater swamps and pocosins.	Yes/Yes
Iresine rhizomatosa	Rootstock bloodleaf	W	Low, wet places, interdune swales, damp woods, edges of brackish marshes.	Yes/No
Lachnocaulon minus	Brown bogbutton	SR-P	Depression ponds and ditches.	Yes/No
Liatris secunda	Sandhill blazing-star	W	Sandhills.	No/No
Lilaeopsis carolinensis	Carolina grasswort	T	Freshwater marshes, pools, and tidal marshes.	No/No
Lophiola aurea	Golden-crest	E	Very wet, mucky habitats in pine savannas.	No/No

Table 3-15 State Rare Species Reported from New Hanover County, North Carolina[a] (Cont.)

Scientific Name	Common Name	State Status[b]	Habitat	Potential Presence on or near WS/GLEF[c,d]
Ludwigia alata	Winged seedbox	SR-P*	Interdune ponds and marshes.	No/No
Ludwigia lanceolata	Lanceleaf seedbox	SR-P	Interdune ponds and open wet areas.	No/No
Ludwigia linifolia	Flaxleaf seedbox	SR-P	Limestone ponds.	No/No
Ludwigia sphaerocarpa	Globe-fruit seedbox	SR-P	Bogs, pools, and lake shores.	No/No
Ludwigia suffruticosa	Shrubby seedbox	SR-P	Limesink ponds and clay-based Carolina bays.	No/No
Magnolia grandiflora	Southern magnolia	W*	Mainland forests with maritime influence.	Yes/No
Nuphar sagittifolia	Narrowleaf cowlily	W	Blackwater streams, rivers, and lakes.	Yes/No
Oenothera riparia	Riverbank evening-primrose	SR-L	Tidal marshes.	Yes[†]/No
Panicum tenerum	Southeastern panic grass	W	Wet savannas, sandhill seeps, and limesink ponds.	No/No
Parietaria floridana	Florida pellitory	W*	Shell middens, disturbed sites, and maritime forests.	No/No
Paspalum praecox	Early crown grass	W	Limesink ponds and savannas.	No/No
Parietaria praetermissa	Large-seed pellitory	SR-P*	Shell middens, disturbed sites, and maritime forests.	No/No
Peltandra sagittifolia	Spoonflower	SR-P	Pocosins and other wet, peaty sites.	Yes[†]/Yes
Persea borbonia	Red bay	W	Sandy upland soils in maritime forests.	Yes/No
Physalis lanceolata	Sandhill ground cherry	W*	Sandhills.	No/No
Phytolacca rigida	Maritime pokeweed	W	Dunes, edges of brackish or salt marshes.	No/No
Platanthera nivea	Snowy orchid	E	Wet savannas.	Yes[†]/No
Polygala hookeri	Hooker's milkwort	SR-D	Savannas.	No/No

Table 3-15 State Rare Species Reported from New Hanover County, North Carolina[a] (Cont.)

Scientific Name	Common Name	State Status[b]	Habitat	Potential Presence on or near WS/GLEF[c,d]
Polygonum glaucum	Seabeach knotwood	SR-T*	Ocean and sound beaches.	No/No
Ptelea trifoliata	Wafer-ash	W*	Rich woods, cliffs, and rock exposures mainly over mafic or calcareous rocks.	No/No
Ptilimnium costatum	Ribbed bishop-weed	SR-P	Tidal swamps or marshes.	Yes/No
Rhexia cubensis	West Indies meadow-beauty	W	Limesink ponds.	No/No
Rhynchospora careyana	Carey's beaksedge	W	Limesink ponds, and clay-based Carolina bays.	No/No
Rhynchospora inundata	Narrowfruit beaksedge	W	Limesink ponds, and clay-based Carolina bays.	No/No
Rhynchospora pallida	Pale beaksedge	W	Savannas, sandhill seeps, and pocosins.	Yes/No
Rhynchospora scirpoides	Long-beak baldsedge	W	Beaver ponds, limesink ponds, and wet savannas.	No/No
Rhynchospora tracyi	Tracy's beaksedge	SR-P	Clay-based carolina bays, and limesink ponds.	Yes[†]/No
Sabatia dodecandra	Large marsh pink	W*	Tidal, brackish, and freshwater marshes.	No/No
Sagittaria isoetiformis	Quillwort arrowhead	SR-P	Limesink ponds, clay-based Carolina bays, beaver ponds, and natural lakes.	No/No
Salvia azurea	Azure sage	SR-P*	Sandhills.	No/No
Schizachyrium littorale	Seaside little bluestem	W	Coastal dunes and maritime dry grasslands.	No/No
Schoenoplectus americanus	Olney threesquare	W	Tidal marshes.	No/No
Schoenoplectus californicus	California bulrush	W*	Tidal marshes.	No/No
Scleria georgiana	Georgia nutrush	W	Savannas.	No/No
Scleria reticularis	Netted nutrush	SR-O	Clay-based carolina bays and limesink ponds.	No/No
Sesuvium portulacastrum	Shoreline sea-purslane	SR-P	Ocean beaches.	No/No

Table 3-15 State Rare Species Reported from New Hanover County, North Carolina[a] (Cont.)

Scientific Name	Common Name	State Status[b]	Habitat	Potential Presence on or near WS/GLEF[c,d]
Sideroxylon lycioides	Buckthorn bumelia	W	Maritime forests, bluffs, or forests over calcareous or mafic rocks.	No/No
Solidago tortifolia	Twisted-leaf goldenrod	SR-P*	Dry savannas and mesic flats.	Yes/No
Spiranthes laciniata	Lace-lip ladies'-tresses	SR-P	Moist wet habitats.	Yes[†]/No
Symphyotrichum elliottii	Elliot's aster	W*	Freshwater or brackish marshes.	No/No
Syngonanthus flavidulus	Yellow hatpins	W*	Ditches, pocosin ecotones, and savannas.	Yes/No
Trifolium carolinianum	Carolina clover	SR-O*	Savannas and sandy open areas.	No/No
Typha domingensis	Southern cattail	W*	Brackish marshes.	No/No
Utricularia cornuta	Horned bladderwort	SR-P*	Bogs and limestone ponds.	No/No
Utricularia olicacea	Dwarf bladderwort	T	Limesink ponds and beaver ponds.	No/No
Verbena scabra	Sandpaper vervain	W*	Marsh edges and shell middens.	No/No
Vigna luteola	Wild cowpea	W*	Marsh edges and wet open areas.	No/No
Viola villosa	Carolina violet	W*	Moist places, especially pocosin edges.	Yes/No
Xyris smalliana	Small's yellow-eyed-grass	W	Pineland pools, limesink ponds, and shores.	No/No
Yucca aloifolia	Aloe yucca	W	Dunes.	No/No
Yucca gloriosa	Moundlily yucca	SR-P	Dunes.	No/No
Zizania aquatica	Wild rice	W	Freshwater marshes.	No/No
Invertebrates				
Amblyscirtes alternata	Dusky roadside-skipper	SR+	Open pine woods and savannas.	Yes/No

Table 3-15 State Rare Species Reported from New Hanover County, North Carolina[a] (Cont.)

Scientific Name	Common Name	State Status[b]	Habitat	Potential Presence on or near WS/GLEF[c,d]
Anodonta couperiana	Barrel floater	E*	Ponds or slow-flowing streams in soft substrates.	Yes/No
Calephelis virginiensis	Little metalmark	SR	Savannas and pine flatwoods.	Yes/No
Catocala amestris	Three-staff underwing	SR	Sand ridges and flatwoods with leadplant.	Yes/No
Catocala jair	Jair underwing	SR	Xeric pine-oak sandhills.	No/No
Catocala marmorata	Marbled underwing	SR	Swamp forests with swamp cottonwood.	Yes/No
Catocala messalina	Messalina underwing	SR	Maritime forests and mesic sandhills.	No/No
Cerma cora	A bird-dropping moth	SR	Levee forests with hawthorn.	No/No
Chaetaglaea fergusoni	A noctuid moth	SR	Sandhills.	No/No
Cyclophora sp. 1 (*culicaria*)	Sand-myrtle geometer	SR	Flatwoods with sand-myrtle.	Yes/No
Datana ranaeceps	A hand-maid moth	SR	Recently burned flatwoods and sandhills.	Yes/No
Doryodes sp. 1	A noctuid moth	SR	Savannas, flatwoods, and sandhills.	Yes/No
Drasteria graphica	Graphic moth	SR	Maritime shrub thickets.	No/No
Elliptio marsupiobesa	Cape Fear spike	SC	Low-gradient creeks in variable substrates.	Yes/No
Eupithecia peckorum	An inchworm moth	SR	Sandhills and flatwoods.	Yes/No
Heterocampa varia	A prominent moth	SR	Xeric pine-oak sandhills.	No/No
Lithophane laceyi	A pinion moth	SR	Swamp forests.	Yes/No
Lynceus gracilicornis	Graceful clam shrimp	SC	Temporary ponds, pools, and ditches.	Yes/No
Metarranthis sp. 1	An new inchworm moth	SR	Pocosins.	Yes/Yes
Papilio cresphontes	Giant swallowtail	SR	Primarily coastal in maritime forests or thickets.	No/No
Procambarus plumimanus	Croatan crayfish	SR	Rivers, ponds, ditches, and borrow pits.	Yes/No

Table 3-15 State Rare Species Reported from New Hanover County, North Carolina[a] (Cont.)

Scientific Name	Common Name	State Status[b]	Habitat	Potential Presence on or near WS/GLEF[c,d]
Ptichodis bistrigata	Southern ptichodis	SR	Xeric sandhills.	No/No
Satyrium favonius favonius	Southern oak hairstreak	SR	Maritime forests along the southern coast.	No/No
Schizura apicalis	Plain schizura	SR	Dry woodlands or scrub.	Yes/Yes
Trichosilia manifesta	An owlet moth	SR	Xeric oak woodlands.	No/No
Zale declarans	An owlet moth	SR	Maritime forests with live oak.	No/No
Fishes				
Fundulus luciae	Spotfin killifish	SR	Ponds and pools along the coast.	Yes†/No
Heterandria formosa	Least killifish	SC	Streams and lakes near Wilmington.	No/No
Amphibians				
Ambystoma mabeei	Mabee's salamander	SR*	Savannas, wet woods, and swamps.	Yes†/No
Pseudacris ornata	Ornate chorus frog	SR*	Swamps, savannas, and wooded ponds and pools.	Yes/No
Reptiles				
Crotalus adamanteus	Eastern diamondback rattlesnake	E	Pine flatwoods, savannas, and pine-oak sandhills.	Yes/Yes
Deirochelys reticularia	Chicken turtle	SR	Quiet waters of ponds, ditches, and sluggish streams.	Yes/No
Malaclemys terrapin centrata	Carolina diamondback terrapin	SC	Salt or brackish marshes, estuaries.	No/No
Masticophis flagellum	Coachwhip	SR	Dry and sandy woods, mainly in pine/oak sandhills.	Yes†/Yes
Micrurus fulvius	Eastern coral snake	E	Pine-oak sandhills, sandy flatwoods, and maritime forests.	Yes/Yes

Table 3-15 State Rare Species Reported from New Hanover County, North Carolina[a] (Cont.)

Scientific Name	Common Name	State Status[b]	Habitat	Potential Presence on or near WS/GLEF[c,d]
Regina rigida	Glossy crayfish snake	SR*	Marshes, cypress ponds, and other wetlands.	No/No
Seminatrix pygaea	Black swamp snake	SR	Lush vegetation of ponds, ditches, or sluggish streams.	Yes/No
Sistrurus miliarius	Pigmy rattlesnake	SC	Pine flatwoods, pine/oak sandhills, other pine/oak forests.	Yes/Yes
Birds				
Charadrius wilsonia	Wilson's plover	SC	Beaches, island-end flats, and estuarine islands.	No/No
Columbina passerina	Common ground-dove	SR	Dunes, sandy fields, and margins of marine woods and thickets.	No/No
Egretta aerulea	Little blue heron	SC	Forests or thickets on maritime islands.	No/No
Egretta tricolor	Tricolored heron	SC	Forests or thickets on maritime islands.	No/No
Haematopus palliatus	American oystercatcher	SC	Estuaries, oyster beds, and mudflats.	No/No
Ixobrychus exilis	Least bittern	SC	Fresh or brackish marshes.	No/No
Lanius ludovicianus	Loggerhead shrike	SC	Fields and pastures.	Yes/No
Laterallus jamaicensis	Black rail	SC	Brackish marshes, rarely freshwater marshes.	No/No
Pelecanus occidentalis	Brown pelican	SR	Maritime islands.	No/No
Plegadis falcinellus	Glossy ibis	SC	Forests or thickets on maritime islands.	No/No
Rynchops niger	Black skimmer	SC	Sand flats on maritime islands.	No/No
Sterna hirundo	Common tern	SC	Sand flats on maritime islands.	No/No
Sternula antillarum	Least tern	SC	Beaches, sand flats, and open dunes.	No/No

Table 3-15 State Rare Species Reported from New Hanover County, North Carolina[a] (Cont.)

Scientific Name	Common Name	State Status[b]	Habitat	Potential Presence on or near WS/GLEF[c,d]
Mammals				
Condylura cristata pop. 1	Star-nosed mole – coastal plain population	SC*	Moist meadows, bogs, swamps, and bottomlands.	Yes/No
Lasiurus intermedius	Northern yellow bat	SC	Roosts in Spanish moss and other thick vegetation near water, often in longleaf pine habitats.	Yes/Yes
Neotoma floridana floridana	Eastern woodrat – coastal plain population	T	Forests, mainly in moist areas.	Yes/No
Sciurus niger	Eastern fox squirrel	SR-G	Open forests, mainly longleaf pine/scrub oak.	Yes[†]/Yes

[a] Excludes endangered, threatened, and special concern species previously listed in Table 3-14.

[b] E = endangered; G = game animal that by law cannot be listed for State protection as endangered, threatened, or special concern; SC = special concern; SR = significantly rare; SR-D = significantly rare – disjunct; SR-L = significantly rare – limited; SR-O = significantly rare – other; SR-P = significantly rare – peripheral; SR-T = significantly rare – throughout; T = threatened; W = watch list; * = recorded occurrence is either extirpated, have not been found in recent surveys, or have not been surveyed recently enough to be confident that it is still present, + = record is obscure or undatable.

[c] WS = Wilmington Site, GLEF = proposed GLE Facility site.

[d] † = there is an occurrence record for the species within 3.2 kilometers (2 miles) of the Wilmington Site.

Sources: Buchanan and Finnegan, 2008; LeGrand et al., 2008; NCNHP, 2009.

The following definitions are applicable for the State listed species (Buchanan and Finnegan, 2008; LeGrand et al., 2008):

- *Endangered plant*: any species or higher taxon of plant whose continued existence as a viable component of the State's flora is determined to be in jeopardy. Endangered plants may not be removed from the wild except when a permit is obtained for research, propagation, or rescue that will enhance the survival of the species.

- *Endangered animal*: any native or once-native species of wild animal whose continued existence as a viable component of the State's fauna is determined by the North Carolina Wildlife Resource Commission to be in jeopardy or any species of wild animal determined to be an "endangered species" pursuant to the ESA.

- *Threatened plant*: any resident species of plant that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. Threatened plants may not be removed from the wild except when a permit is obtained for research, propagation, or rescue that will enhance the survival of the species.

- *Threatened animal*: any native or once-native species of wild animal that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range, or one that is designated as a threatened species pursuant to the ESA.

- *Special concern plant*: any species of plant that requires monitoring but which may be collected and sold under regulations adopted under the provisions of the *Plant Protection and Conservation Act*.

- *Special concern animal*: any native or once-native species of wild animal that is determined by the Wildlife Resources Commission to require monitoring but which may be taken under regulation.

- *Significantly rare plant*: any plant species not listed by the North Carolina Plant Conservation Program as endangered, threatened, or special concern species, which is rare in North Carolina, generally with 1 to 100 populations in the State, frequently substantially reduced in numbers by habitat destruction (and sometimes also by direct exploitation or disease).

- *Significantly rare animal*: any wild animal species not listed by the North Carolina Wildlife Resources Commission as an endangered, threatened, or special concern species, but which exists in the State in small numbers and has been determined by the North Carolina Natural Heritage Program to need monitoring.

- *Watch list*: any plant or animal species believed to be rare and of conservation concern in the State but not warranting active monitoring at this time.

Qualifying categories are also applied to some of the species that are considered significantly rare, as follows: *disjunct* – the species in North Carolina is separated from its main range in a different part of the country or world; *limited* – the range of the species is limited to North Carolina and adjacent states and the species may have only 20 to 50 populations in North

Carolina, but fewer than 100 populations rangewide; *other* – the range is sporadic or cannot be described by other significantly rare categories; *peripheral* – the species is at the periphery, or edge, of its range in North Carolina; and *throughout* – the species is rare throughout its entire range (i.e., fewer than 100 populations in total)

3.9 Noise

Any pressure variation that the human ear can detect is considered sound; noise is unwanted sound. Sound is described in terms of amplitude (perceived as loudness) and frequency (perceived as pitch). Sound pressure levels are typically measured on a logarithmic decibel (dB) scale. To account for human sensitivity to frequencies of sound (i.e., humans are less sensitive to lower and higher frequencies and most sensitive to sounds between 1 and 5 kilohertz), A-weighting (denoted by dBA), which is correlated with a human's subjective reaction to sound, is widely used (ASA, 1983; ASA, 1985). To account for variations of sound with time, the equivalent continuous sound level (L_{eq}) is employed. L_{eq} is the continuous sound level during a specific time period that would contain the same total energy as the actual time-varying sound. For example, $L_{eq\ (24)}$ is the 24-hour equivalent continuous sound level. In addition, human responses to noise differ depending on the time of the day (e.g., there is more annoyance over noise during nighttime hours due to low background levels). The day-night average sound level (L_{dn} or DNL) provides an average of the level over a 24-hour period after the addition of 10 dB to noise during nighttime hours (from 10 p.m. to 7 a.m.) to account for the greater sensitivity of most people to it. Day-night average sound level is widely used for community noise and airport noise assessments. Generally, a 3-dB change is considered a just noticeable difference, and a 10-dB increase is subjectively perceived as a doubling in loudness and almost always causes an adverse community response. See the text box (next page) for the definition of noise-related technical terms and some simple rules governing sound levels.

The *Noise Control Act of 1972*, along with its subsequent amendments (*Quiet Communities Act of 1978*, 42 USC 4901 et seq.), delegates to the States the authority to regulate environmental noise and directs government agencies to comply with local community noise statutes and regulations. Many local noise ordinances are qualitative and prohibit excessive noise or noise that results in a public nuisance. Because of the subjective nature of such ordinances, they are often difficult to enforce. However, several States and counties have established quantitative noise level regulations, which typically specify environmental noise limits based on the land use of the property receiving the noise.

New Hanover County has established quantitative community noise limits set forth in Chapter 23, Environment, Article II, Noise, in the County Code of Ordinances (New Hanover County, 2009a), although the State of North Carolina has not. For nonresidentially zoned districts, any noise source should not produce noise levels exceeding 75 A-weighted decibels (dBA), combined with the ambient noise, during daytime hours, and no more than 70 dBA during nighttime hours. Residentially zoned districts have lower criteria of 65 dBA during the daytime and 50 dBA at night. If the ambient noise level already exceeds the criteria, a violation shall occur only when such sound exceeds the ambient noise level by 3 dBA. Noise measurements shall be made at the nearest corner of the primary structure or at the boundary of the public ROW that adjoins the property of interest.

Definition of Noise-Related Technical Terms

Decibel (dB)	A unit describing the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure (typically 20 micropascals per square meter which is the lowest pressure level audible to humans), that is, $20 \bullet \log_{10}(P/P_{ref})$.
Frequency (Hz)	The number of complete pressure fluctuations per second above and below atmospheric pressure. The normal hearing of a young healthy person ranges from 20 to 20,000 Hz.
A-weighted sound level (dBA)	The most common frequency weighting on a sound level meter in a manner similar to the frequency response of the human ear, that is, low sensitivity to the very low and high frequencies and high sensitivity to middle frequencies; correlates well with subjective reactions to noise.
Equivalent continuous sound level (L_{eq})	The sound level (in dBA) that, had it been a steady level during the measurement period, would represent the amount of energy present in the measured, fluctuating sound pressure level.
Day-night average sound level (L_{dn} or DNL)	The sound level (in dBA) over a 24-hour period that accounts for human sensitivity to noise during nighttime hours (10 p.m. to 7 a.m.) due to relatively low background noise. The 10-dB penalty, which means 10 times more sound energy (e.g., noise from one car at night corresponds to a combined noise from 10 cars during the day), is added to the sound level measured during nighttime hours to estimate the DNL.
Loudness	Subjective magnitude of sound. As a rule of thumb, an increase of 10 dB is perceived to be approximately twice as loud. For example, 65 dB is perceived as being twice as loud as 55 dB.

Sound-Related Rules of Thumb

- Sound pressure level decreases at a rate of 6 dB and 3 dB per doubling of distance for point source (e.g., diesel generator at a fixed location) and line source (e.g., road traffic), respectively. For example, if the sound level of a point source is 60 dB at 15 meters (50 feet), then it is 54 dB at 30 meters (100 feet) and 48 dB at 60 meters (200 feet). If the sound level of a line source is 60 dB at 15 meters (50 feet), then it is 57 dB at 30 meters (100 feet) and 54 dB at 60 meters (200 feet).
- The doubling of sound energy increases the sound level by 3 dB. For example, if one source produces 80 dB, then the combined noise levels would be 83 dB for two identical sources and 86 dB for four identical sources.
- If the sound levels from two sources differ by 10 dB, the louder source will predominate. Accordingly, background noise level should be more than 10 dB below the sound level of a source being monitored to have confidence in the accuracy of the measurement.

The EPA identified noise levels requisite to protect public health and welfare against hearing loss, annoyance, and activity interference (EPA, 1974), as shown in Table 3-16. The EPA recommends a day-night average sound level of 55 dBA, which is sufficient to protect the public health and welfare in sensitive areas (e.g., residences, schools, and hospitals) from the effect of broadband environmental noise. These levels are not regulatory goals but are “intentionally conservative to protect the most sensitive portion of the American population” with “an additional margin of safety.” To ensure adequate protection for indoor living, a day-night average sound level of 45 dBA is recommended. For protection against hearing loss in the general population from nonimpulsive noise, the EPA guideline recommends a 24-hour equivalent sound level of 70 dBA or less over a 40-year period.

The Department of Housing and Urban Development (HUD) has developed regulations that are related to the overall community noise level. These regulations would only affect their own programs and are not binding on local communities; that is, HUD has no regulatory authority over noise sources. HUD considers day-night average sound levels from 65 to 75 dBA as “normally unacceptable [for housing]” and DNL levels above 75 dBA as “unacceptable” (24 CFR 51.103). Levels below 65 dBA are considered “acceptable.”

The Wilmington Site, including the proposed GLE Facility, is surrounded by a mix of land uses. The nearest sensitive receptors, areas of human habitation or use where the intrusion of noise has the potential to adversely impact the occupancy, use, or enjoyment of the environment, are located just next to the northeast site boundary and about 1.2 kilometers (0.8 mile) directly to the east of the proposed facility (GLE, 2008). Other land uses adjacent to the site include a hunting/recreational area to the north, the Northeast Cape Fear River to the southwest, I-140 to the south, and NC 133 (Castle Hayne Road) to the east. Highway I-140, which is elevated relative to the site, acts as a natural sound barrier and blocks noises from current site operations to the residences to the south. Industrial land uses are dominant on the west side of the Cape Fear River. No other residences and sensitive receptors (e.g., schools, hospitals, and nursing homes) are located in the immediate vicinity (within about 1.6 kilometers [1 mile]) of the Wilmington Site.

Table 3-16 Summary of Noise Levels Identified as Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety

Effect	Level[a]	Area
Hearing	$L_{eq(24)} \le 70$ dB	All areas (at the ear).
Outdoor activity interference and annoyance	$L_{dn} \le 55$ dB	Outdoors in residential areas and farms and other outdoor areas where people spend widely varying amounts of time and other places in which quiet is a basis for use.
	$L_{eq(24)} \le 55$ dB	Outdoor areas where people spend limited amounts of time, such as school yards, playgrounds, etc.
Indoor activity interference and annoyance	$L_{dn} \le 45$ dB	Indoor residential areas.
	$L_{eq(24)} \le 45$ dB	Other indoor areas with human activities such as schools, etc.

[a] L_{dn} = day-night average sound level; $L_{eq(24)}$ = 24-hour equivalent continuous sound level; dB = decibels.
Source: EPA, 1974.

Per New Hanover County zoning code, the entire Wilmington property (including industrial facilities, forest areas, and open-space areas) is currently zoned I-2 Industrial District (New Hanover County, 2009b). This zone is intended for heavy industrial uses, which allows the highest noise levels. Similar to those of any other industrial facilities, noise emission sources within the Wilmington Site are associated with various activities, including heavy equipment, mechanical systems, vehicular traffic, and public address system (GLE, 2008).

Natural sounds were observed during the baseline sound survey, including birds and insect noise, and leaf-rustling noise by wind. In particular, insect noises peaked at 4 kilohertz; they are typically overwhelmed by other created noises during the daytime but are prominent at night. Medium-density wooded areas and soft grounds could provide some attenuation for noise from the Wilmington Site to propagate to the neighboring areas. Noise sources outside the site boundary include local vehicular traffic on NC 133 and I-140, distant vehicular traffic on I-40, aircraft overflights, yard maintenance activities in the residential community, and gunshots from the hunting/recreation area.

The baseline sound survey was conducted from October 30 to November 1, 2007, to characterize the existing acoustic conditions (GLE, 2008). As shown in Figure 3-15, measurements were made at four onsite locations: northeastern property line near the residences in the Eastern Site Sector (position A); proposed GLE Facility (currently a tree farm) in the North-Central Site Sector (position B); northern edge of the existing GNF-A facility in the Eastern Site Sector (position C); and existing northern entrance roadway in the Eastern Site Sector (position D). Noise levels at the northern property line near the residences representative of community noise level (position A) ranged from 41 dBA (night) to 46 dBA (day) with a day-night average sound level of 48 dBA. These levels are well below the New Hanover County noise ordinance of 50 and 65 dBA, respectively, for residentially zoned districts and the EPA day-night average sound level guideline of 55 dBA. The noise levels at the proposed GLE Facility, which is currently wooded (position B), ranged from 40 dBA (night) to 48 dBA (day) with a day-night average sound level of 48 dBA. At the northern edge of the existing facility (position C), noise levels of 47 dBA (night) and 51 dBA (day) with a day-night average sound level of 54 dBA were recorded, which is characteristic of the noise levels from existing operations. The measurements at the northern entrance roadway (position D) were the highest among those at four measurement locations, ranging from 56 dBA (night) to 61 dBA (day) with a day-night average sound level of 63 dBA,[16] which reflects existing traffic noise levels within the Wilmington Site. Comparisons of sound levels from field observations demonstrated that noise levels at the northeastern property line near the residences have little correlation with consistent noise levels from the existing facilities and the northern entrance roadways. This suggests that sound levels at the northern property line originate from activities in the surrounding community, rather than from activities at the existing Wilmington Site facilities. Noise measurements were conducted in mid-fall when some deciduous trees lose their leaves, which can otherwise attenuate sound propagation to some extent. Accordingly, noise levels during this survey are considered as median values over the year. To date, no noise complaints have been reported from neighboring communities due to noisier sources outside the Wilmington Site, for example, nearby roadways.

[16] This location is inside the Wilmington Site, thus noise levels at this location are not subject to any noise guidelines or regulations. These noise levels are presented for informational purposes only.

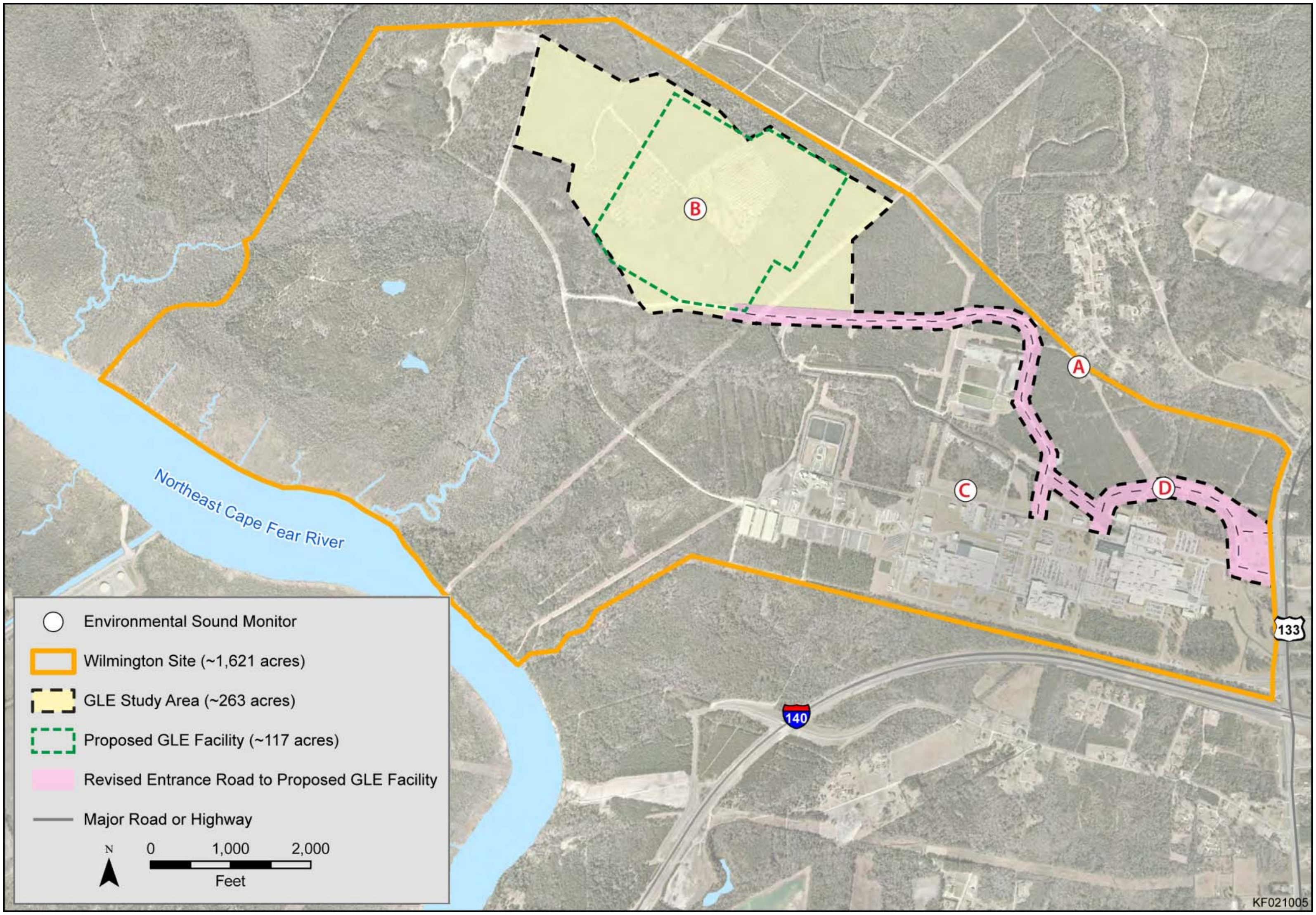

Figure 3-15 Locations of Sound Measurements Conducted from October 30 to November 1, 2007, at the Wilmington Site (Modified from GLE, 2008; GLE, 2009c)

For the general area surrounding the proposed GLE Facility, the countywide day-night sound level based on population density for the New Hanover County was estimated to be 51 dBA, typical of "quiet suburban residential" areas (Miller, 2002; Eldred, 1982).

3.10 Transportation

The Wilmington, North Carolina, area is readily accessible by road, rail, air, and water. The road network includes an interstate highway and several major U.S. highways. Public transportation in the area includes fixed bus and shuttle routes as well as a trolley in downtown Wilmington. The area is home to a major deepwater seaport that is served by a rail network that handles the incoming and outgoing cargo. Commercial airline service is provided by a regional airport.

3.10.1 Roads and Highways

Wilmington serves as the eastern terminus of I-40 as shown in Figure 3-16. I-40 briefly runs northward upon leaving Wilmington, intersecting I-95, the major east coast north-south interstate, at a distance of about 160 kilometers (100 miles). Shortly thereafter, I-40 passes through Raleigh, North Carolina, and begins its westward trek to its western terminus near Los Angeles, California. Another major north-south transportation corridor through the area is U.S. Route 17 that runs along the North Carolina coast, linking North Carolina with Virginia and South Carolina. Other major roads in the area include I-140, U.S. 74, U.S. 76, U.S. 421, and NC 132. All routes are available for the transport of goods and materials. The State of North Carolina has not limited the transport of hazardous materials to specifically designated routes within its boundaries (see *Transportation of Hazardous Materials; Designated, Preferred, and Restricted Routes*, 65 FR 75771, 75802 [December 4, 2000]).

I-140, a four-lane interstate highway (two lanes in each direction), considered to be the Wilmington Outer Loop, is under construction (GLE, 2008). The northern portion has been completed and connects U.S. 421 in the west with I-40 and U.S. 17 in the east. The western section of I-140, which links U.S. 421 with U.S. 74-76, has been funded and is scheduled for construction in 2011, while the southern portion, which is intended to link U.S. 74-76 with U.S. 17, has not yet been funded. As shown in Figure 3-17, the completed portion of I-140 passes directly south of the Wilmington Site and has an interchange with NC 133 (Castle Hayne Road).

Access to the Wilmington Site is gained from Castle Hayne Road immediately north of the I-140 interchange. Castle Hayne Road is a two-lane highway with an additional lane in each direction in the vicinity of the interchange with I-140 and the Wilmington Site. Table 3-17 provides the annual average daily traffic (AADT) flow on major roads near the Wilmington Site entrances. The AADT refers to the average number of vehicles in all lanes in both directions passing a point on a given road during an average day in the year. The current site entrance serves approximately 2800 workers employed at the Wilmington Site (GLE, 2008). Peak traffic periods related to site access occur during shift changes, such as at 3:00 p.m., as noted during a site visit on July 24, 2007 (GLE, 2008).

A second entrance, located 0.04 kilometer (0.25 mile) north of the entrance at the intersection of Castle Hayne Road and I-140, is used for truck deliveries and shipments. About

Figure 3-16 Map of the Wilmington Region

Figure 3-17 Local Map of the Wilmington Area

Table 3-17 Annual Average Daily Traffic (AADT) on Major Roads near the Wilmington Site

Road	General Direction	Location	AADT (Vehicles)
Castle Hayne Rd.	North-South	South of Sonday Rd.	13,000
		North of McDougald	10,000
		North of I-140 near site entrance	12,000
		South of I-140	12,000
		North of Old Mill Rd.	14,000
		North of Kerr Ave.	17,000
I-140	East-West	West of Castle Hayne Rd.	16,000
		East of Castle Hayne Rd., West of I-40	18,000
		East of I-40	14,000
I-40	North-South	North of I-140	30,000
		South of I-140	27,000

Source: NCDOT, 2006.

1000 radioactive material shipments a year are made to and from the Wilmington Site (GLE, 2009a). Outbound radioactive material truck shipments enter I-140 from NC 133 on their way to I-40 and their interstate destinations. Similarly, inbound interstate shipments would take the reverse course, coming in through I-40 to I-140 and exiting at NC 133 near the Wilmington Site entrance.

Wave Transit, the operating name for the Cape Fear Public Transportation Authority, which provides services for the City of Wilmington and New Hanover County (Wave Transit, 2009), operates bus routes in the area around the Wilmington Site. The Castle Hayne route passes by the Wilmington Site entrance on Castle Hayne Road. Wave Transit also operates a trolley that serves the downtown Wilmington area and shuttle buses that serve the University of North Carolina – Wilmington campus approximately 3 kilometers (2 miles) west of downtown.

3.10.2 Rail Network

The CSX Corporation provides freight service to the Wilmington area with primary terminals at the Port of Wilmington and the U.S. Army Military Ocean Terminal at Sunny Point. Nearly all rail freight traffic to these two terminals is routed through Hamlet, 179 kilometers (111 miles) to the west (NCDOT, 2005). Currently, there is no passenger train service to Wilmington, but studies have been conducted to assess interest and feasibility (NCDOT, 2005). The Wilmington Site has no current plans for shipping by rail and no direct rail access, but it is within several miles of the freight terminal in Wilmington.

3.10.3 Water

The Cape Fear River and the Intracoastal Waterway in and around Wilmington are maintained by the U.S. Army Corps of Engineers (USACE) to support commercial and recreational navigation. The southwestern portion of the Wilmington Site borders the Cape Fear River north of the city.

The Port of Wilmington is a major East Coast deepwater port near downtown. Direct rail access and easy access to I-40 are available for freight shipments. Approximately 3.6 million metric tons (4 million tons) of goods pass through the port annually in the form of containerized, bulk, and breakbulk cargoes. The top five imports in fiscal year 2006, in terms of tonnage, passing through the port were forest products, chemicals, cement, general merchandise, and coal (GLE, 2008). Wood pulp, forest products, general merchandise, food, and chemicals were the top five exports, in terms of tonnage, during the same period (GLE, 2008).

3.10.4 Air

The Wilmington International Airport provides regional passenger service to Charlotte, New York, Atlanta, and Philadelphia. The airport is serviced by two major domestic commercial airlines. International service is only provided by either corporate or personal aircraft. The nearest major airports are Raleigh-Durham International Airport (122 kilometers [145 miles] to the north-northwest) and Charlotte-Douglas International Airport (322 kilometers [200 miles] to the west-northwest). Several smaller municipal and private airports and heliports also serve the Wilmington area in New Hanover County (3), Brunswick County (7) and Pender County (4) (FAA, 2009).

3.11 Public and Occupational Health

As described in Sections 3.5 through 3.7, several different media in and around the Wilmington Site contain radionuclides and chemicals that are both naturally occurring and anthropogenic (i.e., resulting from human activity) from historical and current operations at the site. These media include soil, surface water, sediment, groundwater, and air. This section describes these radiological and chemical background and anthropogenic levels in terms of public and occupational exposure and health, as well as historical exposure levels for activities similar to the proposed action. It also summarizes the cancer incidence and death rates in the region, which were necessary to establish baseline information for the Chapter 4 analysis of impacts on public and worker health that may be due to the proposed action.

3.11.1 Background Radiological Exposure

Humans are exposed to ionizing radiation from many naturally occurring sources in the environment and created sources that include human enhancement of natural sources of radiation. The current sources of radiation at the proposed GLE site include natural background sources and created sources, including the GNF-A facility. Section 3.11.1.1 discusses the exposure from general background radiation that includes naturally occurring sources and created sources, excluding the exposure from GNF-A facility operations. Radiological exposures from the operation of the existing GNF-A facility are discussed in Section 3.11.1.2.

3.11.1.1 General Background Radiation

Radioactivity from naturally occurring elements in the environment is present in soil, rocks, and living organisms. A major proportion of natural background radiation comes from naturally occurring airborne sources such as radon. The natural radiation sources contribute approximately 3.11 millisieverts per year (311 millirem per year) to the radiation dose that a member of the U.S. population receives annually. The majority of this exposure – approximately 2 millisieverts per year (200 millirem per year) – is from inhalation of naturally occurring radon gas from soil, rock, and water. The other sources of exposure include external exposure from terrestrial sources and natural radiation of cosmic origin and exposure from radionuclides that exist in the body. The radiation dose from natural sources of external gamma radiation in North Carolina is 1.2 millisieverts per year (120 millirem per year) (Kathren, 1984).

Created sources include computed tomography (CT scan) for medical purposes, nuclear medicine, interventional fluoroscopy for medical purposes, X-rays for medical purposes, consumer products, industrial, and occupational exposure. A person living in the United States received an average effective dose of about 6.2 millisieverts (620 millirem) in 2006 (NCRP, 2009). Figure 3-18 shows the percentage contribution to the total dose from different sources.

3.11.1.2 Radiological Exposure from GNF-A Operations

The existing facilities on the Wilmington Site that can contribute to radiological exposure are the nuclear fuel complex and WFSC. The fuel complex includes the FMO/FMOX buildings, the DCP building, the Waste Treatment Facility, process basins, and other support facilities. The SCO and FCO facilities handle only nonradioactive components. Therefore, no radioactivity is released to the environment from SCO and FCO facilities.

Radiological Exposure to the General Public

Airborne and liquid effluent releases of radionuclides from the existing operations of the nuclear fuel complex and WFSC at the Wilmington Site result in radiation exposure to people in the vicinity of the site. The most likely public exposure pathway is by inhalation of airborne effluents.

The gamma radiation exposure levels measured at the site boundary are at background levels (GLE, 2009a); therefore, direct radiation exposure is not a significant exposure pathway for the public from existing GNF-A operations.

The airborne effluent releases from the FMO facility vents are sampled continuously. For the period 1995 to 2005, the gross alpha activity released per year from the FMO facility vents ranged from 5.55×10^5 to 7.29×10^6 becquerels (15 to 197 microcuries) (GLE, 2008). The maximum release was in 1997, the year in which the FMO facility switched from a wet process of converting uranium hexafluoride (UF_6) to uranium dioxide (UO_2) to a dry conversion process; a decreasing trend has been observed since then.

The airborne effluent from WFSC stacks is monitored for gross beta emissions. Cobalt-60 is the main source of beta emissions. For the period 2006 to 2008, the gross beta concentrations at

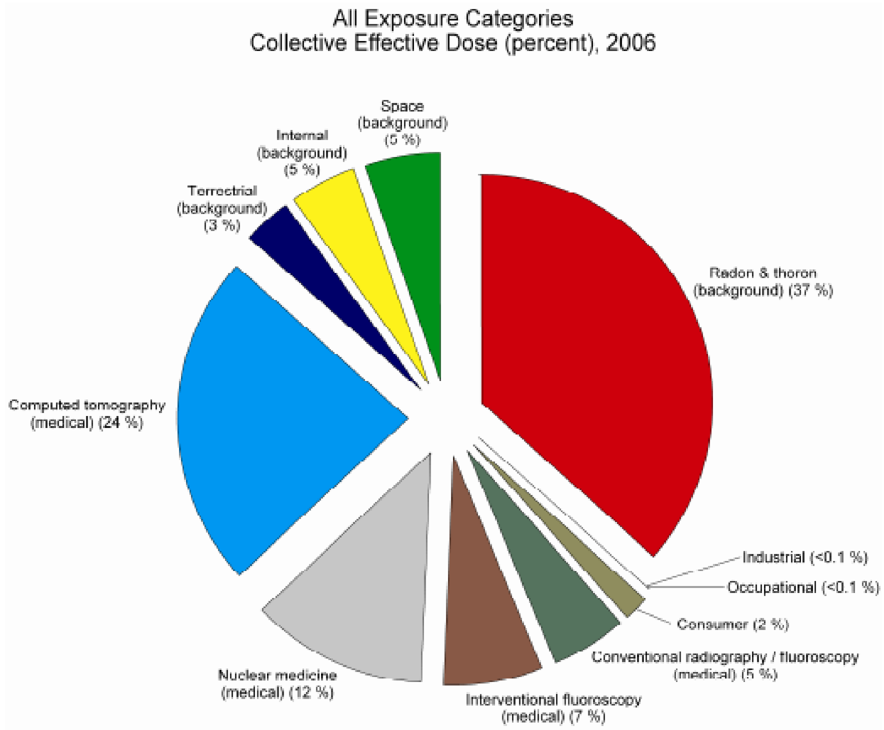

Figure 3-18 Percentage Contribution to the Effective Dose in the U.S. Population for 2006 (NCRP, 2009)

the release points ranged from 6.7×10^{-5} to 4.4×10^{-4} becquerels per cubic meter (1.8×10^{-15} to 1.2×10^{-14} microcuries per cubic centimeter) (GLE, 2009a).

Continuous ambient air monitoring for gross alpha activity is conducted at six air sampling stations as shown in Figure 3-19. For the period 1995 to 2005, average gross alpha measurements from GNF-A ambient air samplers ranged from 8.1×10^{-5} to 1.7×10^{-4} becquerels per cubic meter (2.2×10^{-15} to 4.5×10^{-15} microcuries per cubic centimeter) (GLE, 2008). These levels are approximately one order of magnitude below the most restrictive maximum allowable uranium air concentration limit of 5×10^{-14} microcuries per cubic centimeter in 10 CFR Part 20, Appendix B.

Ambient air radiation levels are also monitored by the North Carolina Radiation Protection Section (RPS) of the NCDENR. There are two RPS air samplers located on the Wilmington Site. The first is at the fence near the southern boundary of the site, and the second is located at the site dock on the Cape Fear River. Both of these air samplers are colocated with GNF-A ambient air samplers. In 1995, GNF-A monitoring and the RPS onsite sampling results were comparable (NRC, 1997). The RPS also has two monitoring stations offsite. A comparison of the GNF-A onsite air sampling results with offsite samplers indicates that the measured concentrations are at background levels and do not indicate any elevated levels of alpha activity (NCDENR, 2009b).

On the basis of modeling of total radionuclide releases to the air for the years 1995 to 2005 from the FMO facility stacks, the estimated radiation dose to the nearest resident assumed to be at

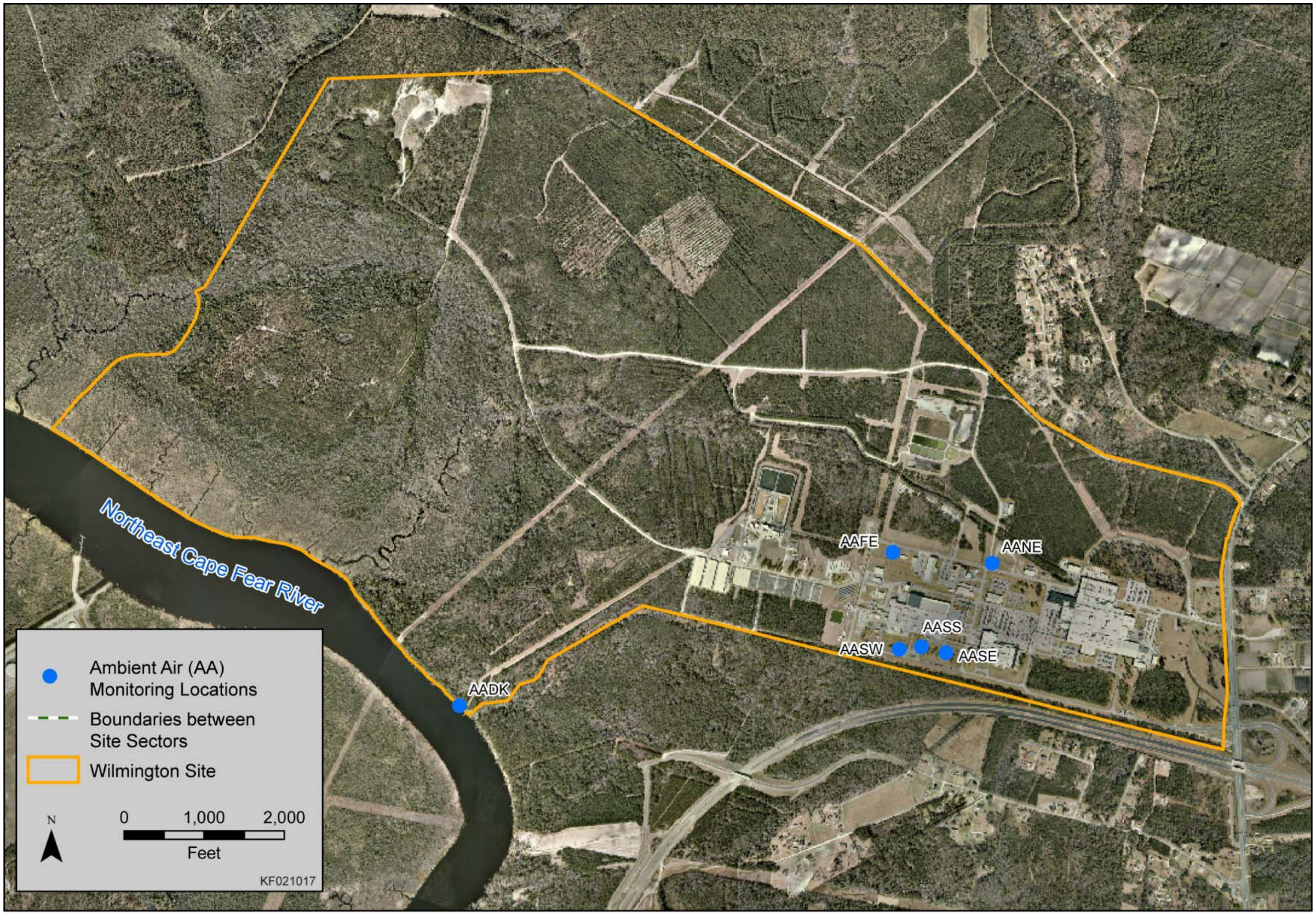

Figure 3-19 Onsite Ambient Air Monitoring Locations for Gross Alpha and Uranium Isotopes (GLE, 2008)

the site boundary (located 130 to 384 meters [427 to 1260 feet] south of the FMO facility stack) by using the COMPLY code, ranged from 0.00027 millisievert (0.027 millirem) in 2002 to 0.0040 millisievert (0.40 millirem) in 1997 (GLE, 2008). These estimated doses to the nearest resident are well below the NRC limit of 1 millisievert per year (100 millirem per year) in 10 CFR 20.1301(a).

To confirm that air emissions are within regulatory requirements and are not harmful to human health, the dose to a hypothetical person living at the site boundary for 2006 to 2008 from FMO facility stack releases was also calculated. The yearly estimated doses from air effluent releases varied from 0.00035 to 0.00040 millisieverts per year (0.035 to 0.040 millirem per year). The distance to the nearest site boundary from different stacks varied from 130 to 384 meters (427 to 1260 feet) (GLE, 2009a). The estimated doses are well below the EPA's NESHAPs limit of 0.1 millisieverts per year (10 millirem per year), and the NRC total effective dose equivalent limit of 1 millisievert per year (100 millirem per year).

There are no liquid effluent releases from the WFSC, and the airborne effluent releases are about four orders of magnitude lower than the 10 CFR Part 20, Appendix B, Table 2 value for Cobalt-60 (GLE, 2009a). The concentrations at the site boundary would be much lower than the concentration at the release point. These concentrations would result in a yearly dose less than 0.0001 millisievert (0.01 millirem) at the site boundary.

Doses from the existing liquid effluent releases at the site were calculated from the liquid effluent flow concentrations from the Final Process Lagoon. The concentrations for 2003 to 2007 varied from 2.0×10^3 to 4.6×10^3 becquerels per cubic meter (5.44×10^{-8} to 1.25×10^{-7} microcuries per milliliter) compared with the NRC uranium liquid effluent concentration limit of 1.1×10^4 becquerels per cubic meter (3×10^{-7} microcuries per milliliter) in 10 CFR Part 20, Appendix B, Table 2. Assuming that an individual continuously ingests this water for one year, this concentration would result in the total effective dose equivalent (TEDE) in the range 0.09 to 0.21 millisieverts per year (9 to 21 millirem per year) (NRC, 2009).

<u>**Radiological Exposure to Occupational Workers**</u>

The Wilmington Site's occupational radiation exposure data for the last five years (FY 2003 to FY 2007) were reviewed (Burrows, 2004, 2005, 2006; Dickson, 2007; Lewis et al., 2008). The TEDE to the average worker during this period varied from 0.77 to 1.06 millisieverts (77 to 106 millirem). None of the workers received a dose greater than 7.5 millisieverts (750 millirem). These doses are well below the NRC limit of 50 millisieverts per year (5000 millirem per year) in 10 CFR 20.1201 and the Wilmington Site's administrative limit of 40 millisieverts per year (4000 millirem per year). Most of this exposure came from inhalation of uranium dust and direct contact with uranium.

3.11.2 Background Chemical Exposure

The existing FMO facility is the main source of potential airborne chemical exposures to either onsite or offsite populations in the vicinity of the proposed GLE Facility. UF_6 and hydrogen fluoride (HF) are the primary chemicals of potential concern because of their toxicity and the fact that both may be emitted as gases or vapors. HF is formed from the conversion of UF_6 to UO_2F_2 (uranyl fluoride) upon contact of UF_6 emissions with water in air. Such conversion is the source of HF emissions from the existing GNF-A facility as well as from the proposed GLE Facility. HF is a gas at ambient temperatures, while UF_6 may be vaporized (sublimated) from a solid state upon heating and may be emitted as a vapor, before condensing (desublimating) back to solid form in air after release. Exposures to UF_6 may occur in either its vapor or solid particulate form in air. However, the range of transport would be somewhat more limited in air than HF because of the precipitation of particulate UF_6 or UO_2F_2.

HF and uranium have different modes of toxicity, as discussed in Section 3.11.3.3, while concentration levels of concern are at similar levels. Because the concentrations of the two chemicals are linked due to the production of HF from UF_6 and because they have similar toxicity benchmark levels, which of the two governs exposure limits depends on the specific benchmark chosen. HF exposure may be limiting when using available limits for ambient air exposures, such as the California Reference Exposure Level of 14 micrograms per cubic meter (0.017 parts per million) for chronic exposures (Cal/EPA, 2003), or the State of Washington's Acceptable Source Impact Level of 8.7 micrograms per cubic meter (0.011 parts per million) (ATSDR, 2003).

Comparable public health benchmarks for uranium air concentrations are not available as such, since uranium is not typically an air pollutant. Occupational exposure standards, on the other hand, may be a bit more restrictive for uranium than for HF. For example, the 50 micrograms per cubic meter (soluble uranium forms) National Institute for Occupational Safety and Health (NIOSH) Time-Weighted Average (TWA) Recommended Exposure Level and the equivalent 50 micrograms per cubic meter Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (NIOSH, 1996, 2005) are more restrictive than OSHA's Permissible Exposure Limit for HF of 2.5 milligrams per cubic meter (3.1 parts per million) in air averaged over eight hours. For further comparison, the NIOSH standard for uranium levels Immediately Dangerous to Life and Health (IDLH) is 10 milligrams per cubic meter over a one-hour exposure, while the NIOSH IDLH for HF is 30 parts per million (25 milligrams per cubic meter) (ATSDR, 2003). Thus, the two chemicals have similar exposure limits in the workplace.

HF is produced at the FMO facility in a dry conversion process used to convert UF_6 to UO_2. Extensive measures are taken to prevent any significant emissions of HF, including the use of high-efficiency particulate air (HEPA) filters on general circulation air vents, and HEPA filter and permitted scrubbers, where needed, on process off-gas ventilation systems (NRC, 1997; NRC, 2009). A continuous HF monitoring system is operated on all process vents that may emit HF.

In 2004, the Wilmington Site emitted about 27 kilograms (60 pounds) of total fluorides and 15 kilograms (32 pounds) of hydrogen fluoride (Section 3.5.3.1), while in 2007, facility-wide fluoride emissions from the FMO and FCO complexes were 145 kilograms (320 pounds) (NRC, 2009). Current NCDENR Air Permit 1756R17 for the facility limits total HF emissions from the HF recovery building to no greater than 0.29 kilogram per day (0.63 pound per day) (24-hour period) and to no greater than 0.029 kilogram (0.063 pound) in any given hour and GNF-A facility-wide fluoride emissions to 9100 kilograms per year (20,000 pounds per year). As a "synthetic minor source," the site is required to report air emissions data to the State every three years, while facilities undergo permit verification annually by the State inspector.

Emissions of other criteria air pollutants and North Carolina TAPs from the FMO facility and other stationary sources near the Wilmington Site are discussed in Section 3.5.3.1. Among the TAPs, which include the Federal HAPs, the greatest emission quantities from the Wilmington Site for 2004 were for nitric acid (178 kilograms per year [393 pounds per year]) and ammonia (108 kilograms per year [237 pounds per year]). As noted in Section 3.5.3.1, these emissions rates are well below the major source thresholds of 9.1 metric tons per year (10 tons per year) for a single HAP and 23 metric tons per year (25 tons per year) for any combination of listed HAPs. Thus, emissions of TAPs are well below levels that would be of concern for health impacts, while those for HF and uranium are of relatively greater concern. Moreover, HF and uranium would be the main toxic air emissions of concern for the proposed GLE Facility.

UF_6 will also be used in the proposed GLE Facility, while both UF_6 and HF could be released from that facility under various accident scenarios. HF would be produced from the reaction of UF_6 with water in air (humidity) under an accidental release of UF_6.

Groundwater beneath the Wilmington Site has been affected by industrial operations at the site and is being actively remediated. Pollutants include VOCs, fluoride, nitrate, and uranium. Affected groundwater is not being used as a source of drinking water (Section 3.7.4.2). A network of groundwater monitoring wells is used to follow contaminant movements and to monitor the site perimeter. None of the surface water streams on the Wilmington Site are affected by chemical contamination. However, the Northeast Cape Fear River upstream of the site is listed as impaired because of mercury pollution, and a section of the river upstream is under a fish consumption advisory for mercury (NCDWQ, 2007).

GNF-A has discharge permits for treated process water and treated sanitary wastewater for an onsite effluent channel, which eventually empties into the Northeast Cape Fear River. The site is required to monitor wastewater discharges as well as stormwater surface runoff under its permits. Treated sanitary wastewater, however, is currently reused as cooling water onsite. Local surface water quality and the requirements of the Wilmington Site's water quality permits are discussed in Section 3.7.1.

The WFSC produces no liquid effluents and no air emissions of chemicals at levels of public health concern. The facility is not listed on either the site's air or water permit lists of site sources.

Hazardous chemical wastes produced at Wilmington Site facilities, the largest volume of which is etch-acid solution, are collected, packaged, temporarily stored on site, and periodically shipped to a Resource Conservation and Recovery Act (RCRA)-permitted facility in Indianapolis, Indiana (GLE, 2008).

3.11.3 Public Health Studies

3.11.3.1 Regulatory Requirements for Public and Occupational Exposure

NRC regulations in 10 CFR Part 20 identify maximum allowable concentrations of radionuclides in air and water above background at the boundary of unrestricted areas to control radiation exposures of the public and releases of radioactivity. The most restrictive maximum allowable concentration in air and water for uranium isotopes is 5×10^{-14} and 3×10^{-7} microcuries per cubic centimeter, respectively (10 CFR Part 20, Appendix B). Other 10 CFR Part 20 requirements are that the sum of the external and internal doses (TEDE) for a member of the public may not exceed 1 millisievert per year (100 millirem per year) (10 CFR 20.1301(a)(1)), and the radiation levels at any unrestricted area should not exceed 0.02 millisievert (2 millirem) in any 1 hour and 0.5 millisievert (50 millirem) in a single year. (10 CFR 20.1301(a)(2)).

In addition to keeping within NRC requirements, releases to the environment must comply with EPA standards in 40 CFR Part 190, "Subpart B – Environmental Standards for the Uranium Fuel Cycle." These standards specify limits on the annual dose equivalent from normal operations of uranium fuel-cycle facilities (except mining, waste disposal operations, transportation, and reuse of recovered special nuclear and by-product materials). The public dose limit for annual whole body and organ is 0.25 millisievert (25 millirem), and for the thyroid it is 0.75 millisievert (75 millirem).

10 CFR 20.1201 limits the TEDE of workers to ionizing radiation. Table 3-18 provides occupational dose limits for radiation workers who work at nuclear facilities. Public and occupational standards for chemical exposures to HF and uranium are presented in the previous section.

3.11.3.2 Health Effects from Radiological Exposure

Radiation interacts with the atoms that form cells. There are two mechanisms by which radiation affects cells: direct action and indirect action. In a direct action, the radiation interacts directly with the atoms of the deoxyribonucleic acid (DNA) molecule or some other component critical to the survival of the cell. Since the DNA molecules make up a small part of the cell, the probability of direct action is small. Because most of the cell is made up of water, there is a much higher probability that radiation would interact with water (NRC, 2010). In an indirect action, radiation interacts with water and breaks the bonds that hold the water molecule together, producing reactive free radicals that are chemically toxic and destroy the cell. The body has mechanisms to repair damage caused by radiation. Consequently, the biological effects of radiation on living cells may result in one of three outcomes: (1) injured or damaged cells repair themselves, resulting in no residual damage; (2) cells die, much like millions of body cells do every day, being replaced through normal biological processes and causing no health effects; or (3) cells incorrectly repair themselves, which results in damaging or changing the genetic code (DNA) of the irradiated cell (NRC, 2004b). Stochastic effects, that is, effects that may or may not occur according to probability, may occur when an irradiated cell is modified rather than killed. The most significant stochastic effect of radiation exposure is that a modified cell may, after a prolonged delay, develop into a cancer.

The biological effects on the whole body from exposure to radiation depend on many factors, such as the type of radiation, total dose, time interval over which the dose is received, and part of the body that is exposed. Not all organs are equally sensitive to radiation. The blood-forming organs are most sensitive to radiation; muscle and nerve cells are relatively insensitive to radiation (NRC, 2010). Health effects may be characterized according to two types of radiation exposure: (1) a single accidental exposure to high doses of radiation for a short period of time (acute exposure), which may produce biological effects within a short time after exposure, and (2) long-term, low-level overexposure, commonly called continuous or chronic exposure. High doses of radiation can cause death. Other possible effects of a high radiation dose include

Table 3-18 Occupational Dose Limits for Adults Established by 10 CFR Part 20

Tissue	Dose Limit
Whole body or any individual organ or tissue other than the lens of the eye	More limiting of 0.05 Sv/yr (5 rem/yr) TEDE to whole body or 0.5 Sv/yr (50 rem/yr) sum of the deep dose equivalent and the committed dose equivalent to any individual organ or tissue other than the lens of the eye
Lens of the eye	0.15 Sv/yr (15 rem/yr) dose equivalent
Extremities, including skin	0.50 Sv/yr (50 rem/yr) shallow dose equivalent

erythema, dry desquamation, moist desquamation, hair loss, sterility, cataracts, and acute radiation syndromes (NRC, 2010). Currently there are no data to unequivocally establish the occurrence of cancer following exposure to low doses and dose rates – below about 100 millisieverts (10,000 millirem) (NRC, 2004b).

In estimating the health impacts from low dose or low dose rate exposure to occupational workers and the general public, the probability of a fatal cancer per unit of radiation exposure recommended by the International Commission on Radiological Protection (ICRP) was used. The estimated probability for workers is 4×10^{-2} sievert^{-1} and for the public it is 5×10^{-2} sievert^{-1} (ICRP, 1991). The estimated probability for the public is higher because it includes young people who are more sensitive to radiation (ICRP, 1991).

The National Program of Cancer Registries (NPCR) is the Centers of Disease Control and Prevention (CDC) State-based cancer control program. Under this program, States collect, manage, and analyze data about cancer incidence and mortality. The CDC and the National Cancer Institute release U.S. Cancer Statistics annually. Table 3-19 lists the cancer incidence and death rates for all cancers for 2000 to 2005 for North Carolina and the United States.

3.11.3.3 Health Effects from Chemical Exposure

Chemicals may enter the body through absorption through the skin, by inhalation, or by ingestion. Chemical exposure produces different effects on the body depending on the mode of action of the chemical and the amount of exposure. Some chemicals can cause cancer, affect reproductive capability, disrupt the endocrine system, or have other health effects. Acute effects from exposure to high levels of toxic chemicals occur immediately (e.g., when somebody inhales or ingests a poisonous substance such as cyanide). Chronic or delayed effects may be more subtle and are due to long-term, low-level exposure to toxic chemicals.

The primary chemicals of interest associated with the existing GNF-A facility, as well as the proposed GLE Facility, are uranium and HF associated with the UF_6 reaction with moisture in air. HF is an irritant gas that causes eye, nose, and skin irritation. Breathing high levels can also harm the lungs and heart (ATSDR, 2003). Irritant effects in humans, including respiratory tract inflammation, begin to be observed in the range of 1 to 10 parts per million, similar to occupational exposure limits. Low-level exposure effects are reversible once the exposure is terminated. Members of the public are generally not exposed to levels that have observable health effects from routine industrial emissions. Various potentially relevant exposure benchmarks for the public and occupational exposure to HF are presented in Section 3.11.2.

Table 3-19 Cancer Incidence and Death Rates for all Cancers for 2000 to 2005[a]

Area	All Cancer Incidence Rate	All Cancer Death Rate
United States	467.6	189.8
North Carolina	453.8	196.1

[a] Per 100,000 persons and are age adjusted to the 2000 U.S. standard population.
Source: CDC, 2009.

Uranium exerts heavy metal toxicity, primarily to the kidney (ATSDR, 1999). Exposure to uranium may be via inhalation or ingestion. The degree of absorption of inhaled uranium from the lung or of ingested uranium into the bloodstream is greater for more soluble forms of uranium, such as UO_2F_2, which is formed from the reaction of UF_6 and water. Little direct toxicological data are available on chemical toxicity in humans at low inhalation exposures. Standards are based mainly on tests in mammals, which show low-level systemic health effects beginning at inhalation exposures in the 0.1 to 1 milligram per cubic meter range for chronic exposures. These levels generally correspond to the occupational exposure standards discussed in Section 3.11.2.

The EPA is responsible for regulating most chemicals that can enter the environment. This authority is typically delegated to the States for implementation, as it is in North Carolina.

Disposal of the hazardous chemicals used at GNF-A is regulated via permits issued under RCRA, while discharges to waterways are regulated via NPDES permits issued under the CWA and air emissions via permits issued under the CAA. These permits are administered and enforced by the NCDENR, Division of Water Quality and Division of Air Quality, respectively. GNF-A is required by the NRC to operate in compliance with all of its permits, therefore minimizing the impact on the environment and on workers and the public.

3.11.3.4 Health Study of Mercury Emissions

In early 2009, Intertox of Seattle, Washington, completed an independent, peer-reviewed, study of potential health impacts from exposure to mercury emissions from the proposed Carolinas Cement plant in Castle Hayne, about 10 kilometers (6 miles) northeast of the proposed GLE Facility. The study concluded that exposures to plant emissions by residents of Castle Hayne and the greater Wilmington area would be minor and would not lead to any health effects, even in maximally exposed individuals, including those who subsisted mainly on fish from the river. The study found that greater than 98 percent of the estimated mercury exposure originating from the cement plant would be via consumption of fish from the Northeast Cape Fear River, which would bioconcentrate mercury transported to the river via the atmosphere. The study did find, however, that some individuals interviewed currently consumed fish from the river in excess of fish advisories in place as a result of existing mercury sources in the area, and thus, could benefit from reducing fish consumption (Intertox, 2009).

Mercury in its various forms is a listed HAP. For New Hanover, Brunswick, and Pender Counties surrounding and including the Wilmington Site, the NCDAQ reported a total of 135 kilograms (297 pounds) of mercury emissions of all forms from stationary sources in 2007 (NCDAQ, 2007). Of the nine source facilities listed by the NCDAC in New Hanover County, none are associated with the Wilmington Site. Mercury fish advisories, such as those that apply to regions of the Northeast Cape Fear River, may be the result of non-point sources or distant sources combined with bioaccumulation processes in fish.

3.11.4 Occupational Injury and Illness Rates

OSHA is responsible for developing and enforcing workplace safety regulations. Occupational hazards can be minimized when workers adhere to safety standards and use appropriate protective equipment; however, fatalities and injuries from accidents can still occur.

No fatalities have occurred in the nuclear facilities on the Wilmington Site. The GNF-A maintains a log and summary of recordable occupational injuries and illnesses under the guidance of OSHA's Occupational Injury and Illness Recording and Reporting Requirements in 29 CFR Part 1904. On the basis of the information provided by GLE (GLE, 2008, 2009a), the annual recordable accidents at the site varied from 3 to 22 for fiscal years 2000 to 2008. The number of recordable injuries/illnesses per year per 100 workers varied from 0.46 to 1.64 over the years 2000 to 2006 (GLE, 2008).

The U.S. Department of Labor, Bureau of Labor Statistics compiles annual injury and illness data, including the incidence rates by industry (DOL, 2008). GNF-A manufactures fuel assemblies and intermediate fuel components for the nuclear power industry, and its operations may also be classified as chemical manufacturing. The Bureau of Labor Statistics' national average incidence rate of nonfatal occupational injuries and illnesses for chemical manufacturing facilities for calendar year 2007 is 3.1, which is higher than the rates of 0.46 to 1.64 for GNF-A.

3.12 Waste Management

This section describes the solid and liquid, nonhazardous, hazardous, and radioactive wastes currently generated and managed by GE at the Wilmington Site. No radioactive mixed waste is currently generated. This reflects the baseline condition and is aside from the wastes that the proposed GLE Facility would generate and manage under the proposed action, which are described in Chapter 2. This section also describes the existing waste management practices used at the Wilmington Site, most of which would also be used to manage wastes from the proposed GLE Facility.

3.12.1 Current Waste Management Program

The Wilmington Site generates a range of gaseous, liquid, and solid waste streams from its current manufacturing operations. The radioactive and nonradioactive air emissions are discussed in Section 3.5.3.1. The liquid and solid wastes generated are regulated by the EPA's waste management and disposal programs implemented under RCRA Subtitle C (Hazardous Wastes) and Subtitle D (Nonhazardous Wastes). Wastewater treatment is discussed in Section 3.12.2. The treatment and disposal of solid waste generated from manufacturing operations and wastewater treatment are covered in Section 3.12.4. The liquid and solid wastes currently generated at the Wilmington Site are summarized in Table 3-21 in Section 3.1.2.3.

3.12.2 Wastewater Treatment

Sanitary wastewater and process wastewater effluents are the largest liquid waste streams generated at the Wilmington Site. The process wastewater effluents are from the current manufacturing operations, and the sanitary wastewater effluents are from the existing building restrooms, cafeteria, and other sanitary facilities. The wastewater streams generated by current operations are summarized in Table 3-20.

3.12.2.1 Sanitary Wastewater

Sanitary wastes at the Wilmington Site are collected in a sewer system that routes the waste to an onsite, activated sludge-aeration, treatment plant that incorporates a membrane bioreactor (GLE, 2008; GNF-A, 2008). The activated sludge process is a biological wastewater treatment process in which wastewater is fed into an aerated tank where microorganisms feed on the waste organic material (the bioreactor). The activated sludge (the microorganisms) is subsequently separated from the treated wastewater along with waste by-products by an ultrafiltration membrane and disposed of. The current activated sludge–aeration treatment plant was commissioned in April 2008. At that time, a water reuse permit from the NCDENR (NCDENR, 2007) was obtained to allow the use of the treated sanitary wastewater effluent as makeup water for Wilmington Site cooling towers (GLE, 2008). All treated sanitary wastewater effluent is currently used as makeup water for the cooling towers.

Prior to 2008, the treated sanitary wastewater effluent was released to the effluent channel, which flows into Unnamed Tributary #1, which empties into the Northeast Cape Fear River (Waters of the United States). The NPDES discharge permit (NPDES Permit NC0001228) for this activity allows up to 283,906 liters per day (75,000 gallons per day) of sanitary wastewater effluent to be discharged from the Wilmington Site (GLE, 2008). Figure 3-20 shows the discharge location of the sanitary wastewater treatment facility (Discharge Location 002). Prior to facility upgrades, the 2006 average daily discharge from the sanitary wastewater treatment facility to the effluent channel through Outfall 002 on its way to Discharge Location 002 was 124,919 liters per day (33,000 gallons per day) (Table 3-20). Sanitary wastewater must meet the monitoring requirements and effluent limitations as set forth in the NPDES permit from the NCDWQ. The sanitary wastewater effluent is monitored at Outfall 002, which is a location along the discharge pipe that drains from the sanitary wastewater treatment facility to the effluent channel just south of the treatment facility. Although GNF-A currently uses sanitary wastewater effluent for cooling tower makeup water, the NPDES discharge permit has been renewed. Therefore, discharge of treated sanitary wastewater to the effluent channel could be resumed, if necessary.

3.12.2.2 Process Wastewater

Current operations at the Wilmington Site include the combined GNF-A FMO facility, GNF-A FCO facility, GE AE operations, and GE SCO facility. These facilities all share a common wastewater treatment system designed to handle pre-treated process wastewater, nontreated

Table 3-20 Wastewater Streams Generated by Current Operations at the Wilmington Site

Wastewater Stream	Generation Frequency	NPDES Limit[a]	2006 Average Daily Flow Rate	Wastewater Treatment
Process wastewater	Continuous	6,813,741 lpd (1,800,000 gpd)	1,802,613 lpd (476,200 gpd)	pH adjustment, settling, aeration
Sanitary waste effluent	Continuous	283,906 lpd (75,000 gpd)	124,919 lpd (33,300 gpd)	Dual-train, extended, activated sludge-aeration wastewater treatment facility with chlorination/dechlorination[b]

[a] gpd = gallons per day; lpd = liters per day.
[b] The Wilmington Site sanitary wastewater treatment facility has recently been upgraded to a single-train, extended aeration activated sludge wastewater treatment facility with membrane ultrafiltration and ultraviolet (UV) filtration (operational March 2008).
Source: GLE, 2008.

process wastewater, filter backwash water, and noncontact cooling water (GLE, 2008). All treated wastewater is sent to the final process lagoon treatment facility (FPLTF), which discharges to the effluent channel (Discharge Location 001 in Figure 3-20). The 2006 average daily discharge from the final process lagoon facility was 1,802,613 liters per day (476,200 gallons per day) (see Table 3-21), approximately one quarter of the 6,813,741 liters per day (1.8 million gallons per day) of treated process wastewater allowed under the current NPDES discharge permit (NPDES Permit NC0001228) (GLE, 2008).

The FMO facility uses a DCP to convert its UF_6 waste directly to the oxide (UO_2). Two liquid waste streams are generated – one with a dilute HF concentration (approximately 1 to 2 percent HF), and a second with a higher concentration of HF (<50 percent). The dilute HF waste solution is mixed with lime ($Ca(OH)_2$) to form calcium fluoride (CaF_2) which is insoluble in water and precipitates out as a solid. The CaF_2 solid phase is dewatered and sent to the Energy*Solutions* disposal facility in Clive, Utah, along with other wastes (see Section 3.12.4.2). The liquid phase from the dewatering unit is pH-adjusted and combined with other waste streams before any final treatment and discharge to the effluent channel. The more concentrated HF solution produced during the conversion of UF_6 to UO_2 is sold for industrial and commercial uses. Under safety condition S-2 of NRC license SNM-1097, GNF-A is granted the special authorizations stated in Section 1.3 of its license renewal application, including authorization to transfer liquid HF to commercial chemical companies or suppliers as long as the concentration of uranium is maintained below three parts per million by weight, uranium-235 enrichment is less than five percent, and members of the general public are not exposed through any pathway to trace uranium concentrations higher than natural levels in products formed from its use (see Section 1.3.3.2 of [GNF-A, 2007]).

3.12.3 Other Liquid Waste

Aside from sanitary and process wastewater streams, other nonhazardous and hazardous liquid wastes are generated at the Wilmington Site. Nonhazardous industrial wastes, such as the 1592 metric tons (1755 tons) of used oils are sent offsite to the FCC Environmental Treatment Facility in Concord, North Carolina, for recycling and reuse as shown in Table 3-21. The GNF-A

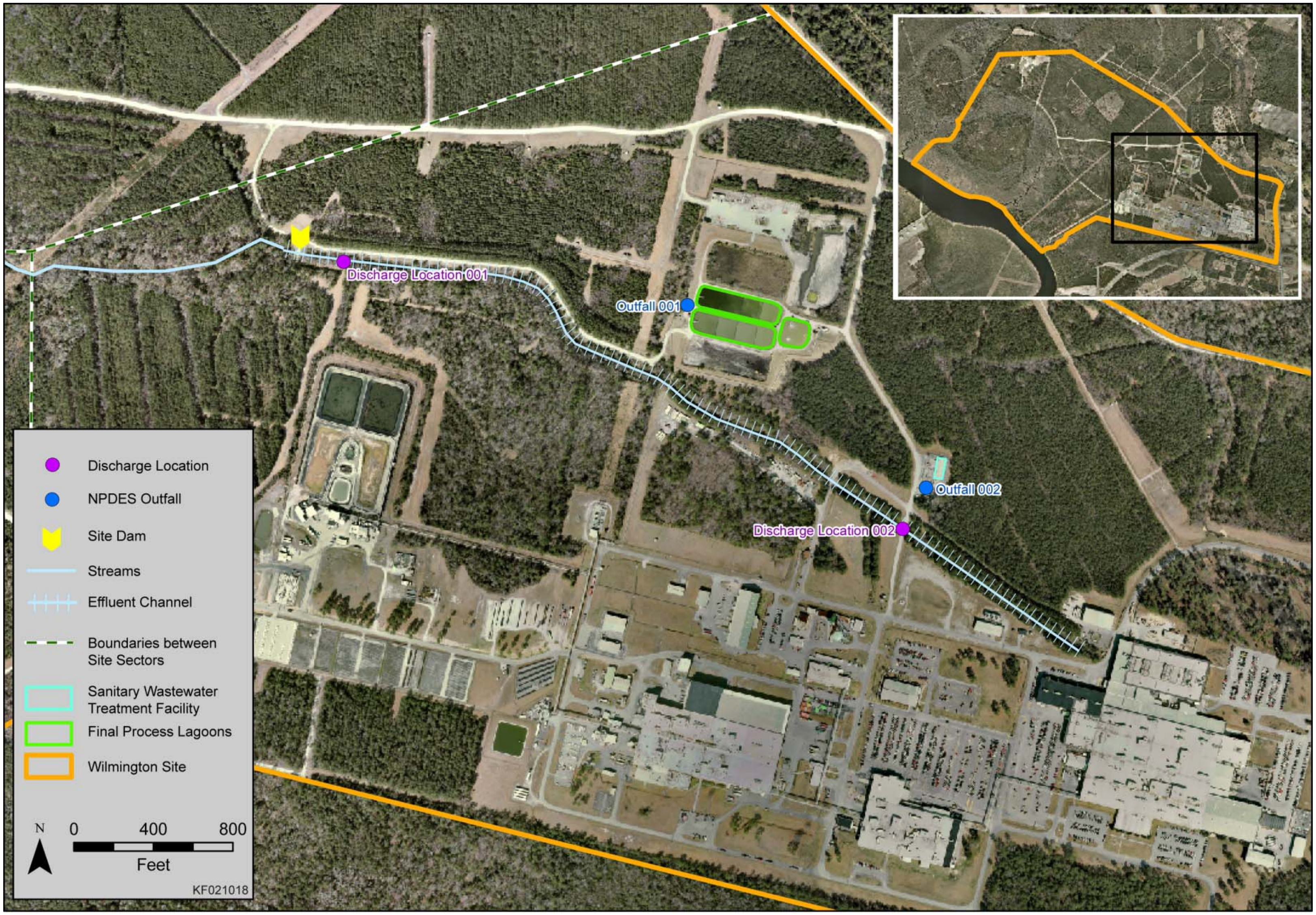

Figure 3-20 Existing Wastewater Treatment Facilities and Discharge Points at the Wilmington Site (GLE, 2008)

Table 3-21 Solid and Liquid Wastes Generated by Current Operations at the Wilmington Site

Waste Type	Waste Generation Source (Wilmington Site)	Waste Composition	Annual[a] Quantity Generated	Offsite Treatment or Disposal Facility (Type and Location)
Municipal solid waste	GNF-A operations and GE AE/SCO	• Refuse and other nonhazardous solid wastes accepted at landfill	898 metric tons (990 tons)	New Hanover County Landfill Wilmington, North Carolina
Nonhazardous industrial wastes	GNF-A operations	• Used NaOH solution[b] • Clean-room sludge • Spent coolant • Used tube reducer • Nonhazardous caustic • Filter medium	97 metric tons (107 tons)	Heritage Environmental Services RCRA Permitted TSDF[c] Indianapolis, Indiana, or other facilities depending on the composition of the waste[d]
	GE AE/SCO	• Pre-rinse emulsifier • Spill cleanup adsorbent media • Mixed dry batteries • Metal chips • Process tank and drain cleanout sludges	36 metric tons (40 tons)	
	GNF-A and GE AE/SCO	• Used oils[e]	1592 metric tons (1755 tons)	FCC Environmental Treatment Facility Concord, North Carolina
Hazardous waste	GNF-A and GE AE/SCO	• HF/HNO_3 waste[f] • Minor quantities of waste paints and solvents and X-ray wastes	1973 metric tons (2175 tons)[g]	Heritage Environmental Services RCRA Permitted TSDF[c] Indianapolis, Indiana
LLRW	GNF-A operations	• Metal parts, filters, and other noncombustible wastes • Dewatered CaF_2[h] solids • Waste incinerator ash	188 metric tons (208 tons)[i]	EnergySolutions LLRW Disposal Facility Clive, Utah

[a] Annual waste quantity records for existing Wilmington Site facilities operations for 2006, with the exception of LLRW.
[b] Used NaOH solution manifested to Heritage Environmental Services is recycled and reused. In 2006, the quantity of recycled/reused NaOH was 70 metric tons (77 tons) of the total 97 metric tons (107 tons) of nonhazardous industrial waste manifested to Heritage Environmental Services from GNF-A operations.
[c] TSDF = Treatment, storage, and disposal facility permitted under RCRA Subtitle C requirements to manage hazardous wastes. Also accepts nonhazardous wastes for treatment and recycling/reuse.
[d] Depending on the composition of the nonhazardous waste, these materials are either shipped directly to the Heritage Environmental Services facility in Indianapolis, Indiana, for treatment and burial and/or routed through Heritage Environmental Services for reuse, reclaim, or treatment at other GE-approved facilities.
[e] Used oils manifested to FCC Environmental are recycled and reused.
[f] HF/HNO_3 waste = hydrofluoric acid (HF) and nitric acid (HNO_3) wastes.
[g] Hazardous waste predominately generated by GNF-A operation with a small quantity from the GE AE operation.
[h] Calcium fluoride (CaF_2).
[i] The value for LLRW is an estimate of annual waste quantity for 2008 and future years to reflect the current LLRW management practices used by GNF-A operations, which reduce the quantity of LLRW shipped to Energy*Solutions* from the historical levels for 2006 and earlier.
Source: GLE, 2008.

FCO facility also generates a sodium hydroxide (NaOH) waste solution and an etch-acid waste solution that are treated separately. The NaOH solution waste, 70 metric tons (77 tons) in 2006, is shipped to Heritage Environmental Services, Indianapolis, Indiana, for recycling (GLE, 2008).

The predominant hazardous waste generated at the Wilmington Site is the spent etch-acid solution (a solution containing HF and nitric acid [HNO_3]) from GNF-A FCO activities. Minor quantities of hazardous waste paints and solvents are also generated. The hazardous wastes are collected and temporarily stored, less than 90 days, in U.S. Department of Transportation (DOT)-approved shipping containers before being shipped offsite to the Heritage Environmental Services RCRA-permitted Subtitle C treatment, storage, and disposal facility (TSDF) (GLE, 2008).

3.12.4 Solid Waste

The types of solid wastes generated currently at the Wilmington Site include municipal solid waste (MSW), nonhazardous industrial waste, and low-level radioactive wastes (LLRW). Table 3-21 summarizes the amounts generated and their offsite treatment or disposal.

3.12.4.1 Municipal Solid Waste and Nonhazardous Industrial Wastes

The GNF-A and GE AE/SCO facilities generated approximately 898 metric tons (990 tons) of MSW in 2006 (GLE, 2008). The waste is disposed of offsite at the RCRA-permitted Subtitle D New Hanover County municipal landfill, and constitutes less than one percent of the approximately 151,000 tons (approximately 210,000 cubic yards [compacted]) of waste received annually at the landfill (NCDENR, 2009). The county has recently permitted the expansion of the landfill from 1.5 million to 2.4 million tons (5.7 million to 8.9 million cubic yards) (NCDENR, 2008a,b). The permit allows for five years of operation with a renewal permit to continue operations required at the end of the five years.

As shown in Table 3-21, the miscellaneous nonhazardous industrial wastes generated at the Wilmington Site are shipped to the Heritage Environmental Services RCRA-permitted Subtitle C TSDF in Indianapolis, Indiana, or other approved treatment and disposal facilities. Industrial waste that is neither a RCRA MSW nor a RCRA hazardous waste under Federal or State laws is regulated under RCRA Subtitle D as nonhazardous waste.

3.12.4.2 Low-Level Radioactive Waste

No LLRW is generated by the GE/SCO operations. LLRW generated by GNF-A operations are segregated into uranium contaminated-combustible and noncombustible materials. The noncombustible materials are collected and stored onsite until a full shipment is ready and then sent to the EnergySolutions LLRW disposal facility in Clive, Utah. These materials are summarized in Table 3-21 and consist of the CaF_2 generated from the conversion of UF_6 to UO_2 and of items from ongoing plant maintenance activities.

The combustible LLRW is incinerated in an onsite natural gas-fired, multiple-chamber waste incinerator. About 166,468 kilograms (367,000 pounds) of LLRW are burned per year in the incinerator; the remaining ash is sent to the EnergySolutions facility in Clive, Utah, for disposal (GLE, 2008).

3.13 Socioeconomics

This section describes current socioeconomic conditions and local community services within the region surrounding the site of the proposed GLE Facility. This region is based on the area in which workers are expected to live and spend most of their salary, and in which a significant portion of site purchase and nonpayroll expenditures from the construction, manufacturing, operation, and decommissioning phases of the proposed GLE Facility are expected to occur (GLE, 2008). This region, referred to in this draft EIS as the region of influence (ROI), corresponds to the Wilmington Metropolitan Statistical Area (MSA), a three-county area comprising Brunswick, New Hanover, and Pender Counties. These three counties cover an area that extends up to approximately 80 kilometers (50 miles) from the Wilmington Site (Figure 3-21).

3.13.1 Population Characteristics

The population in the ROI is characterized in terms of the major population centers around the proposed site, population growth trends, and significant transient and special populations. Minority and low-income populations are discussed in Section 3.14.

3.13.1.1 Major Population Centers

Within the ROI, one city, Wilmington (the county seat) (estimated 2006 population 95,944), is located in New Hanover County; several small towns are located in the remainder of the ROI. In Pender County, Burgaw is the county seat and had an estimated 3904 residents in 2006. The largest town in Brunswick County is Oak Island, with 8152 residents in 2005 (USCB, 2009a). Bolivia is the county seat.

Population density in the ROI is the highest in New Hanover County, with 358.5 persons per square kilometer (928.9 persons per square mile) in 2008. The remaining counties have more land area than New Hanover County, and have smaller populations, thus producing much lower population densities. In Brunswick County, there were 45.9 persons per square kilometer (119.1 persons per square mile), and 22.9 persons per square kilometer (59.5 persons per square mile) in Pender County (USCB, 2009b).

3.13.1.2 Population Growth Trends

Table 3-22 presents recent and projected populations in the ROI and State as a whole. As shown, population in the ROI stood at 346,990 in 2008, having grown at an average annual rate of 3.0 percent since 2000. This growth was higher than the growth rate for North Carolina as a whole, 1.7 percent, over the same period.

Each of the counties in the ROI experienced a growth in population since 2000. Brunswick County recorded a population growth rate of 4.4 percent between 2000 and 2008, while Pender County and New Hanover County grew by 2.9 and 2.3 percent, respectively, in the same decade. The ROI population is expected to increase to 386,954 by 2013, and to 418,832 by 2017. Each of the counties in the ROI is projected to experience positive population growth between 2008 and 2017.

Figure 3-21 Region of Influence for the Proposed GLE Facility

Table 3-22 Population in the ROI and North Carolina

Location	2000	2008	Average Annual Growth (%) 2000-2008	2013	2017
Brunswick County	73,143	102,877	4.4	121,417	136,247
New Hanover County	160,307	192,279	2.3	205,450	215,986
Pender County	41,082	51,834	2.9	60,087	66,599
ROI	274,532	346,990	3.0	386,954	418,832
North Carolina	8,049,313	9,227,016	1.7	10,088,393	10,768,013

Sources: USCB, 2009a; NCOSBM, 2009.

3.13.1.3 Transient and Special Populations

In addition to the permanent resident population, institutional, transient, and seasonal populations occur in the ROI, some of which are not included in the residential population. Institutional populations include school and hospital populations. The transient population consists of visitors participating in various seasonal, social, and recreation activities within the local area. Large increases in population occur in the ROI during the summer, with many tourists and families owning vacation homes; the seasonal population of the region has exceeded the off-season population by up to 47,100 people, or 14.9 percent. The ROI has a small number of temporary farmworkers (USDA, 2009) and also hosts temporary workers in the construction and hospitality sectors (Griffith, 2007).

3.13.2 Economic Trends and Characteristics

3.13.2.1 Employment

Employment in the ROI stood at 120,803 in 2006 (Table 3-23). Over the past decade, there has been a slight employment shift from the government, construction, and farm sectors toward the service, wholesale and retail trade, and manufacturing sectors within the ROI. Currently, the service sector provides the highest percentage of employment in the region, at 49.6 percent, followed by the wholesale and retail trade with 21.2 percent. Smaller employment shares are held by construction (9.5 percent), manufacturing (6.9 percent), and finance, insurance, and real estate (6.6 percent). Within the ROI, the distribution of employment across sectors is similar to that of the ROI as a whole, with higher shares of employment in agriculture (19.8 percent) and manufacturing (10.5 percent) in Pender County, in manufacturing in Brunswick County (8.3 percent), and in wholesale and retail trade (24.5 percent) and construction (11.8 percent) in Pender County. Brunswick County (40.9 percent) and Pender County (30.8 percent) have less service employment than in the ROI as a whole.

3.13.2.2 Unemployment

Unemployment rates have varied across the counties in the ROI (Table 3-24). Over the 10-year period 1999 to 2008, the average rates in Brunswick and Pender Counties were 5.4 percent and 5.3 percent, respectively, with a lower rate of 4.5 percent in Hanover County. The average rate

Table 3-23 ROI Employment in 2006

Industry	Brunswick County	% of Total	New Hanover County	% of Total	Pender County	% of Total	Region of Influence	% of Total	North Carolina
Agriculture[a]	710	3.0	232	0.3	1919	19.4	2861	2.4	81,150
Mining	60	0.2	60	0.1	60	0.6	180	0.1	60
Construction	3024	12.9	7314	8.3	1138	11.5	11,476	9.5	242,148
Manufacturing	1942	8.3	5424	6.2	1014	10.3	8380	6.9	535,689
Transportation and Public Utilities	1749	7.5	2633	3.0	133	1.3	4515	3.7	137,968
Wholesale and Retail Trade	4387	18.7	18,883	21.5	2373	24.0	25,643	21.2	637,411
Finance, Insurance, and Real Estate	1984	8.5	5733	6.5	257	2.6	7974	6.6	240,232
Services	9586	40.9	47,383	54.0	2982	30.2	59,952	49.6	1,721,983
Other	5	0.0	29	0.1	10	0.1	44	0.0	750
Total	23,446	(100)	87,679	(100)	9886	(100)	120,803	(100)	3,602,214

[a] Agricultural employment includes 2007 data for hired farmworkers.

Sources: USCB, 2009c; USDA, 2009.

Table 3-24 ROI Unemployment Rates (percent)

Location	1999–2008	2008	2009[a]
Brunswick County	5.4	6.6	12.1
New Hanover County	4.5	5.3	9.2
Pender County	5.3	6.2	11.7
ROI	4.8	5.8	10.4
North Carolina	5.2	6.3	6.3

[a] Rates for 2009 are the average for January and February.
Sources: DOL, 2009a–d).

in the ROI over this period was 4.8 percent, lower than the average rate for the State of 5.2 percent. Unemployment rates for the first two months of 2009 contrast markedly with rates for 2008 as a whole; in Brunswick and Pender Counties, unemployment rates increased to 12.1 and 11.7 percent, respectively, while in New Hanover County the rate reached 9.2 percent. The average rate for the ROI (10.4 percent) during this period was higher than the corresponding average rates for 2008, while the rate for the State (6.3 percent) remained the same.

3.13.2.3 Income

Personal income in the ROI stood at $10.8 billion in 2006 and has grown at an annual average rate of 3.5 percent over the period 1997 to 2006 (Table 3-25).[17] ROI personal income per capita also rose over the same period, but at a slower rate of 1.0 percent, increasing from $29,783 to $32,897. Per capita incomes were higher in New Hanover County ($35,862) and in Brunswick County ($30,007) in 2006 than in Pender County ($25,361). Although personal income and per capita income growth rates in the ROI have been higher than for the State as a whole, personal income per capita was slightly higher in the State ($34,310) in 2006 than in the ROI.

The median value of owner-occupied housing in the three-county ROI over the period 2006-2008 was $178,567 (USCB, 2009d).

3.13.3 Housing Resources and Community and Social Services

This section describes housing and social services in the ROI, including schools, hospitals and nursing homes, law enforcement, and firefighting.

3.13.3.1 Housing

Between 2005 and 2007, nearly 196,000 housing units were located in the three counties on average, with more than half of these located in New Hanover County, and another third in Brunswick County (Table 3-26). The vast majority of housing units in the region are single-family structures, but the number of multifamily structures is increasing as the region develops

[17] All direct income and direct sales tax impact estimates are provided in 2008 dollars.

Table 3-25 ROI and State Personal Income

Location	1997	2006	Annual Average Growth, 1997-2006 (%)
Brunswick County			
Total income[a]	1.7	2.8	5.1
Per capita income	25,939	30,007	1.4
Median household income	–	45,596[b]	–
New Hanover County			
Total income[a]	5.0	6.7	3.1
Per capita income	32,406	35,862	1.0
Median household income	–	49,068[b]	–
Pender County			
Total income[a]	1.0	1.3	2.7
Per capita income	19,383	25,361	0.4
Median household income	–	42,630[b]	–
ROI			
Total income[a]	7.7	10.8	3.5
Per capita income	29,783	32,897	1.0
Median household income	–	45,765[b]	–
North Carolina			
Total income[a]	180.2	286.0	2.4
Per capita income	31,447	34,310	0.9
Median household income	–	46,107[b]	–

[a] Billion 2008 dollars.
[b] 2006–2008 three-year average
Source: DOC, 2009; USCB, 2009d.

(GLE, 2008). Vacancy rates varied significantly across the three counties, from 42 percent in Brunswick County, which had 15,000 seasonal, recreational, or occasional-use units standing vacant at the time of the 2000 Census, 24 percent in Pender County, and 17 percent in New Hanover County. Owner-occupied units comprise 71 and 78 percent of the occupied units in Brunswick and Pender Counties, respectively, but only 63 percent of the occupied units in New Hanover County, reflecting the concentration of seasonal and recreational activities in the ROI.

Housing density in the ROI was 38.9 units per square kilometer (100.8 units per square mile) on average during the period 2005–2007, compared with 32.6 units per square kilometer (84.7 units per square mile) for the State. There were 182.1 units per square kilometer

(471.8 units per square mile) in New Hanover County, with lower densities in Brunswick County (32.6 units per square kilometer [84.5 units per square mile]) and Pender County (11.1 units per square kilometer [28.7 units per square mile]) (USCB, 2009a).

Housing stock in the ROI as a whole grew at an annual rate of 3.0 percent over the period 2000 to 2005–2007, with 43,840 new units added to the existing housing stock in the ROI (Table 3-26). With an overall vacancy rate of 27 percent, there were 52,749 vacant housing units in the ROI in 2005–2007, of which 11,199 (5206 in Brunswick County, 5015 in New Hanover County, and 978 in Pender County) are expected to be rental units available to construction workers at the proposed GLE Facility.

New Hanover County has the highest housing values in the ROI, with a median value of $228,400 over the three-year period 2006-2008 for owner-occupied units (USCB, 2009d). The median values in Brunswick and Pender Counties were $178,100 and $129,200, respectively.

3.13.3.2 Schools

The ROI has a total of 90 public and private elementary, middle, and high schools, the majority of which are in the Brunswick County, New Hanover County and Pender County school districts. In addition, the University of North Carolina at Wilmington, Brunswick Community College, and Cape Fear Community College are located in the region (NCES, 2009). Table 3-27 provides summary statistics for the schools in the three county school districts, including enrollment, educational staffing and two indices of educational quality – student–teacher ratios and levels of service. Of the 90 schools in the region, only one is within a 6.4 kilometer (4-mile) radius of the proposed GLE site, the Wrightsboro Elementary School, while 21 schools are within a 12.8-kilometer (8-mile) radius of the site (GLE, 2008).

3.13.3.3 Public Safety

The principal law enforcement agency in New Hanover County is the New Hanover County Sheriff's Office, which in 2007 had 275 officers providing law enforcement services, including provision in the unincorporated areas in the vicinity of the proposed GLE Facility (Table 3-28).

Several State, county, and local police departments provide law enforcement in the ROI, including the City of Wilmington police department, which employs 252 law enforcement officers. Other counties in the region have a total of 157 full-time officers – 108 in Brunswick County and 49 in Pender County.

Two fire departments in the ROI, the Wilmington Fire Department and the New Hanover County Fire Department, have 228 career firefighters (Table 3-28). The firefighting service provider closest to the Wilmington Site is the Castle Hayne Volunteer Fire & Rescue, with one full-time firefighter and 10 volunteer firefighters equipped with two pumper trucks, two water trucks, one squad truck, and one heavy rescue truck (GLE, 2008). If the Castle Hayne Volunteer Fire & Rescue would need additional assistance in the event of an incident at the Wilmington Site, an existing mutual aid agreement among Castle Hayne Fire Volunteer Fire & Rescue (GLE, 2008) and the six other fire departments in the county would provide additional support.

Table 3-26 ROI Housing Characteristics

Parameter	2000	2005–2007[b]
Brunswick County		
Owner-occupied	25,013	29,934
Rental	5425	12,381
Vacant units	20,993	30,703
Seasonal and recreational use	15,540	NA[a]
Total units	51,431	73,018
Median Value of Owner-Occupied Units		$178,100[c]
New Hanover County		
Owner-occupied	44,109	51,184
Rental	24,074	30,330
Vacant units	11,433	16,150
Seasonal and Recreational Use	4387	NA[a]
Total units	79,616	97,664
Median Value of Owner-Occupied Units		$228,400[c]
Pender County		
Owner-occupied	13,260	14,960
Rental	2794	4147
Vacant units	4744	5896
Seasonal and recreational use	2881	NA[a]
Total units	20,798	25,003
Median Value of Owner-Occupied Units		$129,200[c]
ROI Total		
Owner-occupied	82,382	96,078
Rental	32,293	46,858
Vacant units	37,170	52,749
Seasonal and recreational use	22,808	NA[a]
Total units	151,845	195,685
Median Value of Owner-Occupied Units		$178,567[c]

[a] NA = not available.
[b] 2005–2007, three-year average.
[c] 2006–2008, three-year average.
Sources: USCB, 2009a,b,d.

Table 3-27 School District Data for the ROI in 2007

Location	Number of Students	Number of Teachers	Student-Teacher Ratio	Level of Service[a]
Brunswick County	11,749	836	14.1	9.5
Hanover County	24,001	1763	13.6	9.7
Pender County	7889	572	13.8	12.5
ROI	43,639	3170	13.8	10.0

[a] Number of teachers per 1000 population.
Source: NCES, 2009.

Table 3-28 Public Safety Employment in the ROI in 2009

Location	Number of Police Officers	Level of Service[a]	Number of Firefighters[b]	Level of Service[a]
Brunswick County	108	1.2	206	2.3
Hanover County	275	1.5	22	0.1
Pender County	49	1.1	0	0.0
ROI	432	1.4	228	0.7

[a] Number per 1000 population.
[b] Number does not include volunteers.
Sources: FBI, 2009; FireDepartments.net, 2009.

3.13.4 Tax Structure and Distribution

The principal sources of tax revenues in the ROI are taxes on real estate and personal property and include taxes levied at the county and municipal level, with tax rates varying between taxing jurisdictions as a result (NCDOR, 2009). In 2009, county property tax rates for New Hanover County and Pender County were $0.45 and $0.65 per $100 of appraised valuation, respectively, while the rate in Brunswick County was $0.31. The municipal tax rate in Wilmington was $0.33 per $100, levied in addition to county property taxes (NCDOR, 2009). Personal income taxes are levied by the State and vary depending on income. A corporate income tax rate of 6.9 percent is levied by the State, which also collects sales and use tax of 4.25 percent of sales, in addition to local sales and use tax rates in most areas of 2.5 percent (NCDOR, 2009).

3.14 Environmental Justice

On February 11, 1994, the President signed Executive Order 12898 “Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,” which directs all Federal agencies to develop strategies for considering environmental justice in their programs, policies, and activities. Environmental justice is described in the Executive Order as “identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations.” On December 10, 1997, the Council on Environmental Quality (CEQ) issued “Environmental Justice Guidance under the National Environmental Policy Act” (NEPA) (CEQ, 1997). In addition to following general guidelines on the evaluation of environmental analyses set forth in the document *Environmental Review Guidance for Licensing Actions Associated with NMSS Programs* (NUREG-1748) (NRC, 2003), the NRC has issued a final policy statement on the “Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions” (69 FR 52040; August 24, 2004) and environmental justice procedures to be followed in NEPA documents prepared by the NRC’s Office of Nuclear Material Safety and Safeguards (NRC, 2004a).

Data on minority and low-income populations within a 6.4-kilometer (4-mile) radius of the proposed GLE site were derived from the 2000 U.S. Census (see Appendix G). The 6.4-kilometer (4-mile) radius is consistent with the NRC final policy statement on the treatment of environmental justice matters (69 FR 52040; August 24, 2004). This area includes a total of 15 Census block groups, including one in Brunswick County, 10 in New Hanover County, the location of the proposed GLE Facility, and four in Pender County (USBC, 2009a). To determine whether environmental justice will have to be considered in greater detail, the NRC staff compared the percentage of minority and low-income populations in Census block groups in the area being assessed with the State and county percentages. If the minority or low-income population in a given tract exceeds 50 percent or is 20 percentage points or more greater than the State or county percentage, environmental justice will have to be considered in greater detail. Generally, the NRC staff considers differences greater than 20 percentage points to be significant.

3.14.1 Minority Populations

The CEQ guidelines define “minority” to include members of American Indian or Alaska Native, Asian or Pacific Islander, Black non-Hispanic, and Hispanic populations (CEQ, 1997). Minority individuals are persons who identify themselves as members of the following population groups: Black or African American, American Indian or Alaska Native, Asian, Native Hawaiian or other Pacific Islander, some other race, and two or more races (meaning individuals who identified themselves on the 2000 Census form as being a member of two or more races, for example, White and Hispanic), and Hispanic or Latino. The 2000 Census allowed individuals the option of identifying themselves in one or more race categories, thereby creating the multiracial census category of “two or more races.” They are generally counted as part of the minority group they identified.

Minority populations can be determined by subtracting White, not Hispanic or Latino populations from the total population. Figure 3-22 identifies the three Census block groups within a 6.4-kilometer (4-mile) radius of the proposed GLE site that contain minority populations. Two block groups had minority populations that were more than 20 percentage points higher than the respective county average, while one Census block group had a minority population that was also more than 20 percentage points higher than the State average. Two of these Census block groups also had a minority population that exceeded 50 percent of the total population. Table 3-29 presents data for minority populations for the 6.4-kilometer (4-mile) area, for each county, and for the State. Appendix G presents the data for the 15 Census block groups that completely or partially fall within the 6.4-kilometer (4-mile) radius.

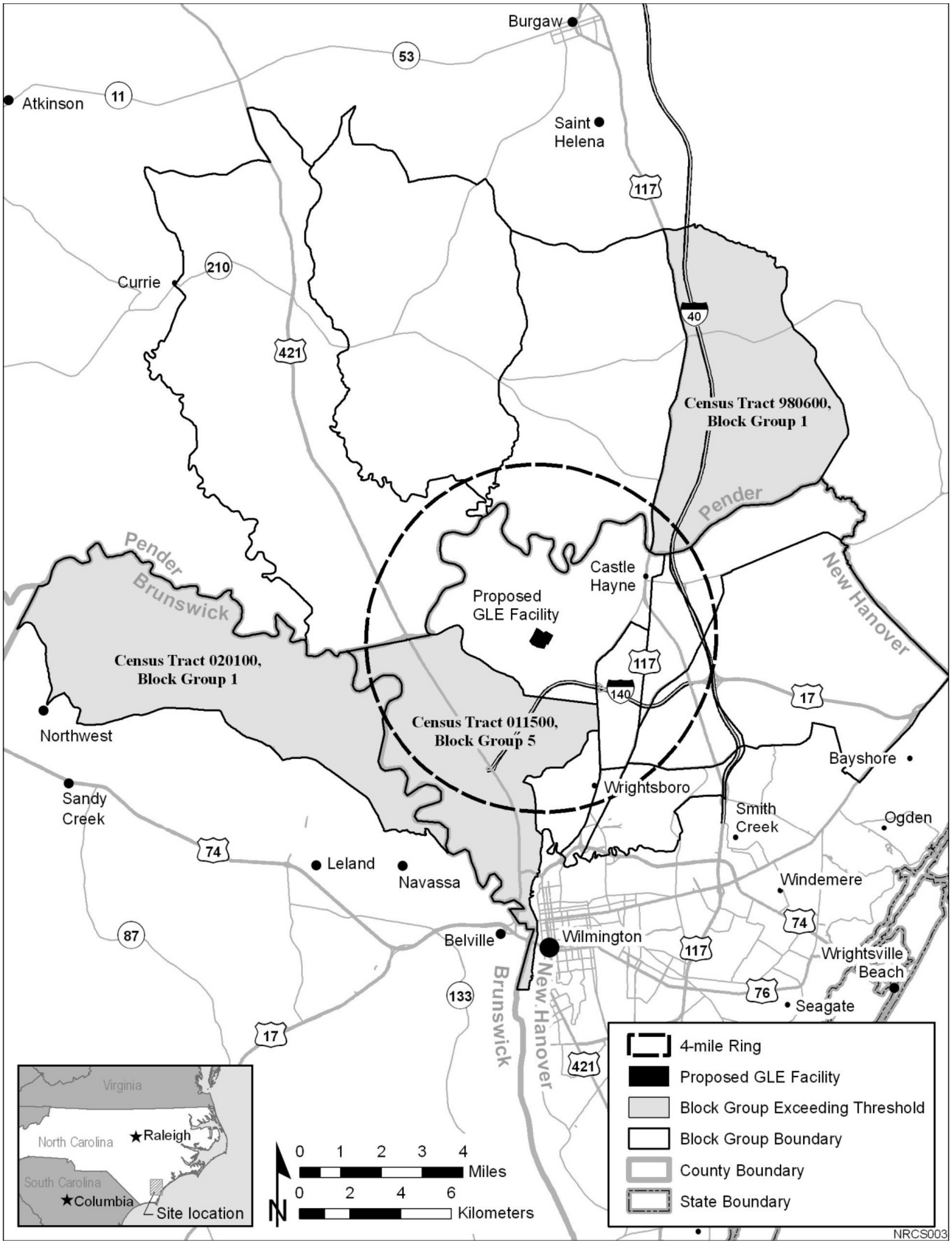

Figure 3-22 Census Block Groups within a 6.4-kilometer (4-mile) Radius of the Proposed GLE Facility with Minority Populations that Exceed 50 Percent of Total Population or Exceed State and County Averages by More than 20 Percentage Points

3.14.2 Low-Income Populations

Low-income populations are those that fall below the poverty level identified by the U.S. Census Bureau, including variations by family size and composition. If the total income for a family or unrelated individual falls below the relevant poverty threshold, then the family or unrelated individual is classified as being “below the poverty level.” For example, in 1999, the most recent year for which census block group data on poverty were available, the poverty threshold for a family of five with three children below the age of 18 was $19,882. For any given family below the poverty line, all family members are considered to be below the poverty line for the purposes of analysis

Figure 3-23 identifies Census block groups within a 6.4-kilometer (4-mile) radius of the proposed GLE site that contain low-income populations in excess of the threshold criteria. In one Census block group, the low-income population was more than 20 percentage points higher than both the State and county average. Table 3-29 presents data for low-income populations for the 6.4-kilometer [4-mile area]), for each county, and for the State. Appendix G presents the data for the 15 Census block groups that completely or partially fall within the 6.4-kilometer (4-mile) radius.

Table 3-29 Minority and Low-Income Populations within a 6.4-kilometer (4-mile) Radius of the Proposed GLE Site

County	4-mile Radius: Total Population[a]	4-mile Radius: Minority Population	4-mile Radius: Percent Minority	County Percent Minority	State Percent Minority
Brunswick County	2030	926	45.6	20.4	32.6
New Hanover County	15,725	3881	24.7	22.1	
Pender County	9044	2753	30.6	30.9	

County	4-mile Radius: Total Population[b]	4-mile Radius: Low-Income Population	4-mile Radius: Percent Low-Income	County Percent Low-Income	State Percent Low-Income
Brunswick County	1952	283	14.5	12.6	12.3
New Hanover County	15,217	1488	9.8	13.1	
Pender County	8948	1430	16.0	13.6	

[a] 2000 data.
[b] 1999 data.
Source: USCB, 2009a.

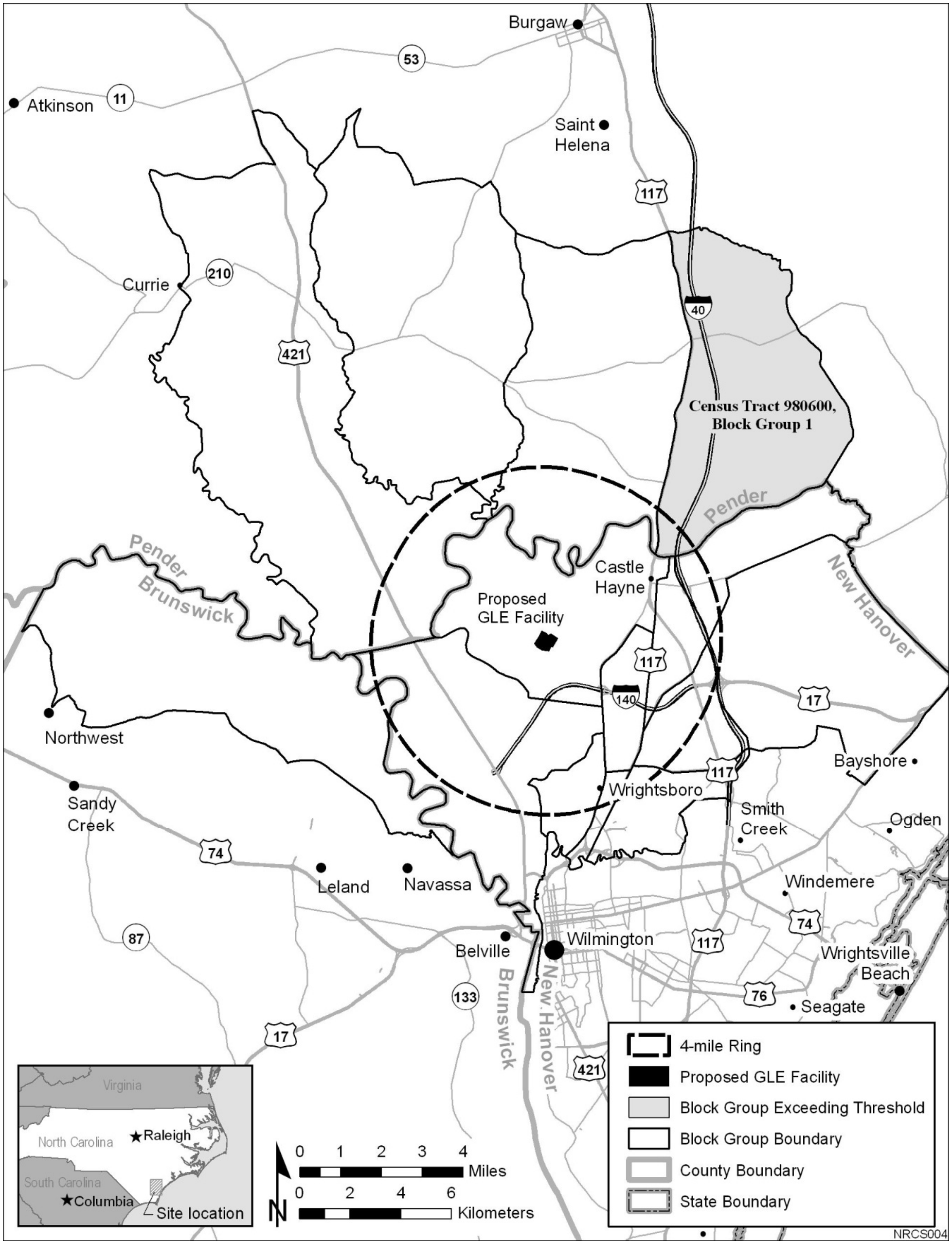

Figure 3-23 Census Block Groups within a 6.4-kilometer (4-mile) Radius of the Proposed GLE Facility with Low-Income Populations that Exceed 50 Percent of the Total Population or Exceed State and County Averages by More Than 20 Percentage Points

3.14.3 Resource Dependencies and Vulnerabilities of Minority and Low-Income Populations

In some cases, minority and low-income groups may rely on natural resources for their subsistence and to support unique cultural practices. Differential patterns of consumption of natural resources should be considered (i.e., differences in rates and/or pattern of fish, vegetable, water, and/or wildlife consumption among groups defined by demographic factors such as socioeconomic status, race, ethnicity, and/or cultural attributes).

In some circumstances, these groups could be unusually vulnerable to impacts from the proposed action. In particular, higher participation in outdoor recreation, home gardening, and subsistence fishing may increase exposure risk to low-income and minority groups through inhalation or ingestion through various environmental pathways.

Potential resource dependencies were sought in the course of public meetings and other information supplied by the Hispanic/Latino and African American/Black communities in meetings with the NRC staff. Letters were also sent to local Federally recognized American Indian tribes determine any potential resource dependencies. These letters described the construction and operation of the proposed GLE Facility, solicited their concerns on the project, and inquired about whether the American Indian tribes desired to participate in the Section 106 consultation process (see Appendix B). The Coharie Indian Tribe has indicated that there are no historic properties in the area of potential effects that could have cultural or religious significance to them. Currently, very few American Indians live in the vicinity of the Wilmington Site.

In addition, the NRC staff examined data provided by the State of North Carolina concerning the health status of the general population in Brunswick County, New Hanover County, and Pender County (Table 3-30). No exceptional health problems were found among residents in the Wilmington area. It was not possible to identify any unusual incidences of birth defects, chronic diseases, or cancer clusters at the county level, the smallest area for which published health information is available. Age-adjusted incidence of cancer is slightly lower in Pender County than elsewhere in the three-county area; rates in each county are lower than in North Carolina as a whole. The income and ethnicity of individuals with chronic diseases are not available.

Table 3-30 Selected Health Statistics for Counties near the Proposed GLE Facility

	Brunswick County	New Hanover County	Pender County	North Carolina
Age-adjusted cancer Incidence rates (per 100,000 population), 2005	474.0	491.4	432.0	511.8
Age-adjusted cancer death rates, (per 10,000 population), 2002-2006	196.8	197.6	217.5	195.8
Age-adjusted major causes of death (per 100,000 population), 2006				
Heart disease	194.0	203.0	215.8	198.7
Trachea, bronchus, or lung cancer	58.8	65.0	62.3	60.4
Cerebrovascular disease	56.8	40.8	46.1	53.2
Chronic lower respiratory diseases	66.4	37.1	35.7	46.4

Source: NC-CATCH, 2009.

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4 ENVIRONMENTAL IMPACTS

4.1 Introduction

This chapter presents the potential impacts associated with the preconstruction activities, construction, operations, and decommissioning of the proposed General Electric (GE)-Hitachi Global Laser Enrichment LLC (GLE) Facility. For the proposed action, this draft Environmental Impact Statement (EIS) considers impacts from construction activities, normal operations, credible accidents, and cumulative impacts and resource commitments. The impacts associated with preconstruction activities are also discussed, although, as discussed in Section 4.2, preconstruction activities are not part of the proposed action. The chapter is organized by environmentally affected areas (i.e., air, water, noise, public and occupational health, etc.), based on the descriptions of preconstruction activities and the proposed action that are included in Section 2.1 of this draft EIS. Impacts on each environmentally affected area are divided into three categories: preconstruction and construction, operations, and decontamination and decommissioning.

Within each resource area, mitigation measures identified by GLE and U.S. Nuclear Regulatory Commission (NRC) staff are disclosed. While the NRC cannot impose mitigation outside its regulatory authority under the *Atomic Energy Act*, the NRC staff has identified mitigation measures within this chapter that could potentially reduce the impacts of the proposed action. For the purposes of the *National Environmental Policy Act* (NEPA) per the U.S. *Code of Federal Regulations* (CFR) Title 10, "Energy," 10 CFR 51.71(d), and 51.80(a), the NRC is disclosing measures that could potentially reduce or avoid environmental impacts of the proposed action. These additional mitigation measures are not requirements being imposed upon GLE, and they are presented in Table 5-2. Any mitigation measures identified by GLE and proposed for implementation within the Environmental Report (ER) (GLE, 2008) were factored into the NRC staff's environmental impact analysis and are presented in Table 5-1.

Section 4.2 discusses the preconstruction activities and the proposed action under consideration in this draft EIS – namely, the construction and operation of the proposed GLE Facility at the existing General Electric (GE) site in Wilmington, North Carolina. Because decommissioning is not expected to occur until 40 years after the license is issued, the decontamination and decommissioning impacts discussed in Section 4.2.17 are preliminary, or estimated, for the proposed GLE Facility. Within 12 months of its decision to cease enrichment activities, GLE will submit a decommissioning plan to the NRC in accordance with 10 CFR 70.38, and would begin the activities described in the decommissioning plan after approval by the NRC. The proposed activities in the decommissioning plan will be subject to further NEPA review, as appropriate, at that time.

In addition, this chapter discusses the potential cumulative impacts (Section 4.3) and impacts of the no-action alternative (Section 4.4). For the purposes of this draft EIS, the assessment of the cumulative impacts of the no-action alternative assumes that certain preconstruction activities have occurred, because these preconstruction activities are expected to occur regardless of whether a license for construction and operation of the proposed facility is granted by the NRC.

The NRC defines three significance levels for rating impacts on a resource (NRC, 2003):

- ***Small impact**: Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.*
- ***Moderate impact**: Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.*
- ***Large impact**: Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.*

Environmental impacts may be radiological or non-radiological. Radiological impacts include radiation doses to the public and workers from the routine operations, transportation, potential accidents, and decommissioning and environmental impacts from potential releases in the air, soil, or water. Non-radiological impacts include chemical hazards, emissions (e.g., vehicle fumes), occupational accidents and injuries (e.g., vehicle collisions), and workplace accidents.

The analyses in this chapter are based on the assumption that a licensing decision would be made in late 2011, construction (if authorized) would start in 2011, and license termination would occur in 2051. Subsequently, the Commission's *Notice of Hearing and Commission Order* (75 FR 1819) specified that a licensing decision be made within 30 months of the Order (i.e., June 2012). Thus, the NRC staff currently expects that a licensing decision will be made in 2012, construction will begin in 2012, and that termination of the 40-year license, if granted, will occur in 2052. The NRC staff expects that the dates for start-up and final construction (2013-2017) and full facility operations (2017) will remain unchanged. The NRC staff expects that any resulting changes in the licensing and construction schedule would cause slight changes to certain analyses (e.g., air quality, socioeconomics, and cost–benefit) but would not affect the conclusions regarding impacts on these resource areas. Any necessary changes to the analyses will be reflected in the final EIS.

4.2 Preconstruction Activities and the Proposed Action

As described in Section 2.1 of this draft EIS, the proposed action is the construction, operation, and decontamination and decommissioning of the proposed GLE Facility. Under the proposed action, the NRC would issue a license to GE-Hitachi Global Laser Enrichment LLC in accordance with the requirements of 10 CFR Parts 70, 40, and 30 to possess and use by-product source and special nuclear material.

The NRC has granted an exemption (NRC, 2009a) for GLE to conduct certain preconstruction activities without an NRC license to construct and operate the proposed GLE facility. The NRC staff concluded that the request to perform these activities is authorized by law, will not endanger life or property or common defense and security, and is in the public interest. The approved preconstruction activities include:

- Clearing of approximately 40 hectares (100 acres) for the proposed GLE Facility;
- Site grading and erosion control;

- Installation of a storm retention system;

- Construction of main access roadway and guardhouse(s);

- Placement of utilities (electricity, potable water, process water, water for fire suppression, sanitary sewer, and natural gas);

- Construction of parking lots and minor roadways; and

- Construction of administrative building(s) (GLE, 2009b).

No core production facilities would be constructed as part of the preconstruction activities. Because preconstruction and construction activities are closely related, this section discusses impacts of preconstruction activities, construction, and operations, although preconstruction activities are not part of the proposed action. Because of the difficulty in separating the impacts of preconstruction and construction, these impacts are evaluated together and an estimate is provided regarding the apportionment of impacts between preconstruction activities (authorized under the exemption) and construction as defined in 10 CFR 51.4. Therefore, the impacting activities are organized into three phases:

- preconstruction and construction of new facilities

- facility operations

- decontamination and decommissioning

4.2.1 Land Use Impacts

Land use impacts occur when an area is committed in a way that precludes all other future land use or alters the land use of adjacent properties. Land use impacts can occur in the short term or in the long term. Land use impacts also occur when activities take place that are incompatible with the zoning designated by county or State officials. Most of the project area currently contains mixed pine forest. The project area is bordered to the east by GE's Fuel Manufacturing Operation (FMO) plant and aircraft engine plant. To the west is the Northeast Cape Fear River. Residential developments are located to the northeast, east, and south. The project area under consideration is zoned by New Hanover County for heavy industrial use. West of the Northeast Cape Fear River is the L.V. Sutton Power Plant. The areas to the northeast, east, and south are zoned for residential development. The construction and operation of the proposed GLE Facility are consistent with current zoning. The entire project area is owned by GE. The following sections discuss land use impacts resulting from various phases of the project.

4.2.1.1 Preconstruction and Construction Activities

As described in Section 1.4.1, preconstruction activities include clearing and grading of the land, vegetation removal, improvement of existing roads, and construction of support structures, among other activities. Preconstruction activities will alter the current land use of undeveloped mixed pine forest. Workers will clear and haul the trees from the property. Modification of the current land use resulting from preconstruction activities does not represent a major impact. Open undeveloped land is found in the immediate vicinity of the project. The alteration of the land use is consistent with current zoning. Preconstruction activities are not expected to affect surrounding land use.

Construction consists of erecting the main facilities at the proposed plant and installing the main plant components. Most activities would occur on the Wilmington Site, which has restricted access. Potential impacts outside of the property boundary could result from construction traffic. These impacts are discussed in Section 4.2.10. Construction activities will be temporary (see Section 2.1.5). The project area is identified in the Wilmington-New Hanover County Coastal Area Management Act (CAMA) as a wetland and aquifer resource protection area. The designation as a wetland resource protection area is intended to limit the destruction of wetlands. No wetlands remain within the footprint of the project. Additionally, the aquifer would not be affected by construction activities. County officials have agreed that the resources identified in the CAMA plan are being appropriately considered and that construction and operation of the facility are not expected to impact these resources (New Hanover County, 2009a).

For the reasons discussed above, land use impacts from preconstruction and construction activities would be considered to be SMALL. The estimated relative contributions to impacts are 50 percent during preconstruction activities and 50 percent during construction.

4.2.1.2 Facility Operations

Operation of the proposed GLE Facility will affect land use. The operation of a uranium enrichment plant represents a departure from the current land use of undeveloped forest. The plant would operate on the existing Wilmington Site in an area that is zoned for heavy industrial use. No conflict exists between operation of an enrichment plant and the zoning. It is possible that operation of the plant could have an effect on the low-density residential use on properties to the north, east, and south. However, these residential developments already exist in close proximity to the FMO plant, the GE aircraft engine plant, and the L.V. Sutton Power Plant. The operation of these facilities has not altered or affected surrounding land use. Residential developments continue to be planned for the area (New Hanover County, 2009a). The greatest potential for impacts on land use would occur during operations because it would occur over the longest period of time. However, land use associated with operation of an enrichment facility is consistent with other industrial development in the immediate area, which has not altered the surrounding land use. Therefore, overall impacts on land use from operations are expected to be SMALL.

4.2.1.3 Mitigation Measures

To mitigate land use impacts, GLE proposes to use existing service road routes and utility rights-of-way (to the fullest extent practicable) to minimize the need for clearing additional wooded areas, and to use existing wastewater treatment and solid waste management infrastructure (to the fullest extent practicable) to reduce the total area required for the proposed GLE Facility. In addition, the New Hanover County Soil Erosion and Sedimentation Control Ordinance identifies best management practices (BMPs) for construction in New Hanover County (New Hanover County, 2007). The BMPs are discussed in detail in Section 4.2.5.3.

BMPs for construction would help moderate the short-term land use effects associated with preconstruction and construction activities. BMPs for controlling waste disposal, erosion, and runoff would help restrict the effect of facility operations on surrounding land use.

4.2.2 Historic and Cultural Resources Impacts

The *National Historic Preservation Act* (NHPA) requires Federal agencies to consider the effects of their undertakings on historic properties. Historic properties are defined as resources that are eligible for listing on the NRHP. The criteria for eligibility are listed in Title 36, "Parks, Forests, and Public Property," Part 60, Section 4, "Criteria for Evaluation," of the U.S. *Code of Federal Regulations* (36 CFR Part 60.4) and include (1) association with significant events in history; (2) association with the lives of persons significant in the past; (3) embodies distinctive characteristics of type, period, or construction, or (4) sites or places that have yielded or are likely to yield important information (ACHP, 2008). The historic preservation review process (Section 106 of the NHPA) is outlined in regulations issued by the Advisory Council on Historic Preservation (ACHP) in Title 36, "Parks, Forests, and Public Property," Part 800, "Protection of Historic Properties," of the U.S. *Code of Federal Regulations* (36 CFR Part 800). The NRC is coordinating its Section 106 review through NEPA per 36 CFR 800.8(c). The Area of Potential Effect for the project is defined as the 106-hectare (263-acre) study area. The NRC has consulted with the North Carolina State Historic Preservation Office (SHPO), the ACHP, and several American Indian tribes.

Section 106 of the NHPA identifies the process for considering whether a project will affect a significant cultural resource. The Section 106 process requires consultation between the lead Federal agency and the SHPO, which is the custodian of information on cultural resources for the state. The Section 106 process also requires that Native American groups who have aboriginal ties to the project area be consulted to determine if resources important to the tribe are present.

Cultural resources, especially archaeological sites, are sensitive to disturbance and are nonrenewable. Much of the information possessed in an archaeological site is derived from the spatial relationships between soil layers and artifacts. Once these spatial relationships are altered, they can never be reclaimed. As a result, the greatest threat to archaeological resources are ground-disturbing activities that will alter the spatial relationships. Most ground-disturbing activities would occur during preconstruction activities, when the site is cleared and prepared for construction.

4.2.2.1 Preconstruction and Construction Activities

Preconstruction activities have the potential to impact historic and cultural resources. Ground-clearing activities such as vegetation removal, grading and recontouring for drainage have the greatest potential for impacting historic and cultural resources. Much of the ground disturbance expected for the proposed GLE Facility would occur during preconstruction activities. The area that would be affected by preconstruction activities was surveyed for historic and cultural resources in 2008. Site 31NH801 was identified during the survey and was determined to be eligible for listing on the NRHP (GLE, 2008; NCDCR, 2009). The site is located adjacent to one of the access roads that was identified in the original construction designs. GLE has reconfigured the access roads needs for the plant and will no longer develop the road adjacent to site 31NH801 (GLE, 2009b), therefore, no impacts are expected to site 31NH801 from preconstruction or construction activities. The newly defined areas were surveyed in 2009 and no additional NRHP-eligible cultural resources were identified (ESI, 2009).

The North Carolina SHPO requested that it be contacted in the event of an unanticipated discovery of cultural resources during the project. The SHPO also requested that, in the event that human remains are found during project activities, the applicable procedures in North Carolina General Statute 70 Article 3 be followed (NCDCR, 2009). The statute states that when unmarked remains are encountered, work cease immediately in the vicinity of the find and that work not be allowed to continue without authorization from either the county medical examiner or the State archaeologist (N.C. General Statute 70.3(b)). GLE has developed an unexpected discovery procedure, which has been reviewed by the North Carolina SHPO. The SHPO found the procedure to be adequate (NCDCR, 2010).

No NRHP-eligible cultural resources are expected to be directly impacted by preconstruction activities. Construction activities would take place on ground previously disturbed by preconstruction activities. Most impacts on historic or archaeological resources would occur prior to construction. No construction activities are expected to occur in the portion of the Wilmington Site where historic and cultural resources are known to exist. If the expected construction area for the project changes during licensing, GLE would submit a supplement to its license application so that the license would accurately address the proposed NRC-licensed activities. As one part of the evaluation of such a supplement, NRC would evaluate whether the change constituted a change in the area of potential effects, and NRC would reflect that determination in its ongoing consultation with the North Carolina SHPO. If, after facility licensing, additional NRC-licensed construction is to be performed, the licensee would be required to revise the applicable licensing documents, and, where required by applicable regulations, submit an application for a license amendment. For those changes requiring an application for a license amendment, the NRC would determine an area of potential effects for the Federal action of granting the license amendment, and would consult with the SHPO as appropriate regarding the proposed amendment.

Overall, the impacts on historic and cultural resources from both preconstruction and construction activities would be SMALL. While there is some potential for ground disturbance to occur in previously undisturbed areas during construction, most impacts on historic and cultural resources would be expected to occur during ground clearing. Therefore, the estimated relative contributions to impacts are 95 percent during preconstruction activities and five percent during construction.

4.2.2.2 Facility Operations

Facility operations have the potential to affect historic and cultural resources; however, impacts are not expected. Operations could affect resources if expansion of the plant was deemed necessary in areas that contain historic and archaeological resources. No facility activities are expected to affect site 31NH801. The North Carolina SHPO asked to review the measures that will be taken by GLE to ensure protection and preservation of site 31NH801 from future ground-disturbing activities (NCDCR, 2009). Consultation between the NRC, North Carolina SHPO, and GLE is ongoing. The expected impact level for operations ranges from SMALL to

MODERATE. Impact levels could be reduced if a plan for site 31NH801 is developed and implemented.

4.2.2.3 Mitigation Measures

No direct impacts on historic and cultural resources are currently expected. To protect site 31NH801, GLE has posted signs stating that no unauthorized excavation is permitted. GLE also proposes to maintain the current graded and vegetated state of the bank at the side of the existing gravel road (GLE, 2008). GLE has also developed internal procedural guidance for unexpected archaeological discoveries and/or human remains (GLE, 2009h). In the event that new cultural resources are discovered in the area of potential effects, GLE would implement these procedures, which include notification of certain local and State agency representatives, including the State Archaeologist.

4.2.3 Visual and Scenic Impacts

The following section discusses the potential visual impacts that could result from preconstruction activities through operation of the proposed GLE Facility. Visual impacts anticipated from the project are primarily associated with preconstruction and construction activities. Construction crews, cranes, trucks loaded with building materials, and vegetation removal represent the greatest potential for visual impacts.

4.2.3.1 Preconstruction and Construction Activities

Impacts on visual resources are possible from preconstruction activities. Currently, the project area is a mixed pine forest. As described in Section 1.4.1, actions associated with preconstruction include vegetation removal, grading, installation of utilities, and construction of support buildings, among other activities. Most visual impacts would result from vegetation removal and the increased traffic to the northern portion of the site. The vegetation screen along the northern part of the site would not be altered by preconstruction activities. The greatest visual impacts would be experienced by the four properties along Dekker Road that back onto the Wilmington Site. The increased traffic on the site access road would not be visible from Dekker Road. Increased traffic along Castle Hayne Road from construction traffic would be noticeable to users of the Castle Hayne Road and potentially I-140. These impacts would be temporary. Activities occurring within the project area would be largely out of site from Castle Hayne Road and I-140.

Construction activities would be concentrated on the Wilmington Site. Truck and worker traffic would increase on the site access road during construction. Visual impacts could result from the increased traffic entering the site; however, the impacts would be temporary. The main project area is surrounded by a vegetation barrier. Therefore, construction activities would be largely screened even from the residences along Dekker Road. The greatest visual impact associated with construction would be from increased traffic. Construction cranes would be visible from greater distances. However, these would only be temporary impacts. The construction cranes would be visible from I-140 and likely south of I-140 as well as Castle Hayne Road.

Both preconstruction and construction activities would result in visual impacts. The estimated relative contributions to impacts are 25 percent during preconstruction activities and 75 percent during construction. Overall, the visual and scenic impact from preconstruction and construction activities would be SMALL.

4.2.3.2 Facility Operations

There is the potential for visual impacts from operations. The two most visible features of the new plant would be the water tower at 39.6 meters (130 feet) tall and a portion of the operations building referred to as the operations building tower. The operations building tower would have front and side profiles of 37 meters (120 feet) by 200 meters (660 feet). The height of the operations building tower will depend on the final process design; however, it could reach up to 49 meters (160 feet) above grade. The water tower would be visible from south of I-140 and from along Castle Hayne Road. The proposed water tower is the same height as the existing water tower, the top of which would be visible from south of I-140 (see Figure 3-3). Although the operations building tower could be approximately 10 meters 930 feet) taller than the water tower, it would be visible primarily from Castle Hayne Road and from the Wooden Shoe subdivision northeast of the Wilmington Site because the proposed facility is set back further within the Wilmington Site than the existing water tower. The new water tower and the operations building tower would not represent a major alteration of the existing visual environment. Portions of the new plant may be visible from I-140. The planting of additional vegetation on the perimeter of the plant after construction may minimize visual impacts.

In Section 3.4, the U.S. Bureau of Land Management (BLM) Visual Resource Inventory process was applied to the study area. Based on that review, the study area was found to have low scenic quality. The environment in the project area is not unique for the area. The site of the proposed GLE Facility is adjacent to other industrial developments and will therefore not alter a pristine environment. Likewise, the project area is not in a location that is sensitive to visual intrusions. There is limited expectation that the area would be kept in a wilderness setting.

Operations would be expected to have visual impacts, but these impacts would not represent a major alteration from the current setting. Operational visual impacts are expected to be SMALL.

4.2.3.3 Mitigation Measures

To mitigate impacts on visual and scenic resources, GLE proposes to locate the proposed GLE Facility away from site boundaries bordering on existing development along NC133 and I-140, maintain (to the fullest width practicable) the existing tree buffer along the northeast Wilmington Site boundary to limit visibility of the proposed GLE Facility structures and access road traffic from offsite, and use exterior building colors and landscaping that soften visual impacts. Additional mitigation measures identified by NRC staff could include the planting of additional vegetation on the perimeter of the facility site to help screen the study area.

4.2.4 Air Quality Impacts

This section describes potential air quality impacts associated with construction and operation of the proposed GLE Facility in Wilmington, North Carolina. Because certain activities that can cause air quality impacts may take place in more than one of the project phases described in

Section 4.2 the lifespan of the GLE project is considered in four separate phases[1] for the air quality impacts analysis:

- access road construction and land clearing (does not include other preconstruction activities, such as ancillary building construction)

- building construction (including ancillary building construction that occurs as part of preconstruction activities)[2]

- start-up and final construction (includes concurrent indoor construction with staged testing and start-up of process units as completed)

- facility operations

Air emissions from these activities were estimated using the standard emission factor references followed by air dispersion modeling to estimate concentrations at and beyond the Wilmington Site boundaries. Potential impacts from access road construction, land clearing, building construction, and start-up and final construction are presented in Section 4.2.4.1, and those from facility operations are discussed in Section 4.2.4.2. Mitigation measures for these phases are presented in Section 4.2.4.3. Potential impacts from decontamination and decommissioning are discussed in Section 4.2.17.4. Greenhouse gas (GHG) emissions are addressed in Section 4.2.18.

During the access road construction, land clearing, and building construction phases, the main source of emissions would be fugitive dust from soil disturbances. During the start-up and final construction phase and the operations phase, all non-radiological emissions would be small because no fossil fuels would be burned for the processes.

4.2.4.1 Access Road Construction, Land Clearing, and Building Construction

Development of the proposed GLE Facility includes access road construction, land clearing, building construction activities (erection of main GLE buildings and ancillary buildings and structures), and start-up and final construction activities (concurrent indoor construction with

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[1] As discussed in Section 4.1, the air impacts analysis was based on the assumption that a licensing decision would be made in late 2011, construction (if authorized) would start shortly after the licensing decision was made, and license termination would occur in 2051. The analysis also was based on the assumption that initial operations would begin in 2013, final construction activities would continue from 2013 to 2017, and that full operations would be achieved in 2017. Subsequently, the Commission's *Notice of Hearing and Commission Order* (75 FR 1819) specified that a licensing decision be made within 30 months of the Order (i.e., June 2012). Thus, the NRC staff currently expects that a licensing decision will be made in 2012, construction will begin in 2012, and that termination of the 40-year license, if granted, will occur in 2052. The NRC staff expects that the dates for start-up and final construction (2013-2017) and full facility operations (2017) will remain unchanged. These schedule changes, which will be reflected in the final EIS, are expected to cause slight changes to the air impact analysis because of seasonal effects, but are not expected to change any of the impacts conclusions.

[2] For the purposes of estimating emission inventories and air quality modeling, the construction of ancillary structures, which falls under preconstruction, is grouped into building construction.

staged testing and start-up of process units as completed). Construction would last almost seven years, but facility operations would begin in 2013. Potential air quality impacts from construction activities of the proposed GLE Facility would be the highest during this initial two-year period, which would include a high level of soil disturbance by heavy construction equipment. For air quality impact analysis, it is assumed that new onsite access road construction would begin in early 2011, followed by land clearing from mid- to late 2011. Because these activities have been authorized by exemption (see Section 1.4.1), changes in the licensing schedule discussed in Section 4.1 are not expected to change the schedule of these preconstruction activities.

During access road construction, land clearing, and building construction activities, air emissions of criteria pollutants,[3] volatile organic compounds (VOCs), and a small amount of hazardous air pollutants (HAPs) (e.g., benzene) would include primarily fugitive dust emissions from soil disturbances and engine exhaust emissions from heavy equipment and commuter, delivery, and support vehicular traffic traveling within, to, and from the facility. Small quantities of additional VOCs and HAPs emissions would be released from the refueling and onsite maintenance of the off-road construction equipment, and from certain painting and other construction-finishing activities.

For road construction, land clearing, and building construction activities, the primary concern is the potential air impact of fugitive dust that results from soil disturbances, such as site clearing, bulldozing, compacting, grading, and vehicular traffic on unpaved roads or bare grounds. These activities would involve the intense use of heavy equipment over a short time period. Air emissions from building construction such as erection of structures and equipment installation would be typically lower than those from road construction and land clearing. Wind erosion from material stockpiles and disturbed areas are also fugitive dust sources, especially under relatively high-wind conditions. Engine exhaust emissions from heavy equipment and vehicles would release small amounts of particulate matter (PM), mostly fine particles ($PM_{2.5}$), which are different from large particulate matter (PM_{10}) from mechanical soil disturbances. Potential impacts of fugitive dust emissions on ambient air quality would be high because of near-ground-level release, if there is a short-distance buffer to the site boundaries.

Typically, source types, air pollutants, and their levels of emissions into the atmosphere would vary over the life of the project. The level of fugitive dust emissions would vary from day to day and from location to location, depending on the specific type of operation involved, the level of activities, soil types, and prevailing meteorological conditions (e.g., wind speed and direction, atmospheric stability, recent precipitation). No information on the detailed time schedule, heavy equipment usage, and activity levels are available at this time. Detailed schedule, equipment usage, and activity levels typically become available when a construction contract is developed. General area-wide emission factors based on area of and duration of disturbances were used. A PM_{10} emission factor of 0.94 metric ton per hectare-month (0.42 ton per acre-month) was applied to large-scale earthmoving activities, such as road construction and land clearing, while

[3] A list of six common air pollutants that are regulated by the U.S. Environmental Protection Agency (EPA) on the basis of certain criteria (i.e., information on human health and/or environmental effects of pollution). Criteria pollutants include sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone (O_3), particulate matter (PM_{10} with an aerodynamic diameter of 10 micrometers or less and $PM_{2.5}$ with an aerodynamic diameter of 2.5 micrometers or less), and lead (Pb).

a PM_{10} emission factor of 0.25 metric ton per hectare-month (0.11 ton per acre-month) was applied to building construction activities, such as erection of building structures and equipment installation (MRI, 1996). It is also assumed that 10 percent of PM_{10} emissions of fugitive dust is $PM_{2.5}$ (Countess Environmental, 2006). For this analysis, a control efficiency of 74 percent is assumed during the road construction and land clearing phase (Countess Environmental, 2006). No dust control was assumed by GLE during the building construction phase. Dust emissions caused by wind erosion might be small at the Wilmington Site compared with other fugitive dust emissions and are not estimated. This is because of: (1) infrequent wind speeds high enough to trigger wind erosion; (2) natural mitigation due to a high number of precipitation days (over 118 days per year with a precipitation ≥0.025 centimeter [0.01 inch]), and (3) tall trees surrounding the construction site acting as a wind barrier.

Engine exhaust emissions from on-road vehicles traveling to and from the Wilmington Site are estimated using emission factor motor vehicle model, MOBILE6.2 (EPA, 2003). Emission factors for off-road construction equipment were estimated using the U.S. Environmental Protection Agency's (EPA's) nonroad emission factor model (EPA, 2004). Daily and annual emissions for criteria pollutants and VOCs are presented in Table 4-1. During the construction phases, exhaust emissions from heavy equipment and vehicular traffic, including sulfur oxide (SO_x), nitrogen oxide (NO_x), carbon monoxide (CO), and VOCs are relatively small. However, as mentioned previously, fugitive dust emissions from soil disturbances, including particulate matter, are a major concern during the construction phase and are about an order of magnitude higher than other criteria pollutant and VOC emissions. Detailed information on underlying assumptions, emission factors, and emission estimation methodology are described in Appendix E of this draft EIS.

For the air quality modeling analysis, the latest version of the AERMOD model, Version 09292 (EPA, 2009a), which is the EPA's preferred or recommended model for a wide range of regulatory applications, was used to estimate concentration increments at receptors at and beyond Wilmington Site boundaries as a result of air emissions from the proposed GLE Facility.

Hourly surface and twice-daily upper sounding data from the nearest State Climate Office of North Carolina and National Weather Service (NWS) stations were used for the analysis. The nearest surface meteorological station is the Horticultural Crops Research Station, which is located about 3 kilometers (2 miles) directly east of the proposed GLE Facility. Surface characteristics for this station are representative of those for the proposed GLE Facility after tree removal, so this station is considered the primary meteorological station. Hourly surface meteorological data from Wilmington/New Hanover County Airport, which is located about 8 kilometers (5 miles) southeast of the proposed GLE Facility, are used to supplement the missing onsite data and to estimate boundary layer parameters. Twice-daily upper sounding data from Charleston, South Carolina,[4] which is located about 249 kilometers (155 miles) southwest of the proposed GLE Facility, are used for estimating the heights of the convective

[4] An upper air station at Morehead City, North Carolina, is about 113 kilometers (70 miles) northeast of the proposed GLE Facility, closer than Charleston, South Carolina. However, the latter was chosen considering the similarity of distance and orientation to the ocean.

Table 4-1 Estimated Air Emissions of Criteria Pollutants and VOCs from Construction and Operation of the Proposed GLE Facility[a,b]

Phase	Source Location	Average Daily Emissions (lbs/day)					
		SO_2	NO_x	CO	VOCs	PM_{10}	$PM_{2.5}$
Early Construction							
Road Construction	Onsite	0.14	74.3	51.4	6.00	76.4	19.3
Land Clearing	Onsite	0.14	74.3	51.4	6.00	1395.9	151.2
	Offsite[c]	0.08	30.1	58.9	4.27	0.70	0.68
Building Construction	Onsite	0.10	41.2	99.4	5.56	867.9	92.8
	Offsite	0.60	186.5	401.0	28.0	4.99	4.84
Start-up and Final Construction	Onsite	1.29	17.0	67.8	3.28	14.0	14.0
	Offsite	0.66	132.2	388.7	25.1	5.45	5.28
Operations	Onsite	1.26	14.5	34.9	1.74	13.9	13.9
	Offsite	0.31	41.2	170.6	10.4	2.57	2.49
Phase	**Source Location**	**Average Annual Emissions (tons/yr)[d]**					
		SO_2	NO_x	CO	VOCs	PM_{10}	$PM_{2.5}$
Early Construction	Onsite	0.02	10.0	6.94	0.81	168.7	18.4
	Offsite	0.01	4.07	7.95	0.58	0.09	0.09
Building Construction	Onsite	0.02	7.40	17.8	1.00	155.8	16.7
	Offsite	0.11	33.5	72.0	5.02	0.90	0.87
Start-up and Final Construction	Onsite	0.16	2.48	12.1	0.57	2.52	2.51
	Offsite	0.12	24.1	70.9	4.59	0.99	0.96
Operations	Onsite	0.15	2.01	6.11	0.29	2.50	2.50
	Offsite	0.06	7.51	31.1	1.90	0.47	0.45

[a] CO = carbon monoxide; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter ≤2.5 μm; PM_{10} = particulate matter ≤10 μm; SO_2 = sulfur dioxide, and VOCs = volatile organic compounds.

[b] Detailed information on assumptions, emission factors, and calculations are described in Appendix E.

[c] Offsite emission sources include vehicular traffic traveling on roadways to and from the proposed GLE Facility site.

[d] Assume that construction and operations activities would occur on weekdays and weekends throughout the year, except no work schedule on six holidays (New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, and Christmas Day) during the construction phases. Annual emissions are not 365 times daily emissions due to the 9-month schedule of the road construction and land clearing phase and due to intermittently operating emergency diesel generators during start-up and final construction phase and operations phase.

boundary layer. Four years of meteorological data (2005 to 2008)[5] were processed for input to the AERMOD. For the analysis, receptors at Wilmington Site boundaries are set densely (a few tens of meters) at northern boundaries where maximum concentrations of air pollutants are anticipated, and sparsely (a few hundreds of meters) at other site boundaries where lower concentrations of air pollutants are anticipated. Polar grid receptors are set up to 50 kilometers (31 miles) from the center of the proposed GLE Facility. Detailed information on assumptions, parameter selection, modeling inputs, and air dispersion modeling is available in Appendix E.

Estimated maximum pollutant concentrations during access road construction and land clearing are shown in Table 4-2 for criteria pollutants. Concentration increments for sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and CO are predicted to be negligible. Predicted concentration increments for 24-hour and annual $PM_{2.5}$ are less than 29 percent of their respective standards. However, the modeled 24-hour PM_{10} concentration increment would be above the standard (about 177 percent) during access road construction and land clearing activities.

To obtain the total concentrations for comparison to applicable air quality standards, modeled concentration increments were added to measured background concentrations representative of the Wilmington Site (Buckler, 2009). For SO_2, NO_2, and CO, background concentrations, not GLE sources, account for most of the total concentrations. The total concentrations would be less than 27 percent of their respective standards. The total concentration for annual $PM_{2.5}$ is estimated to be 70 percent of its applicable standard. Total 24-hour $PM_{2.5}$ concentrations would barely exceed the standard, but the contribution from background is much higher than from GLE emissions. Total 24-hour PM_{10} concentrations would be above the applicable standard, about 195 percent. Note that the concentration increment causes 24-hour PM_{10} exceedances irrespective of background concentration, while the sum of background concentration and the project-related increment contributes to exceeding the 24-hour $PM_{2.5}$ standard. Maximum PM_{10} and $PM_{2.5}$ concentrations associated with road construction and land clearing activities are predicted to occur at the proximate northern boundary of the Wilmington Site near the proposed GLE Facility (less than 50 meters [164 feet] from the boundary) and would last for eight months. Comparably high PM_{10} and $PM_{2.5}$ concentrations are also predicted at the northern Site boundary near the Wooden Shoe residential subdivision, close to which the North access road would be located (about 25 meters [82 feet] from the boundary). These high concentrations would result from fugitive dust emissions during road construction and vehicle traffic on unpaved roads during land clearing activities.

Estimated maximum pollutant concentrations during the building construction phase are presented in Table 4-3. Maximum concentration levels and patterns are similar to those for access road construction and land clearing activities. Concentration increments for SO_2, NO_2, and CO are predicted to be negligible and their total concentrations are well below their respective standards. Total annual $PM_{2.5}$ concentration would be below its respective standard.

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[5] Per EPA's Modeling Guidance (40 CFR Part 51, Appendix W), the most recent consecutive five years of meteorological data representative of the site of interest should be used when estimating concentrations with an air quality model. However, four years of data (2005–2008) were used for this analysis. A problem in wind direction measurements was found at the Horticultural Crops Research Station in 2004 and wind sensor was replaced in January, 2005. Wind roses for 2001–2004 at the station indicated that wind patterns vary significantly from the general patterns in the area, rendering data from this period unusable.

Table 4-2 Maximum Air Quality Impacts Due to Emissions Associated with Road Construction and Land Clearing Activities for the Proposed GLE Facility

		Concentration ($\mu g/m^3$)[b]				Percent of NAAQS/SAAQS	
Pollutant[a]	Averaging Time	Maximum Increment[c]	Background[d]	Total	NAAQS/ SAAQS	Increment	Total
SO_2	3 hours	0.22	213.0	213.2	1300	0.017%	16.4%
	24 hours	0.04	70.4	70.4	365	0.010%	19.3%
	Annual	0.002	17.1	17.1	80	0.003%	21.4%
NO_2	Annual	1.10	26.1	27.2	100	1.10%	27.2%
CO	1 hour	142.75	3543.0	3685.7	40,000	0.36%	9.2%
	8 hours	27.68	2556.0	2583.7	10,000	0.28%	25.8%
PM_{10}	24 hours	264.80	27.0	291.8	150	176.5%	194.5%
$PM_{2.5}$	24 hours	10.03	25.4	35.4	35	28.7%	101.2%
	Annual	1.54	9.0	10.5	15	10.3%	70.3%

[a] CO = carbon monoxide; NO_2 = nitrogen dioxide; $PM_{2.5}$ = particulate matter ≤2.5 μm; PM_{10} = particulate matter ≤10 μm; and SO_2 = sulfur dioxide.
[b] To convert $\mu g/m^3$ to ppm for gaseous pollutants, such as SO_2, NO_2, and CO, divide values in $\mu g/m^3$ by product of 40.82 and molecular weight.
[c] For short-term (≤ 24 hours) averages, second-highest modeled concentrations among site boundary and offsite receptors except 24-hour PM_{10} and $PM_{2.5}$. For PM_{10}, highest of the 5th-highest over 4 years (2005–2008) was presented. For $PM_{2.5}$, the highest of the 4-year average of the 8th-highest concentration at each receptor is presented. For annual averages, highest annual average concentrations over four years are presented.
[d] Source: Buckler, 2009.

However, total 24-hour PM_{10} and $PM_{2.5}$ concentrations would be above their respective standards (about 201 percent and 123 percent, respectively). These exceedances would occur at the proximate northern boundary of the Wilmington Site near the proposed GLE Facility. Unlike impacts during access road construction and land clearing, concentrations at the northern Site boundary, near the North access road and Wooden Shoe residential subdivision, would be about an order of magnitude lower than at the northern Site boundary near the proposed GLE Facility. This is due to paving of the unpaved access road near the end of the road construction and land clearing phase.

During access road construction, land clearing, and building construction activities, potential impacts of SO_2, NO_2, and CO emissions from heavy equipment and vehicles on ambient air quality would be well below the applicable ambient air quality standards. These impacts on ambient air quality would be anticipated to be SMALL. However, total (background plus modeled) 24-hour PM_{10} and $PM_{2.5}$ concentrations mostly resulting from fugitive dust emissions are predicted to exceed the standards at the proximate northern site boundaries near the proposed GLE Facility during land clearing and building construction activities. In addition, high PM_{10} and $PM_{2.5}$ concentrations at the northern Site boundary near the Wooden Shoe residential subdivision result from fugitive dust emissions from vehicle traffic on the unpaved North access

Table 4-3 Maximum Air Quality Impacts Due to Emissions Associated with Building Construction Activities for the Proposed GLE Facility

		Concentration (µg/m³)[b]				Percent of NAAQS/SAAQS	
Pollutant[a]	Averaging Time	Maximum Increment[c]	Background[d]	Total	NAAQS/ SAAQS	Increment	Total
SO_2	3 hours	0.26	213.0	213.3	1300	0.020%	16.4%
	24 hours	0.05	70.4	70.4	365	0.013%	19.3%
	Annual	0.009	17.1	17.1	80	0.012%	21.4%
NO_2	Annual	1.31	26.1	27.4	100	1.31%	27.4%
CO	1 hour	846.31	3543.0	4389.3	40,000	2.12%	11.0%
	8 hours	192.74	2556.0	2748.7	10,000	1.93%	27.5%
PM_{10}	24 hours	274.63	27.0	301.6	150	183.1%	201.1%
$PM_{2.5}$	24 hours	17.64	25.4	43.0	35	50.4%	123.0%
	Annual	2.40	9.0	11.4	15	16.0%	76.0%

[a] CO = carbon monoxide; NO_2 = nitrogen dioxide; $PM_{2.5}$ = particulate matter ≤2.5 µm; PM_{10} = particulate matter ≤10 µm; and SO_2 = sulfur dioxide.

[b] To convert µg/m³ to ppm for gaseous pollutants, such as SO_2, NO_2, and CO, divide values in µg/m³ by product of 40.82 and molecular weight.

[c] For short-term (≤ 24 hours) averages, second-highest modeled concentrations among site boundary and offsite receptors except 24-hour PM_{10} and $PM_{2.5}$. For PM_{10}, highest of the 5th-highest over 4 years (2005–2008) was presented. For $PM_{2.5}$, the highest of the 4-year average of the 8th-highest concentration at each receptor is presented. For annual averages, highest annual average concentrations over four years are presented.

[d] Source: Buckler, 2009.

road during land clearing activities. These exceedances would occur when the wind blows from the directions ranging from south to west. Most of these exceedances are associated with a couple of hours of high concentrations in the early morning in winter, typical of low wind speeds (about 1 meter per second) and stable conditions. The access road construction, land clearing, and building construction activities would last about nine months and two years, respectively.

Accordingly, potential air quality impacts during road construction, land clearing, and building construction activities are expected to be MODERATE but temporary in nature. Although natural mitigation of fugitive dust emissions is considerably high due to high rates of precipitation in the area, aggressive dust control measures should be implemented during road construction, land clearing, and building construction activities to minimize potential air quality impacts, as discussed in Section 4.2.4.3.

Estimated emissions from engine exhaust and vehicular traffic during the start-up and final construction phase, which would last for five years from 2013 to 2017, would be comparable to those during road construction, land clearing, and building construction activities. However, PM emissions are more than an order of magnitude lower than the previous two phases.

Accordingly, start-up and final construction activities would have SMALL impacts on ambient air quality for all criteria pollutants.

Concentration increments for the two remaining criteria pollutants, lead (Pb) and ozone (O_3), were not modeled. As a direct result of the phase-out of leaded gasoline in automobiles, average lead concentrations in urban areas throughout the country have decreased dramatically. It is expected that emissions of lead from the proposed facility construction would be negligible and would therefore have no or SMALL impacts on surrounding areas.

The high ozone concentrations of regional concern are associated with precursor emissions (nitrogen oxides [NO_x] and VOCs) locally and long-range transport of precursor-laden air masses from neighboring areas under favorable meteorological conditions, such as high temperatures, low wind speeds, intense solar radiation, and an absence of precipitation. The New Hanover County encompassing the proposed GLE Facility is currently in attainment for ozone (40 CFR 81.334) but monitored 8-hour ozone levels in the area approach or are just below the standard (see Table 3-9). Ozone precursor emissions during the three construction phases would be relatively small. As shown in Table 4-1, the highest emissions would occur during the building construction phase, about 37.1 metric tons per year (40.9 tons per year) for NO_x and 5.4 metric tons per year (6.0 tons per year) for VOCs, which are about 0.6 percent and 0.3 percent of total emissions in New Hanover County, respectively. These emissions would be much lower than those for the regional airshed[6] in which emitted precursors are transported and formed into ozone. Accordingly, potential impacts of ozone precursor releases from all construction phases of the proposed GLE Facility on regional ozone would be SMALL.

4.2.4.2 Facility Operations

No criteria pollutants would be generated during operation of the proposed GLE Facility because no combustion is involved. A new operating permit would be required for the proposed GLE Facility. However, criteria pollutant and HAP emission rates are expected to be small during the operations phase, and thus, the proposed GLE Facility would not be a major source of air emissions as defined under the EPA and North Carolina Department of Air Quality (NCDAQ) air permit requirements. The laser uranium enrichment process would occur inside the main GLE building. Short-term uranium-related and/or hydrogen fluoride (HF) emissions would occur during the process and be drawn into the ventilation system with a series of emission control devices such as high-efficiency particulate air (HEPA) filters for ≥99.8 percent removal of PM, and activated carbon beds for ≥99 percent removal of HF. Then, the air stream would be released into the atmosphere through a single building roof stack; accordingly, air emissions through the stack would be minimal. Potential impacts associated with radiological and hazardous emissions are addressed in Section 4.2.11. No continuous combustion sources for space heating (such as boilers) would be needed, because most of the heat generated by the process lasers would be used for building space heating. The only stationary combustion sources at the proposed GLE Facility would be two 382-horsepower auxiliary emergency diesel generator units. These units will be operating on an intermittent basis to provide backup electric power to the proposed GLE Facility in the event of power outage or load-shedding, and to

[6] A geographical area that shares the same air due to topography, meteorology, and climate.

conduct routine maintenance testing.[7] Based on air permit conditions for the existing emergency diesel generators at the Wilmington Site, the permitted number of operating hours per year is 240. However, actual operating hours would vary depending on the number and duration of power disruptions. The other stationary sources are two mechanical-draft cooling towers, which will not be a source of the typical combustion-related criteria pollutants or other toxic emissions, but emit small amounts of particulate matter as drift.

Other onsite miscellaneous sources include uranium hexafluoride (UF_6)-cylinder handling activities and routine equipment maintenance. Accidental releases associated with UF_6-cylinder handling activities would be possible, and associated emissions could be much higher than those from a process building stack. Potential impacts of these releases are addressed in Sections 4.2.11 and 4.2.15. Dedicated onsite transfer vehicles (OSTVs)[8] would be used to ferry the UF_6 cylinders between the proposed GLE Facility's main operations buildings and cylinder storage yards. Small quantities of organic solvents and lubricants would be used for process equipment and vehicle maintenance.

Mobile sources along the onsite roadways including commuting and delivery vehicles traveling to and from the proposed GLE Facility and existing FMO facility would also contribute emissions. Fugitive dust emissions from the disturbed areas during operations would be minimal because most working areas and roadways within the proposed GLE Facility would be paved.

As shown in Table 4-1, estimated emissions during the operations phase are presented for comparison along with construction emissions. Auxiliary diesel generator units account for most of SO_2 and NO_x emissions from onsite operations, while onsite gasoline-engine traffic is a primary contributor to CO and VOC emissions. Two mechanical-draft cooling towers account for most of the PM emissions. Emissions during the operations phase are lower than those during the start-up and final construction phase, and PM emissions are more than an order of magnitude lower than those during access road construction, land clearing, and building construction activities. Accordingly, potential air quality impacts of criteria pollutants resulting from operation of the proposed GLE Facility would be anticipated to be SMALL. Potential impacts of uranium and hydrogen fluoride emissions on public and occupational health associated with operation of the proposed GLE Facility are presented in Section 4.2.11.

As discussed in Section 4.2.4.1, lead emissions from proposed facility construction are expected to be negligible and would therefore have no adverse impacts on surrounding areas.

Ozone precursor emissions during operation of the proposed GLE Facility would be relatively small, about 8.6 metric tons per year (9.5 tons per year) for NO_x and 2.0 metric tons per year (2.2 tons per year) for VOCs, which are less than 0.13 percent and 0.09 percent of total emissions in New Hanover County, respectively. These emissions would be much lower than those for the regional airshed in which emitted precursors are transported and formed into

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7 A program to cut off the electric current on certain large industrial electricity users during times of peak demand under a prearranged agreement.

8 Diesel-powered forklifts are the primary option, but other options, such as propane- and electric-powered OSTVs are also under consideration.

ozone. Accordingly, potential impacts of O_3 precursor releases from facility operations on the regional ozone would not be of concern.

4.2.4.3 Mitigation Measures

As discussed above, air quality impacts are generally expected to be SMALL. However, potentially MODERATE air quality impacts of short duration are possible during road construction, land clearing, and building construction activities. To minimize potential air quality impacts during the road construction, land clearing, building construction, start-up and final construction, and operations periods, the best available practices should be implemented as practically as possible. Air emissions would need to comply with applicable laws, ordinances, regulations, and standards. Fugitive dust emissions and other combustion-related emissions would need to be controlled through stipulations included in the permitting processes. Below are mitigation measures that GLE has committed to implementing (GLE, 2008) and additional mitigation measures identified by NRC staff that could potentially reduce or minimize impacts.

Mitigation Measures for Road Construction, Land Clearing, and Building Construction

Mitigation Measures Identified by GLE

- Water the facility site and unpaved roads to reduce dust.

- Remove dirt from truck tires by driving over a gravel pad prior to leaving the facility site or unpaved access road to avoid spreading sediments on paved roads.

- Cover trucks carrying soil and debris to reduce dust emissions from the back of trucks driving on roadways.

- Pave access road and parking lots as soon as practicable.

Additional Mitigation Measures Identified by NRC

- Post speed limits (e.g., 10 miles per hour) visibly within the construction site, and enforce them to minimize airborne fugitive dust.

- Limit access to the construction site and staging areas to authorized vehicles only, through the designated treated roads.

- Stage construction to limit the exposed/disturbed area at any given time, when practical.

- Train workers to comply with the speed limit, use good engineering practices, minimize drop height of materials, minimize disturbed areas, and employ other BMPs as appropriate.

- To the extent practicable, conduct soil-disturbing activities and travel on unpaved roads during periods of favorable meteorological conditions, as conducting these activities during periods of unfavorable meteorological conditions[9] may result in exceedances of air quality standards. Unfavorable meteorological conditions are infrequent and include (1) periods of low winds and stable weather conditions (primarily encountered around sunrise in winter) and (2) periods of high winds.

- All heavy equipment should meet emission standards specified in the *State Code of Regulations*, and routine preventive maintenance, including tuneup to the manufacturer's specification, should be implemented to ensure efficient combustion and minimum emissions.

- Fuel all diesel engines used in the facility and auxiliary diesel generator units with ultra-low sulfur diesel with a sulfur content of 15 parts per million or less.

- Limit idling of diesel equipment to no more than 10 minutes, unless idling must be maintained for proper operation; for example, drilling, hoisting, and trenching.

- Because GLE assumed a dust control efficiency of 55 percent (applying water twice per day for the unpaved North access road during land clearing), more aggressive dust control measures should be implemented (for the entire unpaved access road or for the segments that most contribute to exceedances) to minimize potential dust impacts at the Wilmington Site boundary and the nearby Wooden Shoe residential subdivision. Options include more frequent water spraying (e.g., at every 2-hour watering interval) and the application of a dust suppressant. Selection of the proper dust suppressant should be based on road conditions, environmental impacts (including surface and groundwater quality), and cost (Bolander and Yamada, 1999).

Mitigation Measures for Operation

Mitigation Measures Identified by GLE

- Conduct uranium-enrichment operations inside an enclosed building using a closed-system process with no routine venting of process gases.

- Install and operate leak-detection monitors for process equipment. In the event a leak is detected due to an equipment component malfunction or other reason, safety interlocks will isolate the section of the process where the leak is detected, limiting the potential quantity of gaseous material that could be released inside the proposed GLE Facility's operations building.

- Maintain process areas inside the operations building under continuous negative pressure relative to atmospheric pressure. In the event of a gaseous release in one of these process areas, the negative pressure conditions would prevent outflow of the air from the process areas, effectively containing the released gaseous material to the affected process area.

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[9] Stable meteorological conditions limit dilution of airborne pollutants, which can lead to potentially high pollutant concentrations at the ground level. High winds are unfavorable due to the increased potential for fugitive dust emissions.

- Ventilate the operations building with a high-efficiency, multi-stage air emissions control system. Components of the air emissions control system planned for the operations building consist of high-efficiency particulate arresting (HEPA) filters for removal of solid particulate matter and activated carbon beds for adsorption of HF. Exhaust gases from this emission-control system would be vented to the atmosphere through a single stack.

- Implement a periodic inspection and maintenance program for uranium hexafluoride (UF_6) cylinders stored in outdoor areas.

- Burn low-sulfur fuel oil in the auxiliary diesel generators.

- Store organic solvents, paints, and other volatile organic compound–containing liquids in containers covered with tightly fitting lids.

Additional Mitigation Measures Identified by NRC

No additional mitigation measures to minimize potential impacts on ambient air quality from the operation of the proposed GLE Facility are proposed by NRC.

4.2.5 Geology and Soil Impacts

This section discusses the assessment of potential environmental impacts on geologic resources and soils during preconstruction activities, construction, and operation of the proposed GLE Facility. Potential impacts include soil erosion due to ground disturbance and changes in drainage. Section 3.6 of this draft EIS provides a description of site soils and the geologic setting.

4.2.5.1 Preconstruction and Construction Activities

As described in Section 1.4.1, preconstruction activities would include clearing of about 40 hectares (100 acres) at the proposed GLE site (GLE, 2009b), among other activities. Because the site is generally quite level, regrading would be minimal. Additional activities may include construction of two wet detention basins and topsoil stripping and stockpiling. These ground-disturbing activities would result in short-term soil erosion, which could be minimized by following BMPs, including but not limited to the use of silt fencing, reseeding of areas, and proper construction of drainages and culverts. These activities are controlled by the New Hanover County Erosion and Sedimentation Control Ordinance (New Hanover County, 2007), which authorizes permits as appropriate.

The heavy equipment used during preconstruction or construction activities could potentially leak fuel, oil, or grease to site soils. Following BMPs, as discussed in Section 4.2.5.3, would reduce the associated impacts.

Under the proposed action, approximately 91 hectares (226 acres) of land would be disturbed in the Wilmington Site's North-Central and Eastern Site Sectors, including the approximately 40 hectares (100 acres) described above for the proposed GLE site in the north-central site sector, plus about 5 hectares (13 acres) for support structures to the east and about 13 hectares (33 acres) associated with the North access road.

Soil-related aspects of the construction phase would include soil excavation for foundations and buried utility lines, soil storage and removal, and stormwater management. These activities are controlled by the New Hanover County Erosion and Sedimentation Control Ordinance (New Hanover County, 2007), which authorizes permits as appropriate. Most of the project area is Murville sand and Leon sand soil types, and their erodibility is slight (USMC, 2009; GLE, 2008).

Construction vehicles and equipment could potentially leak fuel, oil, or grease to site soils. Following BMPs, as discussed in Section 4.2.5.3, would reduce the associated impacts.

Preconstruction and construction activities would not impact site geologic resources because the site lacks significant geologic resources. Construction activities would involve acceptable amounts of crushed stone and/or sand and gravel from offsite sources for use in construction of roads and buildings.

Overall, the impact on geology and soil is considered SMALL. The estimated relative contributions to the soil-related impacts are 50 percent during preconstruction activities and 50 percent during construction. These figures are estimated based on assumed similar disturbed land footprints and equipment use during both phases for similar durations.

4.2.5.2 Facility Operations

During operations, soil disturbance would take place at a reduced level, as some construction projects would be completed while others would be ongoing. Restoration and seeding of cleared land would need to occur to limit erosion due to stormwater. Roads, parking lots, and roofs would create impervious surfaces and increase runoff, consequently increasing the erosion potential. Large storm events could create erosion along drainages or at culverts, causing a need for maintenance or drainage system improvement. Proper site development and culvert design would limit this impact. The county notifies owners of deficient components of a stormwater system (New Hanover County, 2009c). Correction is the responsibility of the owner, otherwise the county would mitigate and recover costs from the owner.

Vehicles and equipment used in unpaved areas could potentially leak fuel, oil, or grease to site soils. Following BMPs, as discussed in Section 4.2.5.3, would reduce the associated impacts.

Groundwater extraction is expected to have a minimal effect on groundwater levels, and the associated degree of subsidence is expected to be negligible. Other geologic hazards to the site (e.g., volcano, tsunami, landslide, radon gas, methane gas, subsidence due to mining) are not anticipated. The overall impact on geology or soil during operations is expected to be SMALL.

4.2.5.3 Mitigation Measures

GLE proposes to employ a number of measures to mitigate impacts on soil and geological resources (GLE, 2008), including:

- minimization of the construction footprint to the extent possible

- minimization of soil disturbance

- use of soils from onsite borrow pits that are accessible via existing roadbeds if additional soil is needed

- management of construction activities so that only designated areas within the GLE study area are disturbed and no heavy equipment or construction operations are allowed to affect areas outside the study area unless specifically designated

- use of adequate containment methods during excavation

- use of site-stabilization practices (e.g., placing crushed stone on top of disturbed soil in areas of concentrated runoff)

- use of silt berms, dikes, and sediment fences

- stabilization of drainage culverts and ditches by lining with rock aggregate/rip-rap to reduce flow velocity and prohibit scouring

- reuse and/or appropriate placement of excavated materials to decrease exposed soil piles

- placement of gravel construction pads at the entrance/exits of construction areas

- stabilization of the site with low-maintenance landscaping and pavement

In addition, the New Hanover County Erosion and Sedimentation Control Ordinance (New Hanover County, 2007) contains BMPs for control of soil and sediment. For erosion control, BMPs include but are not limited to the use of silt fencing, reseeding of disturbed areas, minimizing soil disturbance during the construction phase through planning and engineering design, and proper construction of drainages and culverts. Implementation of BMPs would limit the impact of soil erosion and soil contamination. Soil-disturbing activities are controlled by the New Hanover County Erosion and Sedimentation Control Ordinance, which authorizes permits as appropriate. The county will periodically inspect land-disturbing activities at a site to ensure compliance with the permit. Failure to conform to the permit would lead to issuance of a Notice of Violation to GLE from New Hanover County, and continuing violations would lead to the imposition of penalties assessed against GLE (New Hanover County, 2007). Implementation of proper, generally accepted BMPs for storage, handling, spill prevention, and spill response would reduce the impact of contamination associated with fuels, oils, and grease from equipment used onsite (or from other chemicals or wastes managed onsite).

4.2.6 Surface Water Resources Impacts

This section discusses the assessment of potential environmental impacts on surface water during preconstruction activities, construction, and operation of the proposed GLE Facility. The discussion includes the potential impact due to turbidity from soil erosion and contaminants in runoff.

4.2.6.1 Preconstruction and Construction Activities

Preconstruction activities are expected to include the construction of stormwater detention basins and the clearing of approximately 40 hectares (100 acres) of land at the GLE site. As discussed in Sections 4.2.5.1 and 4.2.5.3, BMPs would be implemented and the process would be inspected by the county so that soil erosion and the associated increase to turbidity would be minimized. Still, a short-term decrease in surface water quality in unnamed tributaries of Prince George Creek and the Northeast Cape Fear River and potentially the creek and river themselves may be realized due to sedimentation and turbidity associated with erosion during preconstruction and construction activities.

Currently, the North Carolina Department of Environmental and Natural Resources (NCDENR) requires the permittee to monitor daily rainfall, visually inspect runoff outfalls on a regular basis, and thoroughly document monitoring activities and data (NCDENR, 2009b). Recent EPA rules address stormwater runoff at construction sites (EPA 2009e). As of August 2011, all sites that disturb 20 or more acres will require self-monitoring on a regular basis and will need to meet the EPA's effluent limitation guidelines for turbidity of 280 nephelometric turbidity units. The NCDENR issued a new general permit for construction activities, effective January 1, 2010 (NCDENR, 2009b), but the turbidity monitoring requirements are not included. The NCDENR general permit will be updated before August 2011 to include those requirements.

Construction of the purposed facility would involve new buildings, parking lots, UF_6 storage areas, and landscaping. Excavations for foundations or buried utility lines would lead to possible short-term soil erosion problems with associated impacts on surface water quality. Again, BMPs would be expected to minimize the impacts, as discussed in Section 4.2.5.3.

The proposed North access road would have a new stream crossing at a tributary of Prince George Creek and possibly change a jurisdictional channel. This could lead to erosion and increased sediment load. Following BMPs for this type of action would minimize the impact.

Use of construction vehicles and equipment during preconstruction or construction activities poses the possibility of leaks or spills of fuels, oil, or grease, which could run off and impact surface water in the unnamed tributaries of Prince George Creek and the Northeast Cape Fear River and potentially the creek and river themselves. As described in Section 4.2.6.3, BMPs for storing and handling these liquids and for dealing with such releases would limit or eliminate their effect on surface water quality. Because of the distance from the main work area to the drainages, it is unlikely that a minor spill would directly reach the Northeast Cape Fear River or Prince George Creek. Infiltration into site soil would likely eliminate runoff of the liquid.

Preliminary plans for the proposed GLE Facility include a runoff pond to receive water from the UF_6 storage pads (tails), two State-permitted stormwater wet detention basins, a small cooling tower for heating, ventilation, and air conditioning (HVAC) equipment, a water tower for potable and perhaps process water, and a firewater pond. The design of the stormwater wet detention basins is not finalized, but they would be constructed according to State and County requirements (GLE, 2009f). They would likely have clay liners, and they would be designed for a 25-year storm event (GLE, 2009f). The runoff pond for the UF_6 storage pad is anticipated to be approximately 3 acres, have a clay liner, and be designed in consultation with the State

Department of Water Quality (GLE, 2009f). Overflow from these basins would presumably be routed to the effluent channel or to the natural drainage fed by the effluent channel.

The overall impact on surface water quality during preconstruction and construction activities is expected to be SMALL due to the nature of the work activities, the site soil characteristics and slopes, and the use of generally implemented BMPs to negate the effect of potential problems from erosion, spills, etc. The estimated relative contributions of these impacts are 50 percent during preconstruction activities and 50 percent during construction. These figures are estimated based on assumed similar disturbed land footprints and equipment use during both phases for similar durations.

4.2.6.2 Facility Operations

A process wastewater effluent rate of about 35,000 gallons per day would result from the proposed action and be discharged at existing Outfall 001. The flow would include 5000 gallons per day of liquid radwaste (from decontamination, cleaning, and laboratory activities) and 30,000 gallons per day of noncontact cooling tower blowdown. The liquid radwaste would be pretreated in the GLE liquid effluent treatment system before transfer to the existing Wilmington Site final process lagoon wastewater treatment facility. The treatment process is very similar to that already in use at the Wilmington Site (GLE, 2009f). Steps in the process would include pH adjustment to precipitate uranium, addition of a flocculent, filtering and drying of uranium floc (flakes of precipitate), and offsite disposal of the resulting solids. The site's process wastewater volume would increase by seven percent over the 2006 level, which is the latest data available (GLE, 2008). Treatment steps would produce an effluent with concentrations similar to those of current process wastewaters (GLE, 2008; GLE 2009f).

The wastewater treatment and industrial reuse system already in place at the Wilmington Site would receive the sanitary effluent from the proposed GLE Facility for use in the cooling tower. The National Pollutant Discharge Elimination System (NPDES) discharge permit remains valid if discharge to Outfall 002 becomes necessary in the future (GLE, 2008).

Stormwater runoff would gather in wet detention basins before discharge to a stream. Stormwater during the operational phase would be regulated by a NPDES permit, which would include a stormwater pollution prevention plan.

If radioactivity were detected in the UF_6 storage pad's runoff pond, the contents would be allowed to settle and precipitate. Liquid would be pumped out and taken to the GLE liquid effluent treatment system. Residual solids would then be analyzed and, if necessary, disposed of as low-level radioactive waste (LLRW) at the Energy*Solutions* facility in Utah (GLE, 2008). When monitoring demonstrates a lack of radioactivity, the pond's effluent would be discharged to the two stormwater ponds and ultimately to the effluent channel above the dam.

Following construction of the North Road, together with completion of associated stream crossings, any increase in turbidity and sediment loading to streams realized during the preconstruction and construction phases would subside during the operational phase. Oil, grease, metals, and other automotive-related contaminants would be present in limited quantities due to general traffic.

The use of herbicides at the proposed facility's landscaped areas would be similar to their use elsewhere at the Wilmington Site. BMPs regarding the use of such chemicals would limit their impact on surface water quality.

No consumptive surface water use would take place during the proposed action.

Watershed modeling suggests that runoff at the proposed GLE Facility would increase by 36 percent over the current conditions in undeveloped land (GLE, 2008). This runoff would be detained in the wet detention pond designed for a 25-year storm. This pond would be designed during final design of the proposed GLE Facility, in compliance with State water quality treatment regulations and county regulations (GLE, 2009f). State regulations require treatment of the first 1.5 inches of rain to remove 85 percent of total suspended solids. New Hanover County (New Hanover County, 2009c) requires peak control of 2-, 10-, and 25-year storms to the predevelopment condition.

During operations, some construction projects would be completed while others would be ongoing. The potential increase in turbidity in site drainages would take place at a level proportional to the intensity and areal extent of soil disturbance. Restoration and seeding of cleared land would need to occur to limit erosion due to stormwater. Roads, parking lots, and roofs would create impervious surfaces and increase runoff, consequently increasing the erosion potential. Large storm events could create erosion along drainages or at culverts, causing a need for maintenance or drainage system improvement.

Overall, the impact on surface water during operations is anticipated to be SMALL due to planned systems for runoff, treatment, and monitoring and experience with the existing Wilmington Site facilities.

4.2.6.3 Mitigation Measures

GLE proposes to employ a number of measures to mitigate impacts on surface water resources (GLE, 2008), including:

- selection of a non-wetland, non-floodplain area for the proposed facility

- implementation of proper construction BMPs as specified by the New Hanover County Erosion and Sedimentation Control Ordinance (New Hanover County, 2007)

- construction of the access road perpendicular to Unnamed Tributary #1 to minimize the impacted area

- design and construction of the upgraded crossing following procedures required by the *New Hanover County Flood Damage Prevention Ordinance* (New Hanover County, 2006)

- limitation of cut/fill slopes to a horizontal-vertical ratio of three to one or less

- use of silt fencing and covering soil stockpiles to prevent sediment runoff

- suspension of general construction activities during storms and impending precipitation

- construction of stream crossings (i.e., installation of culverts) following at least 48 hours of dry weather

- diversion of stream flow during stream-crossing construction to minimize excavation in flowing water

- maintenance of construction equipment to avoid visible leaks of oil, greases, or hydraulic fluids

- restoration of disturbed areas to original surface elevations, where possible

- compliance with all NPDES stormwater and wastewater permit requirements

- routing of stormwater to a new stormwater wet detention basin, designed in accordance with the NCDENR *Stormwater Best Management Practices Manual* (NCDENR, 2007)

- onsite treatment of process and sanitary wastewaters to NPDES-permit limits before discharge to receiving waters

- routine monitoring and inspection of onsite liquid waste storage tanks and containers to detect any leaks or releases to the environment to ensure prompt correction action under the Spill Prevention Control and Countermeasure (SPCC) Plan[10]

- discharge of UF_6 storage pads stormwater runoff to a holding pond for monitoring prior to discharge to the stormwater wet detention basin

- periodic visual inspection of the stormwater wet detention basin to verify proper function, at a frequency sufficient to allow for identification of basin high-water-level conditions and implementation of corrective actions to restore the water level prior to overflow

- construction of a stormwater wet detention basin and implementation of a Wilmington Site stormwater management plan to mitigate a portion of the increased floodwaters from extreme storm events and all stormwater from smaller storm events

- ensuring easy access to the stormwater wet detention basin to allow the prompt, systematic sampling of runoff

In addition, the New Hanover County Erosion and Sedimentation Control Ordinance (New Hanover County, 2007) contains BMPs for control of soil and sediment which relate closely to surface water quality due to sedimentation and turbidity. These are discussed in Section 4.2.5.3. The county notifies owners of deficient components of a stormwater system (New Hanover County, 2009c). Correction is the responsibility of the owner, otherwise the county will mitigate and recover costs from the owner. Implementation of BMPs for storage, handling, spill prevention, and spill response would reduce the impact of surface water

[10] SPCC plans are prepared to prevent the discharge of oil from a facility into navigable waters or adjoining shorelines. These plans require facilities to have adequate containment around oil tanks, such as berms and dikes, to protect soil and water in the event of a spill.

contamination associated with the runoff of fuels, oils, and grease from equipment used onsite (or from other chemicals or wastes managed onsite). Implementing these BMPs would also limit the impact of soil erosion and soil contamination, as discussed in Section 4.2.5.3. Mitigation measures with respect to surface water usage are not relevant because no consumptive surface water use is included in the proposed action.

4.2.7 Groundwater Resources Impacts

This section describes the potential impacts on groundwater resources, which generally are related to possible spills or leaks of fuels or other liquids and to the groundwater-surface water interaction.

4.2.7.1 Preconstruction and Construction Activities

Construction equipment used for clearing, excavating, and construction pose the potential for leaks of fuel, oil, and grease to the soil and ultimately to the groundwater. Following BMPs would reduce the impact to site groundwater. The use of portable toilets would eliminate sanitary system impacts on groundwater. Potable and nonpotable water requirements would be met by transport of offsite water by tanker trucks. These would include acceptable amounts of water for concrete-making and possibly for dust suppression.

Altogether, the impact of preconstruction and construction activities on groundwater use and quality would be SMALL. The estimated relative amounts of impact are 50 percent during preconstruction activities and 50 percent during construction due to use of similar equipment and fuel during these two phases.

4.2.7.2 Facility Operations

During the operational phase, stormwater would collect in a clay-lined wet detention basin and eventually drain to surface water bodies. The stormwater should be expected to have no more than trace amounts of radiological contaminants, and the clay liner (GLE, 2009f) should be expected to limit the amount of infiltration to groundwater.

Discharge at site Outfall 001 is and would continue to be from process wastewater. The effluent is and would continue to be received by the effluent channel, which may be locally incised through the semiconfining Peedee clay layer. Some portion of the effluent may therefore potentially infiltrate the Peedee sand aquifer, especially if its water level is drawn down by remedial extraction wells. This infiltration would be contained hydraulically by the site's groundwater remediation system.

Preliminary plans for the proposed GLE Facility include obtaining additional groundwater for potable purposes from the Wilmington Site’s existing production wells east of Castle Hayne Road. The estimated increase in potable water needs from the proposed facility is 11,000 gallons per day. These wells draw from the regionally important Peedee sand aquifer. Water level data show them to be cross-gradient of the overall Wilmington Site, and they do not result in significant drawdown (GLE, 2008). Additional groundwater will also be needed as a source of process water at an estimated rate of 75,000 gallons per day. This groundwater would be purified to remove iron and manganese. Increased drawdown of up to 4 feet in offsite areas is expected, without significant effect on flow directions, water quality, or availability of groundwater for offsite users, as calculated using a groundwater model that is included as an appendix to the Environmental Report (ER) (GLE, 2008). Increased pumping of the site remediation wells would maintain the hydraulic containment of contaminated groundwater. The projected water demand of the proposed GLE Facility is less than the Wilmington Site's water needs in the 1990s, and no water supply issues were known during that period (GLE, 2008).

Two diesel tanks would be present at the GLE site to supply fuel for backup power generation. The *North Carolina Administrative Code* (Title 15A, Chapter 2, Subchapter N [15A N.C. Admin Code 02N]) would govern their construction, leak detection equipment, and operation.

A groundwater monitoring plan for the proposed GLE Facility has not yet been prepared, but it would be developed after the facility design is finalized (GLE, 2009f).

Effluent treatment and monitoring are expected to result in no significant contaminant concentrations in the effluent channel, which has the potential to interact with the Peedee sand aquifer.

Based on the proposed design of site facilities, the treatment and monitoring of effluent, review of local water levels, and model calculations, the overall impact of site operations on groundwater is expected to be SMALL.

4.2.7.3 Mitigation Measures

Although no significant impact on the flow field is anticipated, GLE proposes to employ a number of measures to mitigate impacts on groundwater resources (GLE, 2008), including:

- implementation of hazardous material and waste-handling procedures and secondary containment, as required by applicable laws and regulations

- providing necessary construction water via tanker truck from offsite potable water sources

- reuse of treated sanitary wastewater effluent as makeup water in Wilmington Site cooling towers

- routine monitoring of sitewide groundwater levels, and continued analysis of groundwater monitoring-well and pumping-well networks to confirm that changes in groundwater levels associated with the proposed action are minimal

- readjustment of pumping well rates and/or performance of well maintenance or rehabilitation, as appropriate, in the event of unexpected changes in groundwater levels

- use of low-water-consumption landscaping

- installation of low-flow toilets, sinks, and showers

- performance of localized floor washing using mops and self-contained cleaning machines to reduce water usage compared to conventional washing techniques

In addition, proper BMPs for storage, handling, spill prevention, and spill response would reduce the impact of groundwater contamination associated with the accidental release of fuels, oils, and grease from equipment used onsite (or from other chemicals or wastes managed onsite). If measurable onsite changes in groundwater levels occur as a result of the proposed action, groundwater level monitoring should be expanded to offsite areas.

4.2.8 Ecological Impacts

This section describes the potential impacts on ecological resources that could occur during preconstruction and construction activities (Section 4.2.8.1) and during operation (Section 4.2.8.2) of the proposed GLE Facility. Ecological resources that could be affected include vegetation; wetlands; environmentally sensitive areas; wildlife; aquatic biota; and threatened, endangered, or other special status species. Section 4.2.8.3 presents a list of mitigation measures to minimize impacts on ecological resources, including those that have been identified by the applicant and those that are recommended by the NRC.

Overall, impacts from the proposed GLE Facility (including ancillary facilities such as the access road and transmission line) on ecological resources would depend on:

- the type and amount of habitat that would be disturbed

- the nature of the habitat disturbance (e.g., long-term reduction because of project structure and access road placement or complete, long-term alteration due to the transmission line right-of-way [ROW])

- the biota that occupy the proposed facility site and surrounding areas

- the timing of construction activities relative to the crucial life stages of biota (e.g., nesting or spawning season)

For the purposes of this assessment, impacts from the proposed GLE Facility on ecological resources were considered moderate or large if they would noticeably result in or contribute to any of the following:

- reduction of the quality and/or quantity of habitat for plants, wildlife, or aquatic biota

- an alteration in a species population that would either not destabilize the population (moderate impact) or would destabilize the population to below self-sustaining levels (large impact)

- establishment or increases of noxious weed populations

- interference with the movement of any resident or migratory fish or wildlife species

- violations of the *Endangered Species Act, Bald and Golden Eagle Protection Act, Migratory Bird Treaty Act*, or other applicable Federal and State laws

The changes in any of these conditions must be clearly linked to the proposed GLE Facility and not the result of an unassociated activity.

4.2.8.1 Preconstruction and Construction Activities

This section evaluates the potential impacts of proposed GLE Facility preconstruction and construction activities on ecological resources.[11] Preconstruction activities that could impact ecological resources at the Wilmington Site are listed in the introduction to Section 4.2. Construction activities that could impact ecological resources at the Wilmington Site include: adding the UF_6 storage pads; constructing the operations building; and adding security fencing around the proposed GLE Facility.

More than 75 percent of direct impacts on ecological resources would occur during preconstruction activities. This conclusion is based on professional judgment considerations on the degree of impacts that could occur during preconstruction and construction activities (e.g., vegetation clearing, habitat fragmentation, and injury, mortality, or disturbance to wildlife). The impacts would result primarily from clearing and grading, coupled with the construction of various buildings, the access road, substation and transmission line, stormwater retention pond, and parking lots. Most of the construction activities would occur within areas that would have been disturbed during preconstruction activities (although some revegetation may occur before the operations building and UF_6 storage pads are constructed).

<u>Vegetation</u>

The plant communities that occur on the Wilmington Site are shown in Figure 3-11 and are tabulated in Table 3-12. Table 4-4 summarizes the impacts on plant communities that could occur from preconstruction and construction activities for the proposed GLE Facility, the proposed North access road, and proposed utility structures.

Plant communities affected by preconstruction and construction activities associated with the proposed GLE Facility could incur short- or long-term changes in species composition, abundance, and distribution. Direct impacts would be primarily associated with the loss of habitat within the 81.2 hectares (200.7 acres) disturbed during preconstruction activities for the proposed GLE Facility North access road, and utility structures (Table 4-4). The proposed GLE Facility would eliminate 19.4 hectares (48 acres) of pine plantation, 21 hectares (52 acres) of pine forest, and 6.5 hectares (16 acres) of pine-hardwood forest. The remaining 0.8 hectare (2 acres) would be gravel roads (e.g., a component of the "operational area" habitat) (GLE, 2009e).

Additional impacts would occur within the 11.7 hectares (29 acres) that would be occupied by utility structures (e.g., access driveways, sanitary and process wastewater lift stations, clearings for utility lines, a stormwater wet detention basin, and a fire suppression line) and the 22.1 hectares (54.7 acres) for the proposed north access road (Table 4-4). About 13 hectares (33 acres) of this area would be the alteration of existing operations area to another type of operations area. This would have a small impact on vegetation on the Wilmington Site. The

[11] The significance level of impacts on vegetation, wetlands, wildlife, and aquatic biota from the preconstruction and construction of the GLE Facility are incorporated in Tables 4-5 through 4-7.

Table 4-4 Impacts on Plant Communities Due to Preconstruction and Construction Activities for the Proposed GLE Facility

Proposed Action	Plant Community[a]	Area (acres)[b]	Percent of Plant Community on Wilmington Site
GLE Facility	Operations area	2.0	--[c]
	Pine forest	51.0	17
	Pine-hardwood forest	16.0	7
	Pine plantation	48.0	15
	Subtotal	117.0	
North access road	Alluvial forest	0.6	15
	Canal corridor	0.4	2
	Operations area	25.8	--
	Pine forest	2.7	1
	Pine-hardwood forest	4.4	2
	Pine plantation	17.9	6
	Pocosin/bay forest	2.3	5
	Power line corridor	0.5	3
	Swamp forest	0.1	0
	Subtotal	54.7	
Utility structures[d]	Operations area	7.0	--
	Pine forest	5.0	2
	Pine-hardwood forest	3.0	1
	Pine plantation	12.0	3
	Power line corridor	2.0	11
	Subtotal	29.0	
	Total	200.7	

[a] Characteristic plant species in each community are listed in Table 3-12.
[b] To convert to hectares multiply by 0.4047.
[c] -- = no impact assumed from altering existing operations areas to another type of operations area.
[d] Includes access driveways, sanitary and process wastewater lift stations, clearings for utility lines, a stormwater wet detention basin, and a fire suppression line.
Source: GLE, 2009e.

clearing of 3.0 hectares (7.4 acres) of pine-hardwood forest, 3.1 hectares (7.7 acres) of pine forest, 12 hectares (3.0 acres) of pine plantation, and 1 hectare (2.3 acres) of pocosin/bay forest would have a more measurable impact on vegetation (Table 4-4).

Habitat fragmentation would also result from the clearing and grading activities conducted during preconstruction and construction activities. This would include the creation of isolated patches of forest habitat between utility structures. It is foreseeable that some of these patches could end up being cleared. Overall, this could impact an additional 4 to 6 hectares (10 to 15 acres) of forest (GLE, 2009e). As the utility corridor is routed along the North access road, overall habitat fragmentation resulting from the project would be reduced.

Soil compaction caused by heavy machinery could destroy ground flora and indirectly damage roots of trees (by reducing soil aeration and altering soil structure). These potential impacts would be localized in the areas immediately outside the facility site boundary. Excess soil from preconstruction and construction activities would be deposited in existing operational area habitat in the northwestern portion of the Wilmington Site.

Changes in forest or woodland interiors from tree removal or clearing of adjacent areas could include increased light levels, reduced soil moisture, increased transpiration, introduction of shade-intolerant species, and increased access of herbivores. Additional decline or mortality of trees near the construction boundary may subsequently occur. However, the proposed GLE Facility would be located within an area that has been impacted from logging operations.

Plant communities near preconstruction and construction areas could be affected by hydrologic changes such as reduced infiltration, increased runoff from exposed or compacted soils, and alteration in flow patterns from grading of the proposed GLE Facility site.

Other possible adverse preconstruction and construction effects on vegetation could include the localized deposition of dust and other particulate matter from clearing and grading and from the operation of vehicles and machinery. Dust can physically affect a plant by shading, interference with gaseous diffusion, abrasion of leaf surfaces, and modification of leaf temperature by black deposits. Impacts on vegetation that may occur from dust deposition would be expected to be localized and short-term.

Establishment of the entranceway from Castle Hayne Road and upgrading of the existing access road to the proposed GLE Facility would result in loss of some vegetation along the roadway and could result in indirect impacts on nearby areas from altered drainage patterns, runoff, and sedimentation. The access road to the proposed GLE Facility would mostly involve upgrading of existing roadway. Therefore, vegetation disturbance, and particularly fragmentation of vegetation communities, would be limited in comparison to those that would occur from establishing a completely new access road. Upgrading the access road to the proposed GLE Facility and establishment of the new entranceway to the Wilmington Site would impact areas already considered to be operations area habitat (i.e., 10.5 hectares [26 acres] of the 22 hectares [54 acres]). However, 11 hectares (27 acres) of pine–hardwood forest, pine plantation, pine forest, and pocosin/bay forest along the access road corridor and within the proposed entranceway would also be affected (GLE, 2009e).

Vehicle operation could promote the introduction and establishment of invasive plant species such as Japanese honeysuckle (*Lonicera japonica*), Chinese privet (*Ligustrum sinense*), and Japanese grass (*Microstegium vimineum*). These species can also become established in areas impacted by fragmentation and lead to limitations on the growth of native plants, disruption of natural succession, and limitations on species and structural diversity (Campbell and Johns, 2000).

Accidental releases of hazardous materials (e.g., fuels) could impact plant communities in the vicinity of the spills. Spills would only be expected within small, localized areas that have mostly been disturbed by clearing and grading. Potential adverse impacts from a spill would be minimized by taking corrective actions identified in the SPCC Plan.

In conclusion, MODERATE impacts on vegetation would occur from vegetation clearing, habitat fragmentation, alteration of topography, changes in drainage patterns, and soil compaction; remaining impacts would be SMALL (Table 4-5). Impacts considered MODERATE would occur primarily during preconstruction, as more than 75 percent of direct impacts would occur during this phase. Following preconstruction and construction activities, the proposed GLE Facility area, including the access road and utility structures, would be considered as part of an industrial land cover type on the Wilmington Site (i.e., be classified primarily as operations area habitat).

Wetlands

Wetlands could be impacted by alteration of surface water runoff patterns, soil compaction, or groundwater flow, particularly where facilities are located immediately adjacent to wetland areas. Executive Order 11990, "Protection of Wetlands," requires Federal agencies to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial uses of wetlands. Unavoidable impacts on wetlands within the jurisdiction of the U.S. Army Corps of Engineers (USACE) might require a *Clean Water Act* (CWA) Section 404 Permit, which would trigger the need for a CWA Section 401 Water Quality Certification. An approved mitigation plan might be required prior to the initiation of preconstruction or construction activities.

No wetlands would be directly impacted by preconstruction or construction activities for the proposed GLE Facility. However, jurisdictional wetlands WD, WF, and WG, and one isolated wetland (Wetland WA) occur within the corridor for the revised entrance and roadway (GLE, 2009c). Jurisdictional wetlands have a connection to surface waters. The area of the three jurisdictional wetlands within the proposed access road is 0.021 hectare (0.052 acre). The width of disturbance during construction of the roadway would be 18 meters (60 feet); whereas the corridor analyzed for the access road was up to 61 meters (200 feet) wide. Therefore, it may be possible to avoid direct impacts on the jurisdictional wetlands during construction of the entrance and access road.

It is probable that Isolated Wetland WA would be directly impacted by construction of the access road, resulting in a wetland loss of 0.02 hectare (0.06 acre). Impacts on this wetland would require an Isolated Wetland Permit (GLE, 2008). Based on the North Carolina Division of Environmental Management (1995) guidance for evaluating North Carolina wetlands, the

Table 4-5 Significance Levels of Potential Impacts on Vegetation, Wetlands, and Environmentally Sensitive Areas from the Proposed GLE Facility

	Potential Significance of Impacts According to Habitat Type[a]		
Impact Category	**Upland Vegetation**	**Wetlands**	**Environmentally Sensitive Areas**
Vegetation clearing	Moderate	Small	Small
Habitat fragmentation	Moderate	Small	Small
Alteration of topography	Moderate	Small	Small
Changes in drainage patterns	Moderate	Small	Small
Water depletions	Small	Small	Small
Erosion and sedimentation	Small	Small	Small
Contaminant spills	Small	Small	Small
Fugitive dust	Small	Small	Small
Soil compaction	Moderate	Small	Small
Disruption of groundwater flow patterns	Small	Small	Small
Spread of invasive plant species	Small	Small	Small
Vegetation maintenance	Small	Small	Small
Air emissions	Small	Small	Small
Radiological exposure	Small	Small	Small

[a] Small impact: environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource. Moderate impact: environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource. All moderate impacts would occur during the preconstruction phase.

wetland had a rating of 6 (maximum rating is 100), indicating that the wetland is of low value (GLE, 2008).

Indirect impacts on wetlands could occur from increased stormwater runoff, decreased groundwater recharge, disconnected hydrologic conductivity, or changes in groundwater or surface water flow patterns. Impacts from increased or decreased runoff are expected to be negligible, as impacts on wetlands would be minimized by use of sediment and erosion control measures and wetland hydrology would be controlled by the tidal influence of the Northeast Cape Fear River (GLE, 2008).

A detailed construction design would be prepared prior to preconstruction activities. From this design, a more precise determination of the potential type and extent of impacts on wetlands can be determined; and the USACE and North Carolina Division of Water Quality would determine if wetland mitigation would be required (GLE, 2009e). In conclusion, impacts on wetlands associated with preconstruction and construction activities for the proposed GLE Facility, including the utility structures and access road, would be SMALL (Table 4-5).

Environmentally Sensitive Areas

As discussed in Section 3.8.3, the environmentally sensitive areas (i.e., landscape elements or places that are crucial to the long-term maintenance of biological diversity, soil, water, and other natural resources, especially as they relate to human health, safety, and welfare, both at a local and regional context [Jennings and Reganold 1989]) occurring on or near the Wilmington Site include the Northeast Cape Fear River Floodplain (includes the southwestern portion of the Wilmington Site); the primary nursery area for shellfish and fish within the Northeast Cape Fear River (adjacent to the Wilmington Site); and the floodplains, wetlands, unstable soils, and steep slopes on the Wilmington Site. Except for the probable impact on a 0.02-hectare (0.06-acre) isolated wetland and the possible impact on to up to 0.021 hectare (0.052 acre) of three jurisdictional wetlands, no environmentally sensitive areas would be directly impacted by preconstruction or construction activities. Only minor, localized, indirect impacts on environmentally sensitive areas may occur from erosion and sedimentation or from changes in drainage patterns. Overall, impacts from proposed GLE Facility preconstruction and construction activities on environmentally sensitive areas would be SMALL (Table 4-5).

Wildlife

Impacts on wildlife from preconstruction and construction activities would include (1) habitat disturbance, (2) wildlife disturbance, and (3) injury or mortality of wildlife.

Habitat Disturbance

Most impacts on wildlife from preconstruction and construction activities would occur from habitat disturbance (e.g., clearing and grading for the proposed GLE Facility). Habitats within the footprint disturbed by preconstruction and construction activities would be reduced or altered. Preconstruction and construction activities would also result in habitat fragmentation, particularly at the proposed GLE Facility. The use of an existing accessway for the new access road would minimize habitat fragmentation compared to what would otherwise be caused by creating a new access corridor. As the utility corridor is routed along the North access road, habitat fragmentation would be reduced.

Preconstruction and construction activities for the proposed GLE Facility and its ancillary facilities would cause a loss of habitat, which could result in a long-term reduction in wildlife abundance and richness within the project area. A species affected by habitat disturbance might be able to shift its habitat use for a short period. For example, the density of several forest-dwelling bird species has been found to increase within a forest stand soon after the onset of fragmentation as a result of displaced individuals moving into remaining habitat (Hagan et al., 1996). However, it is generally assumed that the habitat into which displaced individuals move would be unable to sustain an increased level of use over the long term. For example, an increased competition for resources in adjacent habitats would likely preclude the incorporation of the displaced individual into the resident populations.

Habitat disturbance could facilitate the spread and introduction of invasive plant species. Roads (and other linear corridors) could facilitate the dispersal of invasive plant species by altering existing habitat conditions, stressing or removing native plant species, and allowing easier movement by wildlife or human vectors (Trombulak and Frissell, 2000). Wildlife habitat could also be adversely affected if invasive vegetation became established in the disturbed areas and adjacent offsite habitats. The establishment of invasive vegetation could reduce habitat quality for wildlife and locally affect wildlife occurrence and abundance.

Little information is available regarding the effects of fugitive dust on wildlife; however, if exposure was of sufficient magnitude and duration, the effects could be similar to those on humans (e.g., breathing and respiratory symptoms, including dust pneumonia). A more probable effect would be the dusting of plants, which could make forage less palatable. This localized effect would be short-term and would generally coincide with the displacement of and stress to wildlife from human activity. Fugitive dust is not expected to result in any long-term individual or population-level effects.

Wildlife Disturbance

Activities associated with preconstruction and construction activities for the proposed GLE Facility could cause wildlife disturbance, including interference with behavioral activities. The response of wildlife to disturbances caused by noise and human presence would be highly variable and species-specific. Intraspecific responses could also be affected by the physiological or reproductive condition of individuals; distance from the disturbance; and type, intensity, and duration of the disturbance. Seasonal or daily time of noise events could also be a factor in how noise would impact wildlife. Wildlife could respond to a disturbance in various ways, including attraction, habituation, and avoidance (Knight and Cole, 1991). All three behaviors are considered adverse. For example, wildlife might cease foraging, mating, or nesting near areas where construction was occurring. In contrast, wildlife such as bears, foxes, and squirrels could readily habituate and might even be attracted to human activities, primarily when a food source was accidentally or deliberately made available.

Although habitats adjacent to the proposed GLE site would mostly remain unaffected, wildlife might tend to make less use of these areas (primarily because of the disturbance that would occur within the project site). This impact could be considered indirect habitat loss, and it could be of greater consequence than direct habitat loss. The loss of effective habitat (amount of habitat actually available to wildlife) due to roads was reported to be 2.5 to 3.5 times as great as the actual habitat loss (Reed et al., 1996). Many of the individuals that would make use of areas adjacent to a road or other development could be subjected to increased physiological stress as a result of complications from overcrowding (e.g., increased competition for space and food, increased vulnerability to predators, and increased potential for the propagation of diseases and parasites). This combination of avoidance and stress would reduce the capability of wildlife to use habitat effectively.

Principal sources of noise during preconstruction and construction activities would include vehicle traffic and operation of machinery. Regular or periodic noise could cause adjacent areas to be less attractive to wildlife and result in a long-term reduction in use by wildlife in those areas. Responses of birds to disturbance often involve activities that are energetically costly (e.g., flying) or affect their behavior in ways that might reduce food intake (e.g., shift away from a preferred feeding site) (Hockin et al., 1992). A variety of adverse effects of noise on raptors have been demonstrated, but for some species, the effects were temporary, and the raptors became habituated to the noise (Brown et al., 1999; Delaney et al., 1999). A review of the literature by Hockin (1992) showed that the effects of disturbance on bird breeding and breeding success include reduced nest attendance, nest failures, reduced nest building, increased predation on eggs and nestlings, nest abandonment, inhibition of laying, increased absence from nest, reduced feeding and brooding, exposure of eggs and nestlings to heat or cold, retarded chick development, and lengthening of the incubation period. The most adverse impacts associated with noise could occur if critical lifecycle activities were disrupted (e.g., mating and nesting). For instance, disturbance of birds during the nesting season could result in nest or brood abandonment. The eggs and young of displaced birds would be more susceptible to cold or predators.

Overall, direct and indirect impacts from habitat and wildlife disturbance could potentially reduce the carrying capacity of a species range and result in reduced survival or reproduction.

Wildlife Injury or Mortality

Clearing, grading, and other preconstruction and construction activities could result in the direct injury or death of those wildlife species that were not mobile enough to avoid impact areas (e.g., reptiles, small mammals), those that used burrows (e.g., ground squirrels), or those that defend nest sites (e.g., ground-nesting birds). If clearing or other construction activities occurred during the spring and summer, bird nests and eggs or nestlings could be destroyed and more mobile wildlife species, such as white-tailed deer (*Odocoileus virginianus*) and adult birds, might avoid the initial clearing activity by moving into habitats in adjacent areas. However, as previously mentioned, it is conservatively assumed that adjacent habitats are at carrying capacity for the species that live there and could not support additional biota from the construction areas. The subsequent competition for resources in adjacent habitats would likely preclude the incorporation of the displaced individuals into the resident populations.

Direct mortality from construction equipment would be low, as most equipment would be slow moving or stationary. Mortality from vehicle collisions would be expected to occur along the access road.

Wildlife could be exposed to accidental fuel spills or releases of other hazardous materials. Potential impacts on wildlife would vary according to the material spilled, volume of the spill, location of the spill, and the exposed species. A spill would be expected to have a population-level adverse impact only if the spill was very large or if it contaminated a crucial habitat area where a large number of individual animals were concentrated. The potential for either event is very unlikely. In addition, use of the project area by wildlife during construction would be limited, since there would be construction-related disturbances, thus greatly reducing the potential for contaminant exposure.

In conclusion, impacts on some wildlife from vegetation disturbance, wildlife disturbance, and injury or mortality could be MODERATE for some groups of wildlife (Table 4-6). Over 75 percent of the impacts would occur during preconstruction activities, when most of the physical disturbance to habitats would occur. Overall, the adverse impacts of preconstruction and construction activities are expected to be limited to the immediate vicinity of the proposed

Table 4-6 Significance Levels of Potential Impacts on Wildlife from the Proposed GLE Facility

	Potential Significance of Impacts According to Species Type[a]					
Impact Category	Amphibians and Reptiles	Shorebirds, Waterfowl, and Waterbirds	Landbirds	Raptors	Small Game and Nongame Mammals	Big Game Mammals
Vegetation clearing	Moderate	Small	Moderate	Moderate	Moderate	Moderate
Habitat fragmentation	Moderate	Small	Moderate	Moderate	Moderate	Moderate
Movement/dispersal blockage	Moderate	Small	Small	Small	Moderate	Moderate
Alteration of topography	Small	Small	Small	Small	Small	Small
Water depletions	Small	Small	Small	Small	Small	Small
Erosion and sedimentation	Small	Small	Small	Small	Small	Small
Contaminant spills	Small	Small	Small	Small	Small	Small
Fugitive dust	Small	Small	Small	Small	Small	Small
Injury or mortality	Moderate	Small	Small	Small	Moderate	Small
Collection	Small	Small	Small	Small	Small	Small
Human disturbance/harassment	Small	Small	Moderate	Moderate	Moderate	Moderate
Increases in predation rates	Small	Small	Small	Small	Small	Small
Noise	Small	Small	Moderate	Moderate	Moderate	Moderate
Spread of invasive plant species	Small	Small	Small	Small	Small	Small
Air pollution	Small	Small	Small	Small	Small	Small
Radiological exposure	Small	Small	Small	Small	Small	Small

[a] Small impact: environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource. Moderate impact: environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource. All moderate impacts would occur during preconstruction activities.

GLE Facility (within areas subjected to periodic logging or to routine disturbances within or near the operations area) and should not affect the viability of any wildlife populations.

Aquatic Biota

No aquatic habitats are located within the footprint of the areas that will be cleared for the GLE Facility. Furthermore, no surface water withdrawals would be used during any phase of the project. However, portions of four jurisdictional channels, the effluent channel, and Unnamed Tributary #1 to Prince George Creek occur within the corridor for the new access road and entrance. Road-crossing construction over these channels could impact aquatic biota by direct disturbance, deposition of sediments, and degradation of water quality.

Vegetation clearing, grading, and other land-disturbing activities could increase sediment loadings to nearby water bodies (such as the four jurisdictional channels, the effluent channel, and Unnamed tributary # 1 to Prince George Creek listed above) and to Unnamed Tributary #1 to Northeast Cape Fear River. These water bodies would ultimately receive stormwater runoff from the proposed GLE Facility. The effects of suspended sediments on aquatic biota include: (1) lethal effects (e.g., direct mortality of individuals, population reduction, or damage to the ecosystem that affects its capacity to produce biota); (2) sublethal effects (e.g., injury to the tissues or physiology of the organism, but not to the extent that death occurs); and (3) behavioral effects (e.g., alteration of activity patterns or types of activities that an organism would normally undertake in an unaffected environment) (Newcombe and MacDonald, 1991). Implementation of measures to control erosion and runoff into aquatic habitats (Section 4.2.6.3) would reduce the potential for impacts on aquatic biota.

Contaminants could be introduced into aquatic habitats as a result of the accidental release of fuels and lubricants used during preconstruction and construction activities. The level of impacts from releases of toxicants would depend on the type and volume of chemicals entering the waterway, the location of the release, the nature of the water body (e.g., size, volume, and flow rates), and the types and life stages of organisms present in the receiving waterway. In general, lubricants and fuel would not be expected to enter waterways in appreciable quantities as long as heavy machinery is not used in or near waterways, fueling locations for construction equipment are situated away from the waterway, and measures are taken to control spills that do occur.

No significant adverse impacts on aquatic biota (e.g., population-level effects) are expected from preconstruction and construction activities. All activities associated with preconstruction and construction activities would result in SMALL impacts on aquatic biota (Table 4-7).

Threatened, Endangered, and Other Special Status Species

Tables 3-14 and 3-15 in Section 3.8.6 list the threatened, endangered, and other special status species reported from New Hanover County, and indicate which species have been reported or are potentially present on or near the Wilmington Site. The tables also indicate which species could potentially be present in the proposed GLE Facility area. The types of impacts that could affect species as a result of preconstruction and construction activities for the proposed GLE Facility would be fundamentally similar to or the same as those described above for

Table 4-7 Significance Levels of Potential Impacts on Aquatic Biota from the Proposed GLE Facility

Impact Category	Potential Significance of Impacts on Aquatic Biota[a]
Sedimentation from runoff	Small
Water depletions	Small
Changes in drainage patterns	Small
Disruption of groundwater flow patterns	Small
Temperature increases in water bodies	Small
Contaminant spills	Small
Movement/dispersal blockage	Small
Increased human access	Small
Radiological exposure	Small

[a] Small impact: environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource. Impacts on aquatic biota would be small for all project phases (i.e., preconstruction, construction, and operations).

vegetation, wildlife, and aquatic biota. The most important difference from these impacts is the potential consequence of the impacts. Because of low population sizes, threatened, endangered, and other special status species are more vulnerable to impacts (e.g., habitat disturbance) than more common and widespread species.

A copy of the consultation letters received from the U.S. Fish and Wildlife Service (FWS) and National Marine Fisheries Service (NMFS) are provided in Appendix B. The FWS expressed potential concerns for those species that could occur on the Wilmington Site – the West Indian manatee (*Trichechus manatus*), roughleaf loosestrife (*Lysimachia asperulaefolia*), and, in particular, the red-cockaded woodpecker (*Picoides borealis*) (FWS, 2009). Information provided in the FWS correspondence has been incorporated into the evaluations below on Federally listed species and are listed as additional mitigation measures presented in Section 4.2.8.3. The NMFS provided various publications on the shortnose sturgeon (*Acipenser brevirostrum*). Information from these reports was considered in the assessment of potential impacts on the shortnose sturgeon presented below.

Federally Listed Species

The following text provides an assessment of impacts from preconstruction and construction activities for the proposed GLE Facility on the Federally listed species (endangered, threatened, and species of concern) that exist or may exist in the Wilmington Site area. No impacts would be expected on any of the listed species. The significance level of impacts on all listed species would be SMALL.

Carolina bishopweed (*Ptilimnium ahlesii*)

The Carolina bishopweed is a Federal species of concern that inhabits freshwater tidal marshes (Weakley, 2008). No occurrence records for the Carolina bishopweed occur within 3.2 kilometers (2 miles) of the Wilmington Site (NCNHP, 2009). Tidal marshes would not be impacted by preconstruction and construction activities for the proposed GLE Facility; therefore, these activities would have no effect on the Carolina bishopweed.

Coastal goldenrod (*Solidago villosicarpa*)

The coastal goldenrod is a Federal species of concern. It occurs in a wide variety of wooded habitats, occurring in areas associated with natural or human-caused disturbance (CPC, 2008a). An occurrence record for the coastal goldenrod occurs within 3.2 kilometers (2 miles) of the northern boundary of the Wilmington Site (NCNHP, 2009). Habitat suitable for the coastal goldenrod occurs in the pine-hardwood forests in the north-central and south-central portions of the Wilmington Site (GLE, 2008). Preconstruction and construction activities for the proposed GLE Facility would disturb habitat that would be potentially suitable for the coastal goldenrod and may therefore also result in mortality to some individuals. Therefore, these activities may affect, but are unlikely to adversely affect, the species. Clearing and grading that would take place during preconstruction activities would account for nearly the entire amount of habitat disturbance that would occur.

Grassleaf arrowhead (*Sagittaria graminea* var. *weatherbiana*)

The grassleaf arrowhead is a Federal species of concern. It inhabits shallow water and wet shores of ponds, marshes, and ditches. There are no occurrence records for the grassleaf arrowhead within 3.2 kilometers (2 miles) of the Wilmington Site (NCNHP, 2009). Preconstruction and construction activities for the proposed GLE Facility would disturb habitat that would be potentially suitable for the grassland arrowhead (e.g., the jurisdictional channels and wetlands associated with the North access road.) Therefore, these activities may affect, but are unlikely to adversely affect, the species. Clearing and grading that would take place during preconstruction activities would account for nearly the entire amount of habitat disturbance that would occur.

Pickering's morning-glory (*Stylisma pickeringii* var. *pickeringii*)

The Pickering's morning-glory (also known as Pickering's dawnflower) is a Federal species of concern. The species occurs in dry to extremely dry, nutrient-poor, well-drained, coarse sandy soils. Tree cover, ground cover, and litter accumulation are generally sparse (Patrick et al., 1995). It generally forms large mats or clumps in dry, barren, deep sand areas such as the edge of Carolina bays and relic riverine dunes (CPC, 2008b; Weakley, 2008). Preferred locations include frequently burned or clearcut areas with little or no competing vegetation (CPC, 2008b). There is a 1958 occurrence record for the Pickering's morning-glory within 3.2 kilometers (2 miles) of the proposed GLE Facility area (NCNHP, 2009). The operations area in the northwestern portion of the Wilmington Site contains deep sands that are periodically disturbed, and may provide suitable habitat for the Pickering's morning-glory (GLE, 2008). This area may be used as a source of fill or for the deposition of soils excavated during preconstruction and construction activities for the proposed GLE Facility; therefore, these activities may affect, but are unlikely to adversely affect, the species. The need for or disposal of fill would primarily occur during preconstruction activities.

Pondspice (*Litsea aestivalis*)

Pondspice is a Federal species of concern. It inhabits the margins of swamps, cypress ponds, low wet woodlands, and sandhill depressions on wet, sandy or peaty, acidic soils. There is a 1977 occurrence record for the pondspice around the perimeter of an ephemeral pond within the north-central portion of the Wilmington Site (GLE, 2008; NCNHP, 2009). However, hydrological conditions of this pond have since been altered and do not appear to support recruitment of the species. During field surveys for the ER, the existing plants appeared stressed (GLE, 2008). The location of the proposed GLE Facility is over 150 meters (500 feet) southeast of the ephemeral pond (GLE, 2008). Habitat suitable for the pondspice would not be impacted by preconstruction and construction activities for the proposed GLE Facility; therefore, these activities would have no effect on the species.

Raven's seedbox (*Ludwigia ravenii*)

Raven's seedbox is a Federal species of concern. It is an obligate wetland species that inhabits open, wet, peaty areas such as ditches and the margins of swamps, ponds, and bogs. There are no occurrence records for the Raven's seedbox within 3.2 kilometers (2 miles) of the Wilmington Site (NCNHP, 2009). A minor amount of habitat potentially suitable for the Raven's seedbox could not be impacted by preconstruction and construction activities for the proposed North access road. Therefore, these activities may affect, but are unlikely to adversely affect, the species. Clearing and grading that would take place during preconstruction activities would account for nearly the entire amount of habitat disturbance that would occur.

Roughleaf loosestrife (*Lysimachia asperulaefolia*)

The roughleaf loosestrife is a Federally endangered species. It occurs in grass–shrub ecotones adjacent to longleaf pine/scrub oak, pine savanna, flatwoods, and pond pine pocosins (evergreen shrub bogs). It prefers full sunlight and is shade intolerant (CPC, 2008c; NCNHP, 2001). It grows on moist, seasonally saturated sands or shallow organic soils overlying sands. The roughleaf loosestrife has been found in roadside depressions, firebreaks, seeps, and power ROWs (NCNHP, 2001). Habitats within which the species occurs are usually fire-maintained (i.e., areas where natural fires or controlled burns occur). There are no occurrence records for the roughleaf loosestrife within 3.2 kilometers (2 miles) of the Wilmington Site (NCNHP, 2009). Most pocosin habitat that could potentially support the species has been drained from the Wilmington Site and the fire regime necessary for maintaining the species habitat does not occur on the site. Also, habitat for the species is not present within the proposed GLE Facility area (GLE, 2008); therefore, preconstruction and construction activities would have no effect on the roughleaf loosestrife.

Sandhills milkvetch (*Astragalus michauxii*)

The sandhills milkvetch is a Federal species of concern. It inhabits longleaf pine/scrub oak woodlands, growing best in disturbed or fire-prone open understory areas (e.g., xeric to dry-mesic, nutrient-poor soils, thickets, field edges, and road banks). There is a 1946 occurrence record for the sandhills milkvetch within 3.2 kilometers (2 miles) of the proposed GLE Facility area (NCNHP, 2009; GLE, 2008). The longleaf pine/scrub forest in the northwestern portion of the Wilmington Site and the pine plantation in the north-central portion of the site could provide suitable habitat for the species. Preconstruction and construction activities for the proposed GLE Facility would disturb habitat that would potentially be suitable for the sandhills milkvetch; therefore, these activities may affect, but are unlikely to adversely affect, the species. Clearing and grading that would take place during preconstruction activities would account for nearly the entire amount of habitat disturbance that would occur.

Small-leaf meadowrue (*Thalictrum macrostylum*)

The small-leaf meadowrue is a Federal species of concern. Habitat for the species includes swampy woodlands, slopes, and cliffs. There are no occurrence records for the small-leaf meadowrue within 3.2 kilometers (2 miles) of the Wilmington Site (NCNHP, 2009). Habitat suitable for the small-leaf meadowrue would not be impacted by preconstruction and construction activities for the proposed GLE Facility; therefore, these activities would have no effect on the species.

Spring-flowering goldenrod (*Solidago verna*)

The spring-flowering goldenrod is a Federal species of concern. It inhabits a wide variety of habitats such as pine savannas, pocosins, pine barrens, open woods, fields, dry bogs, and disturbed roadsides (CPC, 2008d). There are no occurrence records for the spring-flowering goldenrod within 3.2 kilometers (2 miles) of the Wilmington Site (NCNHP, 2009). Pocosin/bay and pine forests potentially provide limited habitat for the spring-flowering goldenrod on the Wilmington Site (GLE, 2008). Preconstruction and construction activities for the proposed GLE Facility would disturb habitat that would potentially be suitable for the spring-flowering goldenrod; therefore, these activities may affect, but are unlikely to adversely affect, the species. Clearing and grading that would take place during preconstruction activities would account for nearly the entire amount of habitat disturbance that would occur.

Venus' flytrap (*Dionaea muscipula*)

The Venus' flytrap is a Federal species of concern. It inhabits bogs and perennially wet areas, often located between longleaf pine savannas and pocosins on the coastal plains of the Carolinas (Floridata, 2003). Two occurrence records of the Venus' flytrap have been recorded within 3.2 kilometers (2 miles) of the Wilmington Site, one of which is also within 3.2 kilometers (2 miles) of the proposed GLE Facility area (NCNHP, 2009). Suitable habitat for the Venus' flytrap occurs within the western portion of the Wilmington Site where pine forest and pocosin habitats are adjacent to each other. Habitat suitable for the Venus' flytrap would not be impacted by preconstruction and construction activities for the proposed GLE Facility; therefore, these activities would have no effect on the species.

Cape Fear threetooth (*Triodopsis soelneri*)

The Cape Fear threetooth is a Federal species of concern. It is a terrestrial snail that occurs on logs and under litter in swamps and under trash in pine woods (Hubricht, 1985). There are no occurrence records for the Cape Fear threetooth within 3.2 kilometers (2 miles) of the

Wilmington Site (NCNHP, 2009). Preconstruction and construction activities for the proposed GLE Facility would disturb habitat that would be potentially suitable for the Cape Fear threetooth (pine woods); therefore, these activities may affect, but are unlikely to adversely affect, the species. Clearing and grading that would take place during preconstruction activities would account for nearly the entire amount of habitat disturbance that would occur.

Eastern arogos skipper (*Atrytone arogos arogos*)

The eastern arogos skipper is a Federal species of concern. It inhabits native grasslands and savannas. There are no occurrence records for the eastern arogos skipper within 3.2 kilometers (2 miles) of the Wilmington Site (NCNHP, 2009). Habitat suitable for the eastern arogos skipper would not be impacted by preconstruction and construction activities for the proposed GLE Facility; therefore, these activities would have no effect on the species.

Greenfield ramshorn snail (*Helisoma eucosmium*)

The Greenfield ramshorn snail is a Federal species of concern. Within New Hanover County, this freshwater snail is only known from Greenfield Lake in Wilmington. It is also known from Town Creek in Brunswick County and from the Wisconsin River in the northeastern portion of the State. Specimens from Town Creek inhabit densely vegetated areas at depths less than 3 meters (10 feet). There are no occurrence records for the Greenfield ramshorn snail within 3.2 kilometers (2 miles) of the Wilmington Site (NCNHP, 2009). Habitat suitable for the Greenfield ramshorn snail would not be impacted by preconstruction and construction activities for the proposed GLE Facility; therefore, these activities would have no effect on the species.

Rare skipper (*Problema bulenta*)

The rare skipper is a Federal species of concern. It inhabits marshes along tidal rivers. There are no occurrence records for the rare skipper within 3.2 kilometers (2 miles) of the Wilmington Site (NCNHP, 2009). Habitat suitable for the rare skipper would not be impacted by preconstruction and construction activities for the proposed GLE Facility; therefore, these activities would have no effect on the species.

American eel (*Anguilla rostrata*)

The American eel is a Federal species of concern. It spawns in the Sargasso Sea and matures in fresh or brackish waters (estuaries, rivers, streams, ponds, and lakes (NatureServe, 2009). There are no occurrence records for the American eel within 3.2 kilometers (2 miles) of the Wilmington Site (NCNHP, 2009). However, the American eel is expected to occur in the Northeast Cape Fear River near the Wilmington Site (NCDENR, 2008). The river's tributaries on the site could also provide suitable habitat for the American eel. Habitat suitable for the American eel would not be impacted by preconstruction and construction activities for the proposed GLE Facility; therefore, these activities would have no effect on the species.

Shortnose sturgeon (*Acipenser brevirostrum*)

The shortnose sturgeon is Federally listed as endangered. It inhabits the lower reaches of large rivers and Atlantic coastal waters. It primarily occurs in brackish and salt waters of lower coastal river reaches and river estuaries. The shortnose sturgeon ascends into the freshwaters of larger coastal rivers to spawn. Larvae and juveniles prefer deep river channels. It is very rare in the Cape Fear River drainage. There is a 1993 occurrence record for the shortnose sturgeon within 3.2 kilometers (2 miles) of the Wilmington Site (NCNHP, 2009). It may occur in the Northeast Cape Fear River and the lower portions of its unnamed tributaries that occur on the Wilmington Site. It does not ascend into smaller tributaries such as the Prince George Creek (NOAA, 2002). Habitat suitable for the shortnose sturgeon would not be impacted by preconstruction and construction activities for the proposed GLE Facility; therefore, these activities would have no effect on the species.

Carolina gopher frog (*Rana capito capito*)

The Carolina gopher frog is a Federal species of concern. Adults primarily inhabit xeric uplands, especially longleaf pine-turkey oak sandhill associations. They also occur in xeric to mesic longleaf pine flatwoods, sand pine scrub, and xeric oak hammocks. Burrows of gopher tortoises (*Gopherus polyphemus*) and rodents are used for shelter. They will also hide in sewers, under logs, and in or under stumps. Breeding habitat includes ephemeral to semipermanent graminoid-dominated wetlands that lack large predatory fishes. There are no occurrence records for the Carolina gopher frog within 3.2 kilometers (2 miles) of the Wilmington Site (NCNHP, 2009). Habitat suitable for the Carolina gopher frog would not be impacted by preconstruction and construction activities for the proposed GLE Facility; therefore, these activities would have no effect on the species.

American alligator (*Alligator mississippiensis*)

The American alligator is Federally listed as threatened due to its similarity of appearance with the American crocodile (*Crocodylus acutus*). However, the American alligator is not biologically threatened and does not have protection under the *Endangered Species Act* in North Carolina (Hall, 2009). It inhabits slow-moving coastal rivers, canals, lakes, impoundments, marshes, cypress ponds, and estuaries. The American alligator has been recorded from various localities near the Wilmington Site, including the Prince George Creek at its confluence with its Unnamed Tributary #1; the Northeast Cape Fear River at its confluence with Prince George Creek; upstream of the Wilmington Site in Turkey Creek, Morgan Creek, and Long Creek; and south of the Wilmington Site in Ness Creek (GLE, 2008). Occurrences of the American alligator have been reported within 3.2 kilometers (2 miles) of the proposed GLE Facility area (NCNHP, 2009). At the Wilmington Site, potential breeding habitat occurs along the Northeast Cape Fear River and its tributaries, and small alligators may occur within the streams and swamp forest area of the site. Habitat suitable for the American alligator would not be impacted by preconstruction and construction activities for the proposed GLE Facility; therefore, these activities would have no effect on the species.

Mimic glass lizard (*Ophisaurus mimicus*)

The mimic glass lizard is a Federal species of concern. It inhabits longleaf pine savannas and conifer and mixed woodlands where it burrows in the soil or inhabits fallen logs and woody debris. There are no occurrence records for the mimic glass lizard within 3.2 kilometers (2 miles) of the Wilmington Site (NCNHP, 2009). Preconstruction and construction activities for the proposed GLE Facility would disturb habitat that would potentially be suitable for the mimic glass lizard; therefore, these activities may affect, but are unlikely to adversely affect, the species. Clearing and grading that would take place during preconstruction activities would account for nearly the entire amount of habitat disturbance that would occur.

Northern pinesnake (*Pituophis melanoleucus melanoleucus*)

The northern pinesnake is a Federal species of concern. It inhabits xeric pine forest uplands. There is a pre-1927 occurrence record for the northern pine snake within 3.2 kilometers (2 miles) of the proposed GLE Facility area (NCNHP, 2009). Preconstruction and construction activities for the proposed GLE Facility would disturb habitat that would potentially be suitable for the northern pine snake; therefore, these activities may affect, but are unlikely to adversely affect, the species. Clearing and grading that would take place during preconstruction activities would account for nearly the entire amount of habitat disturbance that would occur.

Southern hog-nosed snake (*Heterodon simus*)

The southern hog-nosed snake is a Federal species of concern. It inhabits mature pine forests and sandhill habitats (Jordan, 1998) and spends most of its time buried in soil. Sightings of the southern hog-nosed snake have been made southwest of the Wilmington Site between the Northeast Cape Fear River and the Cape Fear River (GLE, 2008). There are no occurrence records for the southern hog-nosed snake within 3.2 kilometers (2 miles) of the Wilmington Site (NCNHP, 2009). Within the Wilmington Site, the snake could occur within the pine forests, longleaf pine/scrub forests, hardwood forests, and fields. The xeric, sandy soils in the northwestern portion of the site may also be suitable habitat. Preconstruction and construction activities for the proposed GLE Facility would disturb habitat that would potentially be suitable for the southern hog-nosed snake; therefore, these activities may affect, but are unlikely to adversely affect, the species. Clearing and grading that would take place during preconstruction activities would account for nearly the entire amount of habitat disturbance that would occur.

Eastern painted bunting (*Passerina ciris ciris*)

The eastern painted bunting is a Federal species of concern. Habitat includes partly opened areas with scattered trees and brush, riparian thickets and brush, weedy and shrubby areas, woodland edges, yards, and gardens. Salt marsh/forest edges are preferred over interior forests. There are no occurrence records for the eastern painted bunting within 3.2 kilometers (2 miles) of the Wilmington Site (NCNHP, 2009). Preconstruction and construction activities for the proposed GLE Facility would disturb habitat that would potentially be suitable for the eastern painted bunting; therefore, these activities may affect, but are unlikely to adversely affect, the species. Clearing and grading that would take place during preconstruction activities would account for nearly the entire amount of habitat disturbance that would occur.

Red-cockaded woodpecker (*Picoides borealis*)

The red-cockaded woodpecker is Federally listed as endangered. No critical habitat has been designated for the species (FWS, 2008). Habitat that probably supported the largest populations was Coastal Plain longleaf pine forests maintained by frequent fires (Ozier et al., 1999). It requires open stands of mature pine (over 60 years old) for nesting and roosting habitat. Nesting and roosting occur in cavities of live trees that range in age from 63 to over 300 years old for longleaf pine or 62 to over 200 years old for loblolly and other pines. An aggregate (cluster) of 1 to 20 cavity trees are used on an area of 1.2 to 24.3 hectares (3 to 60 acres) (FWS, 2003; NatureServe, 2009). Suitable habitat surrounding a cluster of cavity trees contains open, park-like conditions. Stands of pine or mixed pines and hardwoods that are over 30 years old are used for foraging. A group requires at least 32.4 to 50.6 hectares (80 to 125 acres) of foraging habitat. The territory for a group averages about 81 hectares (200 acres), but can range from 24.3 to over 243 hectares (60 to over 600 acres) (FWS, 2003).

An active red-cockaded woodpecker colony occurs within 8 kilometers (5 miles) northeast of the Wilmington Site. It is located just north of the Northeast Cape Fear River along NC 117 in Pender County (GLE, 2008). There are several occurrence records for the red-cockaded woodpecker within 3.2 kilometers (2 miles) of the western border of the Wilmington Site (NCNHP, 2009). No cavity trees were observed on the Wilmington Site during field surveys conducted in support of the ER (GLE, 2008). The forested habitats on the Wilmington Site meet the minimum area requirements needed for foraging habitat. However, the lack of mature forests would limit the value of the Wilmington Site as foraging habitat. The Sledge Forest, a property containing over 1619 hectares (4000 acres) of high-quality forests directly adjacent to and north of the Wilmington Site, does contain loblolly and longleaf pine trees that are over 300 years old. This area would be suitable as nesting and roosting habitat for the red-cockaded woodpecker. It is possible that woodpeckers that forage in the Sledge Forest could occasionally forage within the western forested portion of the Wilmington Site.

No cavity trees or trees more than 30 years old were observed in the proposed GLE Facility area. Most of the area within which the proposed GLE Facility would be located has been logged within the last 20 years or less (GLE, 2008). It is not expected that habitat suitable for the red-cockaded woodpecker would be impacted by preconstruction and construction activities for the proposed GLE Facility; therefore, these activities would have no effect on the species. However, prior to preconstruction activities, GLE (in consultation with FWS) would conduct surveys for the presence of suitable foraging habitat. If foraging habitat is found, further surveys would be conducted to locate potential cavity trees (GLE, 2009f).

Rafinesque's big-eared bat (*Corynorhinus rafinesquii*)

The Rafinesque's big-eared bat is a Federal species of concern. The species occurs in forested areas. Summer roosts include hollow trees, loose bark, or abandoned buildings in or near wooded areas. Bridges are also used as day roosts and as maternity roosts. Foraging habitat is primarily among the canopies of mature upland and lowland forests (Ozier et al. 1999). There is a pre-2006 occurrence record for the Rafinesque's big-eared bat within 3.2 kilometers (2 miles) of the proposed GLE Facility area (NCNHP, 2009). Preconstruction and construction activities for the proposed GLE Facility would disturb habitat that would potentially be suitable for the Rafinesque's big-eared bat; therefore, these activities may affect, but are unlikely to adversely affect, the species. Clearing and grading that would take place during preconstruction activities would account for nearly the entire amount of habitat disturbance that would occur.

Southeastern myotis (*Myotis austroriparius*)

The southeastern myotis is a Federal species of concern. It roosts in caves, buildings, and snags and hollow trees of pine and hardwood forests, and forages primarily in riparian areas, but also in various upland habitats. There is a 1986 occurrence record for the southeastern myotis within 3.2 kilometers (2 miles) of the proposed GLE Facility area from floodplains north of the Wilmington Site near the confluence of the Northeast Cape Fear River and Prince George Creek (NCNHP, 2009; GLE, 2008). The riparian habitats and pine and hardwood forests on the Wilmington Site provide suitable foraging and breeding habitat for the southeastern myotis. It may also forage in the operations area and transmission line ROWs. Preconstruction and construction activities for the proposed GLE Facility would disturb habitat that would potentially be suitable for the southeastern myotis; therefore, these activities may affect, but are unlikely to adversely affect, the species. Clearing and grading that would take place during preconstruction activities would account for nearly the entire amount of habitat disturbance that would occur.

West Indian manatee (*Trichechus manatus*)

The West Indian manatee is Federally listed as endangered. It inhabits shallow coastal bays, lagoons, estuaries, and rivers. The manatee usually inhabits waters with a depth of 1 to 6 meters (3.3 to 20 feet) (Hall, 2009; NatureServe, 2009). Much of their time is spent submerged or partly submerged. Manatees feed on aquatic vegetation. It is a seasonal inhabitant of North Carolina, being present mainly from June through October. There are no occurrence records for the West Indian manatee within 3.2 kilometers (2 miles) of the Wilmington Site (NCNHP, 2009). However, the Northeast Cape Fear River and some of its tributaries in the area of the Wilmington Site may provide suitable habitat for manatee (Hall, 2009). Habitat suitable for the West Indian manatee would not be impacted by preconstruction and construction activities for the proposed GLE Facility; therefore, these activities would have no effect on the species.

State-Listed Species

Based on the information provided in Table 3-15 (Section 3.8.6.2), a number of State rare species reported from New Hanover County could be impacted by preconstruction and construction activities for the proposed GLE Facility (i.e., those species listed as potentially present on or near the GLE Facility). Impacts on State-listed species would primarily be due to habitat disturbance that occurs from clearing and grading during preconstruction activities. No impacts would be expected to any of the State-listed species. The significance level of impacts on all State-listed species would be SMALL.

4.2.8.2 Operations and Maintenance

This section evaluates the potential impacts of the proposed GLE Facility's operations on ecological resources.

Vegetation

No additional lands beyond those disturbed during preconstruction and construction activities would be affected by operation of the proposed GLE Facility. Activities associated with the operation and maintenance of the proposed GLE Facility would include mowing, hand-cutting, and chemical control of vegetation at the proposed GLE Facility, adjacent facilities (e.g., substation), utility corridors, and along the access road. The transmission line ROW would be maintained on a 3-year cycle, while cutting of danger trees would occur on a 7- to 9-year cycle (GLE, 2009e). The diversity of plant species in these areas is generally kept at a reduced level. In addition to mowing or hand-cutting, herbicides may be used on a very limited basis to control vegetation within the transmission line ROW on a 5-year cycle (GLE, 2009e). Herbicide applications may result in impacts on nontarget species from herbicide drift during application.

Landscaping within the proposed GLE Facility area would be expected to be similar to other operations areas. Lawn areas would be planted in Bahia grass (*Paspalum notatum*) and centipede grass (*Eremochloa ophiuroides*) and various trees and shrubs (GLE, 2008). A cleared security buffer would be maintained around the GLE Facility (GLE, 2009e).

Due to the relatively small size of the cooling tower to be used at the proposed GLE Facility, humidity, fogging, or salt deposition would not be of concern to vegetation. At most, only a localized area of landscaped lawn near the cooling tower may be impacted. No apparent impacts on vegetation were observed near the similarly sized FMO cooling tower.

Normal operation of the proposed GLE Facility would result in the generation of air emissions, wastewaters, and solid wastes that would be treated onsite before being discharged or shipped for disposal offsite. Therefore, no impacts on vegetation due to GLE Facility operations would be anticipated.

The radiological exposures from the proposed GLE Facility's operations would not adversely affect humans (Section 4.2.11.2). The level of radiological safety required for the protection of humans is considered adequate for other animals and plants.[12] Therefore, normal operation of the proposed GLE Facility would not have adverse effects on ecological resources resulting from radionuclide releases.

Table 4-5 summarizes the significance levels of impacts on vegetation that could occur from the proposed GLE Facility. Impacts on vegetation related to the operation of the proposed GLE Facility would be SMALL.

[12] Acute doses of 10 rad (0.1 gray) or less are very unlikely to produce persistent, measurable deleterious changes in populations or communities of terrestrial plants or animals. In addition, there is no convincing evidence from the scientific literature that chronic radiation dose rates below 0.1 rad per day (1.0 milligray per day) will harm animal or plant populations. These conclusions are based on population studies that were available at the time (IAEA, 1992; DOE, 2002). The International Atomic Energy Agency is continuing to review and discuss concepts for a radiological protection framework for the environment, to include appropriate effect levels and dose limits for biota.

Wetlands

The operation of the proposed GLE Facility would not encroach upon or have any other adverse effect on wetlands. Impervious surfaces within a watershed generally result in increased runoff and reduced infiltration, causing changes in the frequency or duration of inundation or soil saturation and greater fluctuations in wetland water levels. However, the routing of GLE Facility drainage to the stormwater retention basin would minimize the potential for wetland water-level fluctuations.

Table 4-5 summarizes the significance levels of impacts on wetlands that could occur from the proposed GLE Facility. Impacts on wetlands related to the operation of the proposed GLE Facility would be SMALL.

Environmentally Sensitive Areas

Other than the potentially minor impacts on wetlands discussed above, no environmentally sensitive areas would be impacted by operation of the proposed GLE Facility. Therefore, impacts on environmentally sensitive areas from operation of the proposed GLE Facility would be SMALL (Table 4-5).

Wildlife

Potential impacts on wildlife from operation of the proposed GLE Facility would include: (1) ongoing habitat disturbance (i.e., reduction, alteration, and fragmentation of habitat due to the presence and maintenance of the proposed GLE Facility and support facilities such as the substation, the access road, and transmission line); (2) wildlife disturbance (e.g., from noise and the presence of workers); and (3) wildlife injury or mortality (e.g., from collisions with the water tower, transmission line, buildings, or vehicles, and from the exposure to contaminants).

Habitat Disturbance

In general, the presence of the proposed GLE Facility (and associated maintenance) could result in areas that were once considered areas with a high probability of being used by wildlife becoming areas of lower habitat use. Maintenance of landscaped areas generally keeps wildlife diversity lower than surrounding habitats. Wildlife species occurring on sites within security areas are typically limited by low habitat quality and generally include common species adapted to industrial sites. The stormwater detention basin and associated drainage ditches could provide habitat capable of supporting some wildlife species (e.g., amphibians, waterfowl). Because the project area would be fenced, big game and other larger mammal species would be physically excluded from the proposed GLE Facility site.

Periodic maintenance of the transmission line ROW in forested areas would maintain the ROW in an early stage of plant community succession, which could benefit small mammals and their predators. Regrowth of trees following maintenance could benefit white-tailed deer that feed on the leaves, twigs, and young shoots of trees and shrubs. Conversely, habitat maintenance would have localized adverse effects on species that prefer late-successional or forested habitats. ROW vegetation maintenance would not be expected to occur more often than once every three years. This would lessen impacts on wildlife species that might use the ROW. No distinct travel or migratory corridors for wildlife species occur on the Wilmington Site. Therefore, the presence of the proposed GLE Facility would not impact wildlife movement. As the proposed GLE Facility would not be located near stream corridors, species such as the American black bear (*Ursus americanus*) that tend to travel along densely vegetated stream banks would not be impacted. The edge habitat established between the existing forested areas and the proposed GLE Facility could attract species such as white-tailed deer and wild turkey (*Meleagris gallopavo*) (GLE, 2008).

Wildlife Disturbance

During operation and maintenance of the proposed GLE Facility, wildlife could be disturbed by noise and the presence of workers. The activities associated with operation of the proposed GLE Facility that could generate noise include transmission lines (corona), vehicles, maintenance equipment, and plant operations. The response of wildlife to these disturbances would be highly variable and depend on the species; distance; timing; and the type, intensity, and duration of the disturbance. Disturbance impacts on wildlife during operations and maintenance would be similar to those discussed for preconstruction and construction activities (Section 4.2.8.1). For example, some individual wildlife might temporarily or permanently move from the project area. Wildlife permanently moving from the area might incur high mortality rates if the surrounding habitats were at or near carrying capacity or if the surrounding areas lacked habitat capable of supporting the displaced individuals.

During operations and maintenance, vegetation maintenance would be required (e.g., regularly within the landscaped project area and along the access road and about every three years within the transmission line ROW). Because of the temporary nature of maintenance activities, disturbance from noise and human presence would be localized and of short duration. During vegetation-clearing operations, wildlife would be displaced to adjacent undisturbed habitats; however, less mobile individuals could be destroyed.

Night lighting could also disturb wildlife in the project area. Lights can directly attract migratory birds (particularly in inclement weather and during low-visibility conditions) and can indirectly attract birds and bats by attracting flying insects. Attraction to lights can increase the potential for birds to collide with structures.

Wildlife Injury or Mortality

Wildlife could be injured or killed by vehicle traffic along the access road to the proposed GLE Facility. Collisions with buildings, the water tower, and the transmission line also represent a potential hazard for birds. The relative abundance of a bird species does not predict the relative frequency of fatalities per species (Thelander and Rugge, 2000). However, resident birds may have a higher probability of collisions than migrants, given that residents tend to fly lower and spend more time in the area (Janss, 2000). Also, birds typically found within the operations area habitats of the Wilmington Site would be most likely to collide with structures due to their close proximity to them.

The potential for bird collisions with transmission lines depends on variables such as habitat, relation of the line to migratory flyways and feeding flight patterns, migratory and resident bird species, and structural characteristics of the lines (Beaulaurier et al., 1984). Birds that migrate at night, fly in flocks, and/or are large and heavy with limited maneuverability are at particular risk (BirdLife International, 2003). Waterfowl, wading birds, shorebirds, and passerines are most vulnerable to colliding with transmission lines near wetlands, while in habitats away from wetlands, raptors and passerines are most susceptible (Faanes, 1987). Young, inexperienced birds, as well as migrants in unfamiliar terrain, appear to be more vulnerable to wire strikes than resident breeders. Also, many species appear to be most highly susceptible to collisions when alarmed, pursued, searching for food while flying, engaged in courtship, taking off, landing, or otherwise preoccupied and not attentive to where they are going, and during the night and inclement weather (Thompson, 1978). Mortality resulting from birds colliding with transmission lines is considered unavoidable. However, mortality levels are not anticipated to result in long-term loss of population viability in any individual species or lead to a trend toward listing as a rare or endangered species, because it is expected that mortality levels would be low.

Except under unusual circumstances, no electrocution of raptors or other birds would be expected, because the spacing between the conductors or between a conductor and a ground wire or other grounding structure would exceed the wing span of the largest birds that occur in the region. Although a rare event, electrocution could occur during current arcing when flocks of small birds cross a line or when several roosting birds take off simultaneously. This is most likely to occur in humid weather conditions (Bevanger, 1995; BirdLife International, 2003). Arcing could also occur from the waste streamers of large birds roosting on the crossarms above insulators (BirdLife International, 2003). The electrocution of other wildlife from contact with electrical transmission lines is even less common. However, non-avian wildlife species that have been electrocuted include snakes, mice, squirrels, raccoons, bobcat (*Lynx rufus*), and American black bear (*Ursus americanus*) (EEI, 1980; Williams, 1990). Among the mammals, squirrels are among the most commonly reported species to be electrocuted because of their proclivity for chewing on electrical wires. Because of the relatively rare nature of electrocutions, they are not expected to adversely affect populations of wildlife species in the vicinity of the proposed GLE Facility.

The potential effects of electromagnetic field (EMF) exposure on animal behavior, physiology, endocrine systems, reproduction, and immune functions have been found to be negative, very minor, or inconclusive (WHO, 2007). Generally, these results are for exposures much higher and longer than would be encountered by wildlife under actual field conditions. Also, there is no evidence that EMF exposure alone causes cancer in animals, and the evidence that EMF exposure in combination with known carcinogens can enhance cancer development is inadequate (WHO, 2007).

During operation and maintenance of the proposed GLE Facility and its ancillary components, wildlife might be exposed to herbicides, fuel, or other hazardous materials. Potential exposure to hazardous materials would be most likely from a spill. A spill could result in direct contamination of individual animals, contamination of habitats, and contamination of food resources. Acute (short-term) effects generally occur from direct contamination; chronic (long-term) effects usually occur from factors such as the accumulation of contaminants from food items and environmental media (Irons et al., 2000). Moderate to heavy contaminant contact is most often fatal to wildlife. Chronic exposure can reduce reproduction, hatching success, and growth and cause a variety of pathological conditions. Contaminant ingestion during preening or feeding might impair endocrine and liver functions, reduce breeding success, and reduce growth of offspring.

The impacts on wildlife from a spill would depend on factors such as the time of year, volume of the spill, type and extent of habitat affected, and home range and density of the wildlife species. A population-level adverse impact would be expected only if the spill was very large or if it contaminated a crucial habitat area where a large number of individual animals were concentrated. The potential for either event would be unlikely. Because the amounts of most fuels and other hazardous materials are expected to be small, an uncontained spill would affect only a limited area. Also, the avoidance of contaminated areas by wildlife during spill response activities (due to disturbance from human presence) would minimize the potential for wildlife exposure.

Most herbicides used within the transmission line ROW would pose little or no risk to wildlife unless the animals were exposed to accidental spills or direct spray or drift or unless they consumed herbicide-treated vegetation. Herbicide applications would be conducted by following label directions and in accordance with applicable permits and licenses. Thus, any adverse toxicological threat from herbicides on wildlife would be unlikely. The response of wildlife to herbicide use would be attributable primarily to habitat changes resulting from treatment rather than toxic effects of the applied herbicide. However, accidental spills or releases of these materials could affect exposed wildlife. Effects could include organ damage, growth decrease, decrease in reproductive output, adverse impacts on the condition of offspring, and death (BLM, 2007).

As previously discussed, no impacts on ecological resources from operation of the proposed GLE Facility due to radiological exposure are expected. The highest exposures to wildlife would be to small animals occupying the UF_6 storage pads. However, periodic surveys and other activities within the UF_6 storage pads would discourage use of the storage pads by wildlife. Thus, the radiological exposures to local wildlife would be negligible.

Table 4-6 summarizes the significance levels of impact to wildlife that could occur from the proposed GLE Facility. Impacts on wildlife due to GLE Facility operations would be SMALL.

Aquatic Biota

No natural water bodies occur within the immediate area of the proposed GLE Facility. The stormwater detention basin could support aquatic biota similar to other onsite stormwater wet detention basins. However, it is not likely that a diverse fish community would occur in the detention basin. More diverse aquatic communities on the Wilmington Site occur in the tributaries to the Northeast Cape Fear River and Prince George Creek, the effluent channel, and process and water treatment lagoons. The Northeast Cape Fear River supports a diverse aquatic community.

During the operations and maintenance phase, aquatic habitats and aquatic biota could be affected by continued erosion and sedimentation and exposure to contaminants. The rates of erosion and the resulting levels of turbidity and sedimentation to aquatic habitats would likely be less than during the preconstruction and construction phases because of the established ground cover and functioning of the stormwater wet detention basin. However, increased discharges to Unnamed Tributary #1 to Northeast Cape Fear River could increase turbidity and sedimentation until the stream channel adjusts to increased flows (GLE, 2008). Wastewater generated during operations would be treated to meet NPDES permit requirements. Therefore, it is not expected that aquatic biota that inhabit Unnamed Tributary #1 to Northeast Cape Fear River, which would receive effluent from the proposed GLE Facility's operations, would be adversely impacted.

The potential exists for toxic materials (e.g., fuel, lubricants, and herbicides) to be accidentally introduced into aquatic habitats during operation and maintenance of the proposed GLE Facility, access road, and transmission line. The level of impacts from releases of toxicants would depend on the type and volume of chemicals entering the waterway, the location of the release, the nature of the water body (e.g., size, volume, and flow rates), and the types and life stages of organisms present in the waterway. Because the amounts of most fuels and other hazardous materials are expected to be small, an uncontained spill would probably affect only a limited area. In general, lubricants and fuel would not be expected to enter wetlands or waterways as long as heavy machinery is not used near waterways, fueling locations for maintenance equipment are situated away from waterways, and measures are taken to control potential spills. Mitigation measures for maintenance of transmission line corridors generally restrict the use of machinery near waterways. Similarly, there are restrictions placed on the application methods, quantities, and types of herbicides that are used in the vicinity of wetlands and waterways in order to limit the potential for impacts on aquatic ecosystems. For example, herbicides would not be used directly along streams, ditches, or the stormwater wet detention basin (GLE, 2008).

Only trace levels of radiological contamination would be released to surface waters from operation of the proposed GLE Facility, with the discharges being within NPDES-permitted levels (Section 4.2.6.2). Therefore, adverse radiological impacts on aquatic biota from the operation of the proposed GLE Facility would not be expected.

Table 4-7 summarizes the significance levels of impacts on aquatic biota that could occur from the proposed GLE Facility. Impacts on aquatic biota from GLE Facility operations would be SMALL.

Threatened, Endangered, and Other Special Status Species

No impacts on threatened, endangered, or other special status species would be expected from operation of the proposed GLE Facility because of the lack of suitable habitats within the immediate project area (in part due to habitat disturbance that would have occurred during preconstruction and construction activities [Section 4.2.8.1] and due to minimal contaminant releases to the environment). Therefore, impacts from GLE Facility operations to these species would be SMALL.

4.2.8.3 Mitigation Measures

This section presents mitigation measures to minimize impacts on ecological resources. Included are mitigation measures that GLE has committed to (GLE, 2008, 2009b) and mitigation measures identified during the NRC staff's review. The mitigation measures are grouped by phase of development. Many of the mitigation measures are general in nature, being applicable to all phases of the project. These general mitigation measures are presented first, with more phase-specific mitigation measures following. A number of the mitigation measures designed to minimize impacts on air quality (Section 4.2.4.3), soils (Section 4.2.5.3), surface waters

(Section 4.2.6.3), noise (Section 4.2.9.3), and waste management (Section 4.2.12.3) would also minimize impacts on ecological resources, and are discussed in the referenced sections.

General Mitigation Measures

Mitigation Measures Identified by GLE

General mitigation measures that GLE has identified in order to minimize impacts on ecological resources include (GLE, 2008):

- Select a non-wetland, non-floodplain area for the proposed facility.
- Maintain the hydrological connectivity of wetlands to surface waters.
- Sod, seed, and/or landscape disturbed areas in accordance with the Sediment and Erosion Control Permit.
- Plant native plant species (i.e., not invasive species) to revegetate disturbed areas and for landscaping the proposed GLE Facility.
- Use nectar- and berry-producing plants for landscaping plants.
- Place bluebird boxes throughout the study area.
- Conduct site-stabilization practices to reduce the potential for erosion and sedimentation.
- Consider the recommendations made by appropriate Federal and State agencies, including the U.S. Fish and Wildlife Service (FWS) and the North Carolina Department of Environmental and Natural Resources (NCDENR).

Additional Mitigation Measures Identified by NRC

- Reduce or prevent the collection, harassment, or disturbance of plants, wildlife, and their habitats (particularly threatened, endangered, and sensitive species) through employee and contractor education on applicable State and Federal laws. Additionally, implement the following measures: (1) instruct all personnel to avoid harassment and disturbance of local plants and wildlife; (2) make personnel aware of the potential for wildlife interactions around facility structures; and (3) ensure that food refuse and other garbage are not available to scavengers.
- Establish a trash abatement program focusing on containing trash and food in closed containers and removing them periodically to reduce their attractiveness to opportunistic species, such as bears, coyotes, and feral dogs.
- Avoid known locations of listed plant species and habitats of listed wildlife species and establish a setback distance (minimum 60 meters [200 feet]) to prevent any destructive impacts associated with construction and decommissioning activities.

- Minimize the number of areas where wildlife could hide or be trapped (e.g., open sheds, pits, uncovered basins, and laydown areas).

- If any federally threatened or endangered species such as the roughleaf loosestrife or the red-cockaded woodpecker are encountered, consult the FWS as required by Section 7 of the *Endangered Species Act*, and determine an appropriate course of action to avoid or mitigate impacts.

- Observe all trees greater than 61 centimeters (24 inches) in diameter identified during GLE's surveys for potential compensatory tree plantings for the potential presence of red-cockheaded woodpecker cavities. If any cavities are observed, consult the FWS as required by Section 7 of the ESA and determine an appropriate course of action to avoid or mitigate impacts.

- Develop an integrated vegetation management plan for the control of noxious weeds and invasive plant species.

Mitigation Measures for Preconstruction and Construction Activities

Mitigation Measures Identified by GLE

Mitigation measures that the applicant has identified in order to minimize impacts on ecological resources during preconstruction and construction activities include:

- Minimize the construction footprint to the extent possible and limit habitat disruption.

- Limit cut/fill slopes to a horizontal-vertical ratio of 3:1 or less.

- Use existing service road routes and utility ROWs to the fullest extent practicable to minimize the need for additional wetlands crossings.

- Construct access road perpendicular to wetlands to minimize the area impacted.

- Avoid temporary storage of materials in wetlands.

- Place fencing/barriers and use signs around wetland areas.

- Use silt fencing and cover soil stockpiles to prevent sediment runoff.

- Restore disturbed areas to original surface elevations.

- Perform surveys of trees greater than 61 centimeters (24 inches) in diameter before beginning preconstruction and construction activities. The impacts on each tree would be mitigated by the planting of one 61-centimeter (24-inch) diameter tree, two 30.5-centimeter (12-inch) diameter trees, or three 20.3-centimeter (8-inch) diameter trees elsewhere on the Wilmington Site.

- Restrict preconstruction activities and the harvesting of trees to periods when the ground is dry.

- If trenches are necessary, ensure that they are closed overnight; inspect trenches that are left open overnight and remove animals prior to backfilling. In addition, place escape ramps at less than 45-degree angles in trenches to provide exit strategies for animals entering the trenches.

- Sod, seed, and/or landscape disturbed areas in accordance with the Sediment and Erosion Control Permit.

- Revegetate disturbed areas with native plant species.

- Install animal-friendly fencing around the proposed GLE Facility site so that wildlife cannot be injured by or entangled in the site's security fence.

- Establish food plots along roadways and under power lines.[13]

Additional Mitigation Measures Identified by NRC

- Minimize the area disturbed by preconstruction activities and the installation of facilities (pipelines, transmission towers, pump stations, substations, laydown areas, assembly areas) to retain native vegetation and minimize soil disturbance.

- Backfill open trenches as quickly as is reasonable.

- To the extent practicable, avoid the use of guy wires, as these pose a collision hazard for birds.

Mitigation Measures for Operations

Mitigation Measures Identified by GLE

No specific mitigation measures to protect ecological resources from the operation of the proposed GLE Facility were identified by GLE (GLE, 2008).

Mitigation Measures Identified by NRC

- Maintain areas left in a natural condition during construction (e.g., wildlife crossings) in as natural a condition as possible within safety and operational constraints.

- To minimize habitat loss and fragmentation, reestablish as much habitat as possible after construction is complete by maximizing the area reclaimed or vegetated during operations.

[13] The NRC does not recommend that food plots be established along roadways, as this could increase the potential for wildlife being run over or hit by vehicles.

- Prevent the establishment and spread of invasive species and noxious weeds within the transmission line ROW, along the access road, and in associated areas of ground surface disturbance or vegetation cutting. Monitor the area regularly and eradicate invasive species immediately.

4.2.9 Noise Impacts

This section describes potential noise impacts of preconstruction activities, construction, and operation of the proposed GLE Facility on neighboring communities. Because the activities that may cause noise impacts do not correspond well to these three phases, in this analysis, noise impacts were organized into road construction, land clearing and grading, and operations activities. As explained further in Section 4.2.9.1, building construction was expected to cause much less noise impact than road construction and land clearing and grading, and was not modeled separately.

In this analysis, noise level data for stationary and mobile sources such as heavy equipment, various types of vehicles, and facility operating units to be used are estimated using standard references and then noise levels at receptors are estimated using sound propagation computer software Cadna/A® developed by DataKustik. Potential impacts from road construction are presented in Section 4.2.9.1, and those from facility operations are discussed in Section 4.2.9.2. Mitigation measures during preconstruction activities, construction, and facility operations are presented in Section 4.2.9.3.

4.2.9.1 Preconstruction and Construction Activities

The commuter and delivery vehicular traffic around the proposed GLE Facility and along the traffic routes nearby would generate intermittent noise. However, the contribution to noise from these intermittent sources would be limited to the immediate vicinity of the traffic routes and would be minor in comparison to the contribution from continuous noise sources such as compressors or bulldozers during preconstruction and construction activities. Sources of noise during preconstruction and construction activities for the proposed GLE Facility would include standard construction activities for moving earth and erecting concrete and steel structures. Noise levels from these activities would be comparable to those from other construction sites of similar size. The noise levels would be highest during land clearing, grading, and road construction, when a large fleet of heavy equipment would be used to clear the site over a short time period. Typically, this phase would be one month of road construction followed by eight months of land clearing and grading.

In general, the dominant noise source for most construction equipment is the diesel engine without sufficient muffling. Pile driving or pavement breaking would normally dominate noise at a construction site, but neither of these activities is planned. During construction, a variety of heavy equipment would be used. Average noise levels for typical construction equipment range from 74 A-weighted decibels (dBA) for a roller to 101 dBA for a pile driver (impact) at the distance of 15 meters (50 feet) from a source (Hanson et al., 2006). During construction at the Wilmington Site, the noise level for any heavy equipment or traffic vehicle would be less than 90 dBA at a 15-meter (50-foot) distance.

Projected sound-level contours including average daytime A-weighted decibels and day-night average sound levels (L_{dn}, dBA) are estimated for road construction and land clearing and grading. The assumed numbers of heavy equipment and vehicle trips for use in sound propagation modeling are presented in Table 4-8. Background and modeled sound levels at the fenceline nearest to the Wooden Shoe residential subdivision are presented in Table 4-9.

The proposed north access road would be constructed to connect the NC 133 (Castle Hayne Road) to the proposed GLE Facility. Road construction 2.6 kilometers (1.6 miles) in distance would last about 1 month and progress westward from the NC 133 along 2.6 kilometers (1.6 miles) in the proposed access road. Predicted noise levels of 68 dBA equivalent sound level (L_{eq}) and 66 dBA L_{dn} would temporarily exceed the daytime 65 dBA L_{eq} for the New Hanover County Noise Ordinance (New Hanover County, 2009b) and the EPA guideline of

Table 4-8 Assumed Number of Noise Sources for Use in Sound Propagation Modeling

Phase	Assumed Value	
Road construction	4	bulldozers
	2	graders
	4	loaders
	2	rollers
	1	excavator
	1	water truck
Land clearing and grading	4	Bulldozers
	2	graders
	4	loaders
	2	rollers
	1	excavator
	1	water truck
	375	passenger vehicles (trips/day)
	35	hauling vehicles (trips/day)
Operations	4	cylinder hauling vehicles dedicated to proposed GLE Facility
	2	hauling vehicles using the western connector to existing facility
	4	air handling units
	1	scrubber exhaust[a]
	2	cooling towers
	2	emergency diesel generators
	6	heat pumps (2 per service building)
	2	pump/lift stations (25 horsepower)
	1	electrical substation (60,000 kilovolt-amperes)
	375	passenger vehicles (trips/day)
	6	hauling vehicles (trips/day)

[a] Scrubber exhaust noise is included in sound propagation modeling, but the scrubber has been removed from the proposed GLE Facility design. Results can be viewed as a conservative estimate during facility operations.
Source: GLE, 2008.

55 dBA L_{dn} (EPA, 1974)[14] at the fenceline where the access road is the closest to the site boundary (not shown in the table). At the fenceline nearest to the Wooden Shoe residential subdivision, predicted noise levels of 61 dBA L_{eq} and 59 dBA L_{dn} would be lower than the daytime equivalent continuous sound level for the New Hanover County Noise Ordinance but exceed the EPA guideline, as shown in Table 4-9. Road construction activities would be of very short duration (about one month). Potential noise impacts on the surrounding community would be MODERATE but temporary in nature when the road construction activities would occur in the proximity of the site property line near the Wooden Shoe subdivision.

Land clearing and grading activities, which would last for about eight months, follow road construction activities. Most land clearing and grading activities would occur away from the fenceline and far from the nearest residential subdivision (about 1.3 kilometers [0.8 mile]). Noise levels from commuting, delivery, and support vehicles traveling the access road would be lower than those during road construction. Predicted noise levels of 61 dBA L_{eq} and 58 dBA L_{dn}

Table 4-9 Estimated Cumulative Sound Levels (dBAs) at the Fenceline Receptor Nearest to the Wooden Shoe Residential Subdivision

		Average L_{eq}[a]		
Activity	**Item**	**Day**	**Night**	**L_{dn}[b]**
	Background (measured)	46	41	48
Road Construction	Modeled	61	41[c]	58
	Background+ modeled	61	41	59
Land clearing and grading	Modeled	42	41[c]	40
	Background+ modeled	48	41	49
Facility Operations	Modeled	38	34	42
	Background+ modeled	47	42	49
	New Hanover County Ordinance (residential)[d]	65	50	NA[e]
	EPA guideline (residential)[f]	NA	NA	55

[a] L_{eq} = equivalent continuous sound level. The "day" time period is 15 hours from 7 a.m. to 10 p.m. and "night" time period is 9 hours from 10 p.m. to 7 a.m.
[b] L_{dn} = day-night average sound level.
[c] No modeling was performed because no activities would occur at night. This background value is used to calculate the L_{dn}.
[d] Source: New Hanover County, 2009b.
[e] NA = not applicable.
[f] Source: EPA, 1974.

[14] This location is not a residence, and thus not subject to the New Hanover County Noise Ordinance or the EPA guideline. These noise levels are presented for informational purposes only.

at the fenceline nearest to the proposed GLE Facility would be lower than the daytime equivalent sound level for the New Hanover County Noise Ordinance but higher than the EPA guideline (not shown in the table). However, noise levels of 48 dBA L_{eq} and 49 dBA L_{dn} at the fenceline receptor closest to the subdivision are predicted to be below the daytime equivalent continuous sound level for the New Hanover County Noise Ordinance and the EPA guideline; thus, potential noise impacts on the surrounding community would be SMALL and temporary in nature.

During the building construction phase, major activities would include building erection and electrical and mechanical installation, and some activities would occur inside the buildings. Typically, heavy equipment with lower noise levels than those during road construction or land clearing and grading would be employed. The start-up and final construction phase would include concurrent indoor construction activities along with staged testing and start-up of process units as completed. Traffic accessing the construction site might increase but the traffic would consist of smaller passenger vehicles, vans, and pickup trucks. Noise modeling was not performed for this building construction phase because noise levels would be expected to be lower than those for the road construction and land clearing and grading phase. Accordingly, potential noise impacts on the nearest Wooden Shoe subdivision would be anticipated to be SMALL during these phases.

In conclusion, road construction noise could temporarily exceed the EPA guideline at the nearest Wooden Shoe subdivision but not exceed the daytime New Hanover County Noise Ordinance level. During land clearing and grading, building construction, and start-up and final construction, noise levels at the nearest subdivision are well below the New Hanover County Noise Ordinance or the EPA guideline due to the distance (about 1.3 kilometers [0.8 mile]).

4.2.9.2 Facility Operations

During facility operations, noise sources would be primarily in enclosures within the main GLE operations buildings with limited rooftop equipment. Various outbuildings are planned with exterior equipment, such as diesel generators, pumps, heat pumps, transformers, and cooling towers. Other noise sources would include vehicular traffic such as commuting vehicles and material delivery vehicles on the proposed north access road, as well as hauling vehicles around the proposed GLE Facility and to and from the cylinder yards and the existing FMO facility (GLE, 2008).

The assumed numbers of stationary noise sources and vehicle trips are presented in Table 4-8. It is also assumed that the proposed GLE Facility is operating 24 hours per day, seven days per week (GLE, 2008). Sound propagation modeling indicates that noise levels of 47 dBA L_{eq} (day), 42 dBA L_{eq} (night), and 49 dBA L_{dn} at the fenceline receptor closest to the Wooden Shoe residential subdivision are estimated to be below the day and night equivalent continuous sound level for the New Hanover County Noise Ordinance and the EPA guideline. These levels are only 1 decibel higher than existing ambient levels at this receptor, which is lower than a 3-decibel change that is considered a barely discernable difference. Accordingly, potential noise impacts on the nearest Wooden Shoe subdivision during operations are anticipated to be SMALL.

4.2.9.3 Mitigation Measures

As discussed above, potentially MODERATE noise impacts during access road construction of short duration (about one month) and SMALL impacts during land clearing and grading, construction, and facility operations are anticipated. All project-related activities should comply with applicable laws, ordinances, regulations, and standards. Mitigation measures during the life of the project are recommended as a means to reduce potential noise impacts on the neighboring communities. Below are mitigation measures that GLE has proposed (GLE, 2008). NRC staff has also identified additional measures that could potentially reduce impacts.

General Mitigation Measures

Mitigation Measures Identified by GLE

- When possible, use quiet equipment or methods to minimize noise emissions.

- For equipment with internal combustion engines, operate equipment at the lowest operating speed to minimize noise emissions, when possible and practical.

- Close engine-housing doors during operation of equipment to reduce noise emissions from the engine.

- Avoid equipment engine idling.

Additional Mitigation Measures Identified by NRC

- Operate all vehicles traveling within and around the project area in accordance with posted speed limits.

- Post warning signs in high-noise areas and implement a hearing protection program for work areas in excess of 85 dBA.

- Project operators should realize that complaints about noise may still occur, even when the noise levels from the facility do not exceed regulatory or guideline levels. Implement a noise complaint process and hotline for the surrounding communities, including documentation, investigation, evaluation, and resolution of all legitimate project-related noise complaints.

Mitigation Measures for Preconstruction Activities and Building Construction

Mitigation Measures Identified by GLE

- Prohibit heavy truck and earth-moving equipment usage after twilight and during early morning hours.

- Equip construction equipment with the manufacturer’s noise-control devices, and maintain these devices in effective operating condition.

- Use quieter, less-tonal devices that comply with all applicable safety restrictions (e.g., Occupational Safety and Health Administration [OSHA] standards) on backup alarms for construction equipment.

Additional Mitigation Measures Identified by NRC

- When possible, schedule different noisy activities to occur at the same time, since additional sources of noise generally do not significantly increase noise levels at the site. That is, less-frequent but noisy activities would generally minimize overall noise disturbance than lower-level noise occurring more frequently.

- Implement noise control measures (e.g., erection of temporary wooden noise barriers) if noisy activities would be expected near sensitive receptors.

Mitigation Measures for Operations

Mitigation Measures Identified by GLE

- Use a quieter, high-efficiency transformer to mitigate noise from the proposed electrical substation.

Additional Mitigation Measures Identified by NRC

No additional mitigation measures to minimize potential noise impacts on neighboring communities from the operation of the proposed GLE Facility are proposed by NRC.

4.2.10 Transportation Impacts

This section addresses the potential impacts on the environment from transportation of workers and materials attributable to preconstruction activities, construction, and operation of the proposed GLE Facility. The main impact of these activities on transportation resources is expected to be increased traffic on nearby roads and highways. Impacts are expected to be SMALL to MODERATE on adjacent local roads, but regional impacts are expected to be SMALL. All incoming and outgoing shipments associated with the construction, operation, and decommissioning of the proposed GLE Facility are anticipated to be transported by truck. All motor vehicle traffic to the facility will use a new entrance, an extension of the existing North Entrance (GLE, 2009e), to the Wilmington Site off of North Carolina Route 133 (Castle Hayne Road).

4.2.10.1 Preconstruction and Construction Activities

Preconstruction and construction activities involve the movement of personnel and equipment to and from the site, the delivery of materials and supplies, and the removal of construction debris and waste. The number and type of truck shipments will vary over the course of the initial three-year preconstruction and construction period depending on the type and level of activity at the site. Truck types would vary from heavy haul tractor-trailer trucks and other heavy haul trucks, such as dump trucks and cement trucks, to light-duty delivery trucks. Site activities would include site clearing and grading, building construction (exterior and interior), installation of process equipment, and utility installation. Preconstruction and construction activities are estimated to add approximately 35 trucks per day to local traffic on average over the construction period (GLE, 2008). This additional traffic load would have only a SMALL impact on local traffic.

The number of construction workers and visitors (e.g., regulatory inspectors, GLE staff) at the construction site would also vary widely over the three-year preconstruction and construction period, depending on progress at the site. During preconstruction and construction activities, prior to initial start-up of operations, an average increase of up to 815 daily trips by construction personnel is anticipated (GLE, 2009e) as shown in Table 4-10. Approximately 200 daily trips by workers are anticipated during preconstruction with an additional 615 daily trips at the onset of construction activities. The heaviest local traffic occurs in the immediate vicinity of the site entrance on Castle Hayne Road near the I-140 on- and off-ramps. With an annual average daily traffic (AADT)[15] level ranging from about 10,000 to 12,000 on Castle Hayne Road, as discussed in Section 3.10.1, an additional 200 to 615 or more trips during peak commuting periods could have a SMALL to MODERATE impact at the local level. Impacts would be lessened if shift changes did not directly coincide with local peak road usage times, including shift changes at the existing Wilmington Site facilities. Because Castle Hayne Road is a major north-south thoroughfare and I-140 is in the immediate area to handle east-west traffic, traffic funnels to and from the site on these roads, keeping impacts limited to the local site vicinity, regional impacts are considered to be SMALL.

Approximately 200 daily trips by construction personnel are expected during preconstruction activities, which would result in SMALL to MODERATE impacts at the site entrance. During construction, approximately 615 to 815 daily trips by construction personnel are expected and would result in MODERATE impacts at the local level.

4.2.10.2 Facility Operations

The facility operations phase would overlap with the construction phase for five years (GLE, 2008). During this time period, vehicular traffic from operations personnel commuting to and from the proposed GLE Facility would add to the increased local traffic from construction workers and shipments, as discussed in Section 4.2.10.1. The remaining years of operations would continue to see vehicular traffic from permanent operations personnel staff, occasional visitors (e.g., regulatory inspectors), and incoming truck shipments for materials and supplies as well as outgoing shipments of product materials and wastes.

<u>Transportation of Personnel, Materials, and Supplies</u>

In addition to the construction-related truck shipments, the natural uranium material used for feed to the enrichment process (i.e., UF_6 feed) would be shipped to the Wilmington Site and enriched UF_6 product, UF_6 tails, empty cylinders, and LLRW, would be shipped from the site. However, the enriched UF_6 product will be another source of material for the FMO facility, and thereby reduce the number of enriched UF_6 shipments coming to the Wilmington Site. A conservative estimate of the annual number of additional heavy-haul truck shipments to and

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[15] Annual average daily traffic (AADT) is a measure of the daily average number of vehicles that pass through a given segment of roadway.

Table 4-10 Estimated Traffic Generated by Construction, Operation, and Decommissioning of the Proposed GLE Facility

Phase	Schedule Assumed in Analysis[a]	Current Schedule	Average Annual Number of Employees[b]	Total Vehicle Trips[c,d]	
				AM Peak Hour Trips	Average Daily Trips (ADT)[e]
Preconstruction and initial construction activities	2011–2012	2011–2012	388[f]	388[g]	815[k]
Start-up operation, overlapping with 1 year of initial construction (2013) and 4 years of final construction activities	2013–2017	2013–2017	743[h]	297	1,560
Production operations	2018–2050	2018–2051	350	140	740
Production operations and initial decommissioning activities	2049-2050	2050–2051	400[i]	190[g,j]	840
Decommissioning	2051-2057	2052–2058	50[i]	50[g]	105

[a] As discussed in Section 4.1, certain impact analyses in this draft EIS are based on a slightly different licensing schedule than is currently expected. These schedule changes, which will be reflected in the final EIS, are expected to cause slight changes in the transportation impact analysis but are not expected to change any of the impact conclusions.

[b]Average annual number of employees during the specified years using annual employment estimates for the proposed GLE Facility.

[c] Number of vehicle trips estimated using Institute of Transportation Engineers (ITE) standard trip generation rates for industrial manufacturing land use (ITE, 2004). The ITE defines manufacturing facilities as areas where the primary activity is the conversion of raw material or parts into finished products. The ITE trip generation rates are total vehicle rates that include trucks. Morning peak-hour trips = 0.4 per employee.

[d] Assumed ITE ADT trip generation rates for industrial manufacturing land use for all phases.

[e] Average daily trips (ADT) = 2.1 per employee.

[f] Actual total number of construction workers onsite on a given day would vary depending on the project's construction stage and required activities. On many days, fewer than 388 workers used for the ADT estimate are expected to be needed to perform the required daily construction activities.

[g] Assumed construction and decommissioning activities conducted only during daylight hours on a Monday through Friday schedule. Therefore, morning peak-hour trip estimates conservatively assume that all workers work the same schedule and arrive at the Wilmington Site at the same time.

[h] Start-up consists of a varying mix of onsite permanent operational workers and temporary engineering and construction workers.

[i] The 50 workers included in the ADT estimate is anticipated to be an upper limit. Actual total number of decommissioning workers on-site on a given day could vary depending on the specific decommissioning-phase activities.

[j] 140 morning peak-hour trips for production workers + 50 morning peak-hour trips for decommissioning workers.

[k] The number of vehicle trips associated with preconstruction and construction are estimated to be 200 and 615, respectively (GLE, 2009e).

Source: Modified from GLE, 2008.

from the Wilmington Site from operation of the proposed GLE Facility, which does not account for the reduced number of enriched UF_6 shipments arriving at the site, is 2100, approximately six trucks per day on average (GLE, 2008). Other supplies and equipment necessary for operations would also be delivered to the proposed GLE Facility on an as-needed basis.

Operations personnel would be expected to reside in the Wilmington Site regional area and commute from all directions, which is similar to current workers at the other site facilities and construction workers for the proposed GLE Facility. As shown in Table 4-10, the average number of workers (construction and operations personnel) at the proposed GLE Facility on a daily basis during operations start-up and construction completion would be approximately 743 (GLE, 2008). About 350 permanent operations personnel would be employed over the 30-year remainder of the operations period. The proposed GLE Facility would operate on a 24-hour, multiple-shift schedule 7 days per week. Thus, not all employees would be arriving and departing at the same time in the morning and evening, respectively.

The number of additional daily vehicle trips resulting from operation of the proposed GLE Facility would increase by about 1560 at the Wilmington Site on average during joint construction and operations activities (see Table 4-10). Once preconstruction and construction activities have concluded, the average number of daily trips by operations personnel associated with the proposed GLE Facility is estimated to be approximately 740. The range of an additional 740 to 1560 daily trips would have a similar effect on the local road network as the increase due to construction traffic for the proposed GLE Facility discussed in Section 4.2.10.1. Traffic in the vicinity of Castle Hayne Road and I-140 near the site entrance may become more congested at times of peak travel associated with shift changes at the proposed GLE Facility resulting in a SMALL to MODERATE impact. Impacts would be lessened if shift changes did not directly coincide with local peak road usage times, including shift changes at the existing Wilmington Site facilities. The impact on regional traffic flow is expected to be SMALL.

<u>Transportation of Radioactive Materials</u>

Operations of the proposed GLE Facility would require the shipment of various radioactive materials to and from the facility:

- natural UF_6 (i.e., not enriched) feed to the facility
- enriched UF_6 product from the facility to a fuel fabrication facility
- depleted UF_6 to a conversion facility
- return of empty feed cylinders with residual contamination
- LLRW for disposal

All shipments are anticipated to occur via heavy-haul tractor trailer combination trucks.

A number of these shipments may have multiple origins or destinations. UF_6 feed may be obtained from a U.S. facility (Honeywell International, Metropolis, Illinois), a Canadian source (Cameco, Port Hope, Ontario, Canada) or overseas sources arriving at U.S. seaports

(Portsmouth Marine Terminal [PMT], Portsmouth, Virginia; Dundalk Marine Terminal [DMT], Baltimore, Maryland). UF_6 product may be used at the Wilmington Site or sent to other fuel fabrication facilities in Columbia, South Carolina (Westinghouse Electric), and Richland, Washington (AREVA NP). The depleted UF_6 tails could be sent to facilities in either Paducah, Kentucky or Portsmouth, Ohio; both facilities are currently under construction for conversion of depleted UF_6 to uranium oxide for disposal. In the case of the LLRW generated at the proposed GLE Facility, only one destination is planned, the EnergySolutions disposal facility in Clive, Utah. Single-shipment and annual impacts are evaluated for all potential shipment routes. Annual impacts are assumed based on all shipments of one material type over the same route (e.g., all depleted UF_6 tails going to Paducah, Kentucky, or all going to Portsmouth, Ohio).

This assessment is based on the transportation assessment presented in the NRC's NUREG-0170 report (NRC, 1977). Since that assessment was conducted, computer models and basic assumptions have been refined, but the overall approach to estimating transportation impacts has remained the same. The technical approach for estimating transportation risks involves use of several computer models and databases. For assessment of normal transport, risks were calculated for the collective populations of all potentially exposed individuals, as well as for a maximally exposed individual (MEI)[16] receptor. Potentially exposed populations include those persons living and working along the transport route, those present at vehicle stops, and those on the road near the shipment. The accident assessment included consideration of the probabilities and consequences of a range of possible transportation-related accidents, including low-probability accidents that have high consequences and high-probability accidents that have low consequences. The details of the transportation analysis are provided in Appendix D.

For all shipments, risks were estimated for truck transport for both normal (incident-free) and accident conditions. In both cases, "vehicle-related" and "cargo-related" impacts were evaluated.

Vehicle-related risks result simply from moving any material from one location to another, independent of the characteristics of the cargo. For example, increased levels of pollution from vehicular emissions during normal conditions may affect human health. Similarly, accidents during transportation may cause fatalities from physical trauma.

Cargo-related risk, on the other hand, refers to risk attributable to the characteristics of the cargo being shipped. The radiological cargo-related risks from the transportation of uranium feed and product materials, depleted uranium tails, empty cylinders with residual heels, and LLRW would be caused by exposure to ionizing radiation. Exposures to radiation occur during both normal transportation and during accident conditions. In the case of the uranium materials considered, cargo-related risks also include chemical hazards during accident conditions.

The risks from exposure to hazardous chemicals during transportation-related accidents, which include consideration of the formation of HF from the reaction of UF_6 with moisture in the air for this assessment, can be either acute (result in immediate injury or fatality) or latent (result in cancer that would present itself after a latency period of several years). However, none of the chemicals that might be released in any of the transportation accidents involving UF_6 is

[16] A maximally exposed individual (MEI) is an individual that may be expected to receive the highest potential radiological dose for a given scenario.

carcinogenic. As a result, no excess chemically induced latent cancers would be expected from accidental chemical releases. The acute health end point – potential irreversible adverse effects – was considered for the assessment of cargo-related population impacts from transportation accidents.

Routine Transportation

Radiological risks during routine transportation would result from the potential exposure of people to low levels of external radiation near a loaded shipment. U.S. Department of Transportation (DOT) and NRC regulations – 49 CFR 73.441 (Radiation Level Limitations) and 10 CFR 1.47 (External Radiation Standards for All Packages) – were set to maintain these external radiation levels at a value considered to be protective of the public. The maximum allowable external dose rate is 0.1 millisievert per hour (10 millirem per hour) at 2 meters (6.5 feet) from the outer lateral sides of the transport vehicle. In this analysis, the external dose rates range from approximately 0.0015 millisievert per hour (0.15 millirem per hour to 0.02 millisievert per hour (2.0 millirem per hour) as shown in Table 4-11, depending on the shipment type. Since the regulatory maximum is approximately 0.14 millisievert per hour (14 millirem per hour) at a distance of 1 meter (3.3 feet), the external dose rates from the GLE Facility shipments are expected to be approximately 20 percent or less than the regulatory maximum.

Single-shipment radiological impacts are presented in Table 4-12 for transportation of the UF_6 feed material, the enriched uranium, the depleted UF_6 tails, empty cylinders, and LLRW. Impacts on an annual basis are presented in Table 4-13 for all shipment types. The most conservative annual impacts can be estimated if the shipment option for each type of shipment with the greatest impacts are selected (i.e., UF_6 feed material from Cameco in Port Hope, Ontario; enriched uranium sent to AREVA in Richland, Washington; depleted UF_6 tails sent to the Paducah conversion facility; empty cylinders sent to Honeywell; and LLRW sent to EnergySolutions).

In the most conservative case, combined total doses of 11 person-rem and 6.0 person-rem were estimated for the public and the transportation crews, respectively, from all shipments on an annual basis. The resulting expected latent cancer fatalities (LCFs) are 0.007 and 0.004, respectively (see Table 4-13). These impacts on the public would be SMALL because the

Table 4-11 Estimated External Dose Rates for Radioactive Material Shipments

Material	Shipment Configuration	Shipment External Dose Rate at 1 m (mrem/hr)
UF_6 feed	1-48Y cylinder	0.29
UF_6 product	5-30B cylinders	0.95
Depleted UF_6 tails	1-48Y cylinder	0.28
Empty cylinders	2-48Y cylinders with residual heels	2.0
LLRW	36-4 × 4 × 4 feet waste boxes	0.15

Sources: GLE, 2008; GLE, 2009b.

Table 4-12 Estimated Collective Population Proposed GLE Facility Single Shipment Transportation Risks

Shipment	Total Distance (km)	Cargo-Related[a] Radiological Impacts: Dose Risk (person-rem)[b]: Routine Crew	Routine Public: Off-Link	Routine Public: On-Link	Routine Public: Stops	Routine Public: Total	Accident[e]	Latent Cancer Fatalities[d]: Crew	Latent Cancer Fatalities[d]: Public	Vehicle-Related Impacts[c]: Latent Emission Fatalities	Vehicle-Related Impacts[c]: Physical Accident Fatalities
UF_6 feed coming from:											
Portsmouth Marine Terminal	463	8.3×10^{-4}	2.2×10^{-5}	8.5×10^{-5}	7.3×10^{-4}	8.3×10^{-4}	1.9×10^{-6}	5×10^{-7}	5×10^{-7}	3×10^{-5}	7.1×10^{-6}
Dundalk Marine Terminal	754	1.3×10^{-3}	6.2×10^{-5}	1.7×10^{-4}	1.1×10^{-3}	1.4×10^{-3}	7.6×10^{-6}	8×10^{-7}	2×10^{-7}	1×10^{-4}	1.1×10^{-5}
Honeywell International	1314	2.4×10^{-3}	9.8×10^{-5}	2.6×10^{-4}	2.1×10^{-3}	2.4×10^{-3}	5.8×10^{-6}	1×10^{-6}	1×10^{-6}	1×10^{-4}	1.7×10^{-5}
Cameco	1397	2.5×10^{-3}	1.1×10^{-4}	3.0×10^{-4}	2.2×10^{-3}	2.6×10^{-3}	1.2×10^{-5}	2×10^{-6}	2×10^{-6}	2×10^{-4}	1.9×10^{-5}
UF_6 product going to:											
Westinghouse Electric	479	2.1×10^{-3}	2.5×10^{-4}	8.9×10^{-4}	7.3×10^{-3}	8.5×10^{-3}	6.6×10^{-6}	1×10^{-6}	5×10^{-6}	3×10^{-5}	9.3×10^{-6}
AREVA NP	4786	2.1×10^{-2}	2.0×10^{-3}	8.7×10^{-3}	7.5E $\times 10^{-2}$	8.6×10^{-2}	9.6×10^{-6}	1×10^{-5}	5×10^{-5}	3×10^{-4}	5.0×10^{-5}
Depleted UF_6 tails going to:											
Paducah conversion facility	1219	2.1×10^{-3}	8.4×10^{-5}	2.3×10^{-4}	1.8×10^{-3}	2.1×10^{-3}	5.0×10^{-6}	1×10^{-6}	1×10^{-6}	1×10^{-4}	1.6×10^{-5}
Portsmouth conversion facility	989	1.7×10^{-3}	7.5×10^{-5}	1.9×10^{-4}	1.5×10^{-3}	1.8×10^{-3}	4.9×10^{-6}	1×10^{-6}	1×10^{-6}	1×10^{-4}	1.5×10^{-5}
Empty 48Y cylinder return to:											
Honeywell International	1314	1.6E $\times 10^{-2}$	1.4×10^{-3}	3.6×10^{-3}	2.9×10^{-2}	3.4×10^{-2}	2.1×10^{-8}	1×10^{-5}	2×10^{-5}	1×10^{-4}	1.7×10^{-5}
LLRW going to:											
EnergySolutions	3947	6.9×10^{-3}	3.4×10^{-4}	1.4×10^{-3}	1.2×10^{-2}	1.3×10^{-2}	5.0×10^{-8}	4×10^{-6}	8×10^{-6}	3×10^{-4}	4.2×10^{-5}

[a] Cargo-related impacts are impacts attributable to the radioactive nature of the material being transported.
[b] To convert person-rems to person-sieverts, divide by 100.
[c] Vehicle-related impacts are impacts independent of the cargo in the shipment.
[d] Latent cancer fatalities were calculated by multiplying the dose by the FGR 13 health risk conversion factors of 6×10^{-4} fatal cancers per person-rem.
[e] Dose risk is a societal risk and is the product of accident probability and accident consequence.

Table 4-13 Estimated Annual Collective Population Proposed GLE Facility Transportation Risks

Shipment	Total Distance (km)	Cargo-Related[a] Radiological Impacts								Vehicle-Related Impacts[c]	
		Dose Risk (person-rem)[b]						Latent Cancer Fatalities[d]			
			Routine Public								
		Routine Crew[e]	Off-Link[f]	On-Link[g]	Stops[h]	Total	Accident[i]	Crew	Public	Latent Emission Fatalities	Physical Accident Fatalities
UF_6 feed coming from:											
Portsmouth Marine Terminal	416,707	7.5×10^{-1}	2.0×10^{-2}	7.6×10^{-2}	6.5×10^{-1}	7.5×10^{-1}	1.7×10^{-3}	4×10^{-4}	5×10^{-4}	3×10^{-2}	6.4×10^{-3}
Dundalk Marine Terminal	679,014	1.2	5.6×10^{-2}	1.5×10^{-1}	1.0	1.2	6.8×10^{-3}	7×10^{-4}	2×10^{-4}	1×10^{-1}	9.5×10^{-3}
Honeywell International	1,182,482	2.1	8.8×10^{-2}	2.3×10^{-1}	1.9	2.2	5.2×10^{-3}	1×10^{-3}	1×10^{-3}	1×10^{-1}	1.5×10^{-2}
Cameco	1,257,364	2.3	9.8×10^{-2}	2.7×10^{-1}	2.0	2.3	1.1×10^{-2}	1×10^{-3}	1×10^{-3}	2×10^{-1}	1.7×10^{-2}
UF_6 product going to:											
Westinghouse Electric	23,971	1.0×10^{-1}	1.2×10^{-2}	4.5×10^{-2}	3.7×10^{-1}	4.2×10^{-1}	3.3×10^{-4}	6×10^{-5}	3×10^{-4}	2×10^{-3}	4.6×10^{-4}
AREVA NP	239,277	1.0	1.0×10^{-1}	4.4×10^{-1}	3.8	4.3	4.8×10^{-4}	6×10^{-4}	3×10^{-3}	2×10^{-2}	2.5×10^{-3}
Depleted UF_6 tails going to:											
Paducah conversion facility	975,262	1.7	6.7×10^{-2}	1.8×10^{-1}	1.4	1.7	4.0×10^{-3}	1×10^{-3}	1×10^{-3}	1×10^{-1}	1.2×10^{-2}
Portsmouth conversion facility	791,411	1.4	6.0×10^{-2}	1.5×10^{-1}	1.2	1.4	3.9×10^{-3}	8×10^{-4}	8×10^{-4}	1×10^{-1}	1.2×10^{-2}
Empty 48Y cylinder return to:											
Honeywell International	65,693	8.1×10^{-1}	6.9×10^{-2}	1.8×10^{-1}	1.4	1.7	1.0×10^{-6}	5×10^{-4}	1×10^{-3}	7×10^{-3}	8.4×10^{-4}
LLRW going to:											
EnergySolutions	142,095	2.5×10^{-1}	1.2×10^{-2}	5.0×10^{-2}	4.2×10^{-1}	4.8×10^{-1}	1.8×10^{-6}	1×10^{-4}	3×10^{-4}	1×10^{-2}	1.5×10^{-3}

[a] Cargo-related impacts are impacts attributable to the radioactive nature of the material being transported.
[b] To convert person-rems to person-sieverts, divide by 100.
[c] Vehicle-related impacts are impacts independent of the cargo in the shipment.
[d] Latent cancer fatalities were calculated by multiplying the dose by the FGR 13 health risk conversion factors of 6×10^{-4} fatal cancers per person-rem.
[e] Collective doses were calculated for truck transportation crew members involved in the actual shipment of material. Workers involved in loading or unloading were not considered.
[f] Dose to persons living or working within 0.8 kilometer (0.5 mile) of each side of a transportation route.
[g] Dose to persons in all vehicles sharing the transportation route. This group includes persons traveling in the same or opposite directions as the shipment, as well as persons in vehicles passing the shipment.
[h] Dose to persons who might be exposed while a shipment was stopped en route. For truck transportation, these stops include those for refueling, food, and rest.
[i] Dose risk is a societal risk and is the product of accident probability and accident consequence.

exposure would be spread out among all people along the transportation routes. For example, 50 annual shipments of the empty cylinders with tails to the Honeywell facility resulted in an estimated dose of 1.7 person-rem to 367,776 persons along the route, for an average individual dose of 0.0046 millirem. Thus, an average member of the public would receive only 0.002 percent or less of the value for exposure to natural background radiation in one year.

For an MEI member of the public (defined as being located 30 meters [98 feet] away from a shipment passing at a speed of 24 kilometers per hour [15 miles per hour] [NRC, 1977]), the greatest radiological risk would be from the empty cylinders with heels shipments, as shown in Table 4-14. The remaining heels in the cylinders contain a concentration of residual daughter radionuclides that pose a greater external radiation hazard than present in full UF_6 cylinders. In this case, a risk of 8×10^{-7} (a chance of less than 1 in 1.3 million) of contracting a fatal cancer is estimated and is 0.00004 percent of the value for an annual exposure to natural background radiation. However, the value for potential exposure to multiple shipments would be correspondingly higher. For example, if the same maximally exposed member of the public were present for three shipments of depleted UF_6, that individual would receive a dose of approximately 2.6×10^{-5} millirem.

For transportation crew members, the largest estimated single shipment dose to one transportation crew member would be 11 millirem for shipments of the enriched product from the proposed GLE Facility to the AREVA facility in Richland, Washington. In this case, the risk of contracting a fatal cancer is 1 in 160,000. The transportation crew member dose of 11 millirem is about 10 times lower than the estimated dose of 1.02 millisievert (102 millirem) if the dose rate in any normally occupied space in the vehicle was at the regulatory limit of 0.02 millisievert per hour (2 millirem per hour) [10 CFR 71.47(b)(4)].

No latent fatalities were estimated from vehicle emissions on an annual basis (risk < 0.5). In addition, the proposed action annual truck travel on U.S. highways for the most conservative case, 2,700,000 kilometers (1,700,000 miles) as shown in Table 4-13, is only 0.0012 percent of similar truck travel on an annual basis in the United States, 229,600,000,000 kilometers

Table 4-14 Maximally Exposed Individual Routine Dose from Radioactive Material Shipments[a]

Material	Single Shipment Exposure (mrem)[b]
UF_6 feed	9.1×10^{-6}
UF_6 product	9.2×10^{-5}
Depleted UF_6 tails	8.8×10^{-6}
Empty cylinders	1.3×10^{-4}
LLRW	1.7×10^{-5}

[a] Individual is located 30 m from the passing shipment. Shipment is traveling at 24 km/hr.
[b] To convert millirems to millisieverts, divide by 100.

(142,706,000,000 miles) (BTS, 2009). Thus, impacts on the public from vehicle emissions are considered to be SMALL.

Accident Impacts

Overall annual transportation accident impacts from the proposed action are considered to be SMALL. The total annual radiological collective population accident dose risk to the public from all shipments for the most conservative case was estimated to be 1.6×10^{-2} person-rem. The resulting estimated LCFs are 1×10^{-5} annually. These impacts on the public would be SMALL because the exposure would be spread out among all people along the transportation routes. For example, 50 annual shipments of the empty cylinders with tails to the Honeywell facility resulted in an estimated accident dose risk of 1×10^{-6} person-rem to 367,776 persons along the route, for an average individual dose of 2.7×10^{-9} millirem. Thus, an average member of the public would receive a negligible percentage of the value for exposure to natural background radiation in one year.

Chemical impacts would be negligible; past analyses of depleted UF_6 shipments have shown that the estimates of irreversible adverse effects to be approximately 1 to 3 orders of magnitude lower than the estimates of public LCFs from radiological accident exposure (DOE, 2004a and 2004b; NRC, 2005a). In addition, only one percent or less of those persons experiencing irreversible adverse effects due to exposure to HF or uranium compounds actually results in fatality (Policastro, 1997).

Total fatalities from direct physical trauma as a result of accidents were estimated to be 0.034 per year. Thus, no fatalities are expected from accidents on an annual basis.

4.2.10.3 Mitigation Measures

The major impact identified in Sections 4.2.10.1 and 4.2.10.2 was related to traffic congestion near the Wilmington Site entrance, primarily as a result of commuting construction and operations workers. Measures identified by GLE that would lessen such impacts include (GLE, 2008):

- Locate the proposed facility near an interstate highway interchange to facilitate employee commuter traffic and minimize the distance that truck traffic must travel on local surface streets. Selecting the Wilmington Site for the proposed action achieves this measure because of its proximity to I-140 on Castle Hayne Road.

- Increase the number of entry gates to the Wilmington Site from NC 133, including one dedicated to workers. The design for the Wilmington Site achieves this measure through the addition of a new, separate entrance dedicated to traffic destined for the proposed GLE Facility, thereby distributing the traffic load and reducing the impact on a single point of entry and exit.

- Implement roadway improvements such as deceleration lanes, turn lanes, and traffic control devices (e.g., traffic lights) to NC 133 as required by the North Carolina Department of Transportation (NCDOT) for issuance of a driveway permit for connecting the new entrance.

- Work with the NCDOT to evaluate driveway- and roadway-improvement options to minimize impacts (and help regulate traffic flow in an orderly manner).

- Schedule/stagger worker shift changes for off-peak traffic periods, including those from shift changes for existing Wilmington Site facilities and other planned operations.

- Route truck shipments of radioactive materials around cities by using a U.S. Interstate Highway Systems bypass or beltway (when available).

- Schedule truck deliveries and shipments for off-peak traffic periods to reduce potential congestion on local roadways during peak worker commuting periods.

- Encourage carpooling for construction and operations workers.

4.2.11 Public and Occupational Health Impacts from Normal Operations

This section presents the environmental impacts on the surrounding public and on workers at the proposed GLE Facility from preconstruction activities, construction, and operation of the proposed facility for both radiological and non-radiological (i.e., hazardous chemical) exposures. For members of the public, this draft EIS considered the affected population within an 80-kilometer (50-mile) radius of the proposed GLE Facility, with the primary exposure pathway being from gaseous effluents. Workers at the proposed GLE Facility could similarly be exposed to airborne or gaseous releases in addition to direct chemical and radiation exposures from handling UF_6 cylinders, working near enrichment process equipment, or decontaminating cylinders and equipment. The analysis presented in this section is based on the assumptions that preconstruction and construction activities would start in 2011 and would continue until 2017, operations would start in 2013, and there would be about four years of overlap between construction and operations of the proposed GLE Facility. NRC staff now expects that a licensing decision will be made in 2012 and that construction would begin at that time, but that the dates for initiation of preconstruction activities (2011), initial operations (2013), and full operations (2017) would remain unchanged. These schedule changes are not expected to affect the analysis of public and occupational health from normal operations.

4.2.11.1 Preconstruction and Construction Activities

This section evaluates the potential for occupational injuries and illnesses associated with the proposed preconstruction and construction activities. It also evaluates the potential public and occupational health impacts from non-radiological and radiological releases during preconstruction and construction activities.

<u>Occupational Injuries and Illnesses</u>

The proposed action involves a major construction activity with the potential for industrial accidents related to construction vehicle accidents, material-handling accidents, and trips and falls. Resultant injuries could range from minor temporary injuries to long-term injuries and/or disabilities to fatalities. The proposed activities are not anticipated to be any more hazardous than those for a typical large industrial construction or demolition project.

Non-radiological impacts associated with preconstruction and construction activities were estimated using annual injury and illness data for heavy construction compiled by the U.S. Department of Labor, Bureau of Labor Statistics (BLS). This bureau compiles statistics by the North American Industry Classification System, which replaced Standard Industrial Classification Codes in 2002. Preconstruction and construction activities for the proposed GLE Facility are classified under North American Industry Classification System Code 237, *Other Heavy and Civil Engineering Construction*. The most recent data available for incident rates for total recordable cases and lost workday cases, in units of incidents per 100 full-time equivalents, were obtained from the BLS publication "Table 1, Incident Rates of Nonfatal Occupational Injuries and Illnesses by Industry and Case Types 2007" (DOL, 2008a). The most recent data available for fatality incident rates for construction (North American Industry Classification System Code 237) for calendar year 2007, in units of incidents per 100,000 full-time equivalents, were obtained from BLS publication "Table 2, Fatal occupational injuries by industry and selected event or exposure, 2007" (DOL, 2008b). The number of construction workers per year (full-time equivalents) and the duration of preconstruction and construction activities were obtained from the ER prepared to support the proposed action (GLE, 2008). The incident rates for total recordable cases, lost workday cases, and fatalities were applied to the projected number of construction worker-years for the seven-year project to estimate the total number of incidents. The incident rates, total full-time equivalents, and total incidents are summarized in Table 4-15.

Table 4-15 provides estimates of 95 lost work incidents of illness and injury to construction workers and less than one fatality over the approximately seven-year schedule. These totals include preconstruction impacts that are not part of the proposed action. Based on these estimates, impacts on occupational safety from preconstruction and construction activities would be SMALL. Assuming that preconstruction activities would be completed in the first year, about 15 percent of these impacts, as well as those for non-radiological and radiological exposures discussed below, would occur during preconstruction activities. In estimating the impact from preconstruction activities, it is assumed that 290 full-time equivalents (FTEs) (GLE, 2008) would be involved compared to 1938 FTEs involved in total construction activities.

Non-Radiological Impacts

Occupational exposures during preconstruction and construction activities would include exposure of construction workers to airborne fugitive dusts generated from vehicle traffic and heavy equipment use, exposure to pollutants emitted from diesel and gasoline powered equipment (e.g., carbon monoxide, nitrogen oxides, sulfur oxides, and particulate matter), and exposure to vapors from any fuels, paints, or solvents used during construction. Any such exposures would be expected to be minor and would be minimized using work practices and personal protective equipment specified in a construction health and safety plan. Construction activities would be subject to OHSA construction regulations (29 CFR Part 1926, *Safety and Health Regulations for Construction*). Such exposures would be typical of construction projects of industrial facilities. Worker exposure to low-level background emissions of uranium and HF from the existing FMO plant and from the proposed GLE Facility during the overlap period of its construction and early operation is discussed under cumulative impacts in Section 4.3.8 and under facility operations in Section 4.2.11.2. As noted in these sections, such exposures would be minor.

Table 4-15 Health and Safety Statistics for Estimating Industrial Safety Impacts Common to the Workplace and Total Incidents for Preconstruction and Construction Activities

FTE		Total Recordable Cases		Lost Workday Cases		Fatalities	
Average FTEs per year	Total FTEs[a]	Incidents per 100 FTEs[b]	Total Recordable Cases	Incidents per 100 FTEs[b]	Lost Workday Cases	Incidents per 1,000,000 FTEs[c]	Total Fatalities
277	1938	4.9	95	2.6	50	216	0.42

[a] FTEs (full-time equivalents) (GLE, 2008).
[b] Source: DOL, 2008a.
[c] Source: DOL, 2008b.

The estimated levels of air pollutants emitted during road construction, land clearing, and building construction activities are presented in Section 4.2.4. As indicated there, impacts on air quality during these preconstruction and construction activities would be SMALL. Preconstruction and construction activities are not expected to cause any exceedances of ambient air quality criteria, with the possible exception of minor exceedances of short-term criteria for particulate matter ($PM_{2.5}$ and PM_{10}) from fugitive dust emissions. Worker exposures would be limited through the use of dust masks or respirators, as appropriate.

Impacts on surface water and groundwater during preconstruction and construction activities have also been analyzed in this draft EIS in Sections 4.2.6 and 4.2.7, respectively. These analyses showed that surface water impacts would be minimized during these activities though the use of BMPs and engineering controls (see Section 4.2.5.3). Releases to surface water streams would be governed under an NPDES permit. Temporary increases in sedimentation and turbidity in streams may occur from stormwater runoff from soils disturbed by construction activities. As for surface waters, impacts on groundwater would be prevented using best practices and engineering controls to prevent or contain any spills of hazardous materials, including fuels for vehicles and equipment.

Radiological Impacts

Radiological impacts during preconstruction and construction activities would be received primarily by the construction workers. Exposures to the offsite public would not be expected due to the distance from construction emission sources. Construction workers would not be monitored for radiation exposure by the onsite radiation exposure control program. Thus, the applicable dose limits for the construction workers would be as for the general public listed in 10 CFR 20.1301(a)(1) (i.e., 0.1 sievert per year [100 millirem per year]).

Preconstruction and construction activities would not generate any radiological contamination, but they could disturb areas previously contaminated due to deposition of contaminated particulates on soil from air effluent releases of past FMO facility operations as well as to the current air emission from FMO facility operations. Preconstruction and construction workers would also be exposed to emissions from the proposed GLE Facility during the overlap period of construction and early operation.

The primary exposure pathways for construction personnel would be: (1) inhalation of contaminated dust resuspended by construction activities in contaminated soils; (2) inhalation of air effluent releases from FMO operations; (3) inhalation of air effluent releases from the proposed GLE operations after 2013; (4) external exposure from previously contaminated ground; and (5) external exposure from onsite sources, such as the cylinder storage yards. The construction workers were not assumed to consume food grown at the Wilmington Site or consume water impacted by site contamination. Therefore, potential exposure from ingestion of food and drinking water was not included. The external exposure from the air submersion pathway was also ignored, as it would be small compared to direct external exposure.

For calculating the doses to workers from the various existing soil contamination, the RESRAD code Version 6.5 (Yu et al., 2001) was used in conjunction with contamination data from site environmental reports (GNF-A, 2007) and the environmental assessment for the license renewal for the Global Nuclear Fuels-Americas (GNF-A) (FMO) facility (NRC, 2009c). A description of the modeling approach in RESRAD code for this analysis is provided in Appendix C. The CAP88-PC computer code was used in estimating the internal dose from FMO and GLE air emissions (see Section 4.2.11.2). For estimating the external dose from the cylinder storage yard, the RESRAD-BUILD code Version 3.5 (Yu et al., 2003) was used. A description of the modeling approach in RESRAD-BUILD code and the CAP88-PC code's modeling approach for this analysis are also provided in Appendix C.

The maximum estimated dose for each of the exposure pathways was calculated for an annual exposure period. These estimated doses are:

- internal dose from inhalation of resuspended contaminated soil: $<6 \times 10^{-5}$ millisievert per year (6×10^{-3} millirem per year)

- external dose from contaminated soil: $<3.2 \times 10^{-4}$ millisievert per year (3.2×10^{-2} millirem per year)

- internal dose from inhalation of air emissions from FMO operations: $<2.8 \times 10^{-5}$ millisievert per year (2.8×10^{-3} millirem per year)

- internal dose from inhalation of air emissions from the proposed GLE operations: $<3.2 \times 10^{-7}$ millisievert per year (3.2×10^{-5} millirem per year) (Section 4.2.11.2)

- external dose from the existing site sources: $<1.05 \times 10^{-1}$ millisievert per year (10.5 millirem per year)

The total maximum possible dose before and after the start of GLE operations is $<1.05 \times 10^{-1}$ millisievert per year (10.5 millirem per year). The dose is dominated by the external dose received from existing site sources.

The maximum dose to construction workers of 1.05×10^{-1} millisievert (10.5 millirem) is a very small fraction of background radiation exposure in the United States, which averages approximately 3.1 millisieverts per year (311 millirem per year) (Section 3.11.1). The estimated maximum yearly dose applies to workers in both the preconstruction and construction phases.

The total maximum possible dose to construction workers from all pathways is less than the limit of 1 millisievert per year (100 millirem per year) in 10 CFR 20.1301(a)(1), even for estimates combining the most conservative analytical assumptions. This is a negligible dose, representing a lifetime excess cancer risk of less than 5×10^{-6} (less than a 5 in 1,000,000 chance of getting cancer) when using a risk coefficient of 5×10^{-2} risk per sievert (5×10^{-4} risk per rem) (ICRP, 1991). Based on this assessment, the impact on workers from radiological exposure during preconstruction and construction is SMALL.

The dose to the offsite public will be significantly smaller than that for construction workers, as they will not have any potential for measurable exposure from the existing site contamination. The impact on the offsite public from preconstruction and construction is therefore SMALL.

4.2.11.2 Facility Operations

This section evaluates potential occupational injuries and illnesses, as well as public and occupational health impacts associated with non-radiological and radiological releases, from operation of the proposed GLE Facility.

Occupational Injuries and Illnesses

The estimated rates and numbers of injuries to workers during operation of the proposed GLE Facility were determined from Bureau of Labor Statistics tables of rates and from numbers of expected workers in the same manner as for preconstruction and construction. For these estimates, operation of the proposed GLE Facility is classified under North American Industry Classification System Code 325, *Chemical Manufacturing*. The most recent data available for incident rates for total recordable cases and lost workday cases, in units of incidents per 100 full-time equivalents, for North American Industry Classification System Code 325 were obtained from the BLS publication “Table 1, Incident Rates of Nonfatal Occupational Injuries and Illnesses by Industry and Case Types 2007” (DOL, 2008a). The most recent data available for fatality incident rates for *Manufacturing* (North American Industry Classification System Code 325) for calendar year 2007, in units of incidents per 100,000 FTEs, were obtained from the BLS publication “Table 2, Fatal Occupational Injuries by Industry and Selected Event or Exposure, 2007” (DOL, 2008b).

Incident rates for total recordable cases, lost workday cases, and fatalities were applied to the projected annual number of workers (GLE, 2008) over the years of the projected operation schedule to estimate the total number of incidents. The estimated total incidents of each type are presented in Table 4-16. For the first six years of operations, 550 workers would be required, and 350 workers would be required thereafter. A total of 14,500 FTEs were computed from a projected 38 years of operations.[17]

[17] The assumption that the proposed GLE Facility would operate for 38 years, if a license is granted, is based the assumption that operations would begin in 2013 and continue until 2050, with license termination occurring in 2051. As discussed in Section 4.2, the NRC staff still expects operations to begin in 2013, but a license, if issued, would be issued in 2012 and terminate in 2052. Thus, a slightly longer operational period may result in a slight difference in the total projected full-time equivalent employment during operations. This slight change is not expected to affect any of the impacts conclusions.

Table 4-16 Health and Safety Statistics for Estimating Industrial Safety Impacts Common to the Workplace and Total Incidents for Facility Operations

FTE		Total Recordable Cases		Lost Workday Cases		Fatalities	
FTEs per Year	Total FTEs[a]	Incidents per 100 FTEs[b]	Total Recordable Cases	Incidents per 100 FTEs[b]	Lost Workday Cases	Incidents per 100,000 FTEs[c]	Fatalities
550	14,500	3.1	450	1.7	247	2.8	0.41

[a] Full-time equivalents (FTEs) (GLE, 2008).
[b] Source: DOL, 2008a.
[c] Source: DOL, 2008b.

A total of 450 total recordable incidents and 247 lost workday incidents are projected for 38 years of operation of the proposed GLE Facility. Over the same period, less than one fatal injury is projected. According to the small number of projected non-fatal and fatal incidents, impacts on occupational health and safety during facility operations are expected to be SMALL.

Routine Non-Radiological Impacts

Since the proposed GLE Facility would be based on a new, laser-based, technology, no historical data are available on workplace concentrations of toxic chemicals of concern, UF_6 and HF. However, it is expected that the greatest potential for occupational exposures inside the GLE process building could be due to connecting and disconnecting of the UF_6 cylinders during operations and repair activities, which are the processes that produce the highest potential emissions of UF_6 at existing uranium enrichment facilities employing centrifuge technologies (GLE, 2008). GE-Hitachi experience in UF_6 cylinder handling at its FMO facility would be useful in limiting exposures. Any released UF_6 would react with ambient moisture to form HF and uranyl fluoride (UO_2F_2). Airborne concentrations of HF and UO_2F_2 inside facilities are expected to be insignificant with respect to general worker exposure. Workers would use ventilation equipment in the immediate vicinity of cylinder handling or similar operations with potential UF_6 releases to minimize exposures. An analysis performed for the proposed American Centrifuge Plant (ACP) in Piketon, Ohio, found that workplace HF concentrations from these operations would be, on average, less than one percent of the Occupational Safety and Health Administration's Permissible Exposure Limit of 2.5 milligrams per cubic meter of air over an 8-hour averaging time. The Piketon facility is assumed to be an appropriate model for such exposures at the proposed GLE Facility, as exposures would most likely occur during the same kind of operations associated with the connecting and disconnecting of cylinders to and from process lines. Concentrations in the immediate vicinity of the release point could be briefly as high as 10 percent of the limit and would be limited by ventilation equipment. The corresponding analysis for UF_6 at ACP found that maximum expected levels of 0.7 milligrams per cubic meter would be well below the relevant workplace one-hour standard of 10 milligrams per cubic meter of uranium (NRC, 2006). Based on this analysis, the impacts associated with routine occupational exposures to HF and UF_6 in the workplace should be SMALL.

Large volumes of UF_6 would be present at the proposed GLE Facility as feed material and product material as a consequence of the primary function of the facility – uranium enrichment. This material, which is solid at ambient temperatures, would be stored in appropriate steel canisters in the feed storage and product storage areas. There would be no routine exposures to solid UF_6.

Worker health and safety would be the focus of the GLE Nuclear Safety Program and the Industrial Safety Program administered by the Industrial Health and Safety manager at the Wilmington Site. Work practices at the proposed GLE Facility would be evaluated to assure that workers were protected through the implementation of appropriate safety measures, including the use of safety equipment and personal protective equipment (GLE, 2008). Worker exposure to industrial chemicals would be limited to safe levels though a combination of minimizing airborne releases within and outside of the proposed GLE Facility and use of appropriate protective equipment, such as fume hoods, in situations where elevated air concentrations could exist. Hazardous chemicals would be handled under written procedures administered by the Industrial Safety Program. Industrial activities would be subject to OSHA's industrial regulations (29 Part CFR Part 1910, *Occupational Safety and Health Standards*), as well as site licenses and permits (GLE, 2008).

Because of the controls on chemical exposures that would be in place under an ongoing chemical safety program, non-radiological impacts on workers from routine operation of the proposed GLE Facility are expected to be SMALL.

The proposed GLE Facility would use banks of lasers to effect the enrichment of uranium. Thus, potential worker exposure to laser light would be a safety concern. Injuries to the eye would be the primary concern. Lasers would normally be operated within enclosures, while lasers would be equipped with interlocks to prevent inadvertent exposures from opening of enclosures. To ensure that protections are in place and to prevent any accidental exposures, a formal laser safety program would be implemented at the facility, headed by a Laser Safety Officer and employing a written laser safety protocol. The program would require laser safety training for all personnel working with or around laser equipment. Laser safety reviews would be conducted in advance of any maintenance, repair, or non-routine activity where exposures are possible. At the State level, laser safety would be overseen by the North Carolina Department of Labor, Division of Occupational Safety and Health. Applicable regulations relevant to laser safety would include Federal standards for ionizing and non-ionizing radiation, General Industrial Regulations for eye and face protection under 29 CFR 1910.132, and laser exposure limits under American National Standards Institute standard ANSI Z136.1. North Carolina Department of Environmental Health General Industry Standards (under 13 N.C. Admin Code 07F) would apply as well. With laser protections in place, laser impacts on worker health would be SMALL.

With respect to public health impacts, non-radiological releases from operation of the proposed GLE Facility to surface water and groundwater, including liquid waste effluents from decontamination, cleaning, and laboratory processes and from cooling tower blowdown, should be small and should not degrade existing water quality (Sections 4.2.6.2 and 4.2.7.2). Therefore, the public health impacts associated with such liquid releases would also be SMALL.

Potential long-term, low-level HF and uranium exposure to members of the public would be the primary offsite chemical exposures of concern. Public health impacts from such exposures are expected to be SMALL, however. The building housing the enrichment process would be operated under negative pressure. Any leaks, therefore, would exit the building only through the ventilation system, which would be equipped with a HEPA filter to remove particulate matter and with carbon beds to remove gaseous contaminants (GLE, 2008). Only minor quantities of UF_6 or HF would thus escape the system, as dictated by the efficiency of the filter devices.

As discussed in Section 4.2.4.2, carbon beds are expected to remove ≥99 percent of the HF in the gas vented through the operations building stack. The specific quantity of HF that would pass through the emissions control devices is not known at this time, but should be below levels established in a required air permit for the proposed GLE Facility and protective of public health (i.e., the facility would be assumed to meet its air permit requirements). Absent such estimates, onsite and offsite exposures were estimated using estimates for the National Enrichment Facility (NEF), a three million separative work unit (SWU) gas-centrifuge plant proposed to be built in New Mexico (NRC, 2005b). Most HF emissions would be expected to occur in feed and product ends of the operations at both types of plants, so similar emission levels would be expected for a given amount of UF_6 processed. Since the proposed GLE Facility would have twice the output of this facility, twice its estimated discharge point (ventilation stack) concentration of 3.9 micrograms per cubic meter, or 7.8 micrograms per cubic meter (0.0095 parts per million), was assumed to be the concentration at the proposed GLE Facility's stack. Table 4-17 shows modeled HF concentrations at various onsite and offsite locations after dispersion. A maximum HF concentration of only 3.7×10^{-4} micrograms per cubic meter (4.5×10^{-7} parts per million) is estimated at the location of an onsite member of the public or construction worker, which is far below the OSHA chronic (8-hour) exposure level of 2.5 milligrams per cubic meter (31 parts per million), while offsite locations would be far below public exposure standards discussed in Section 3.11.2. Given that the concentrations estimated for receptor locations would be far below levels of concern, the stated assumptions should be sufficiently accurate for the purposes of the analysis.

Uranium concentrations to which receptors could be exposured are shown in Table 4-17. These concentrations were based on GLE's estimated emission rate for uranium isotopes, (GLE, 2008; Table S-2) after converting uranium activity to mass. The maximum uranium concentration is estimated to be 1.9×10^{-7} micrograms per cubic meter at the location of the onsite member of the public.

Both the estimated HF and uranium concentrations at onsite exposure locations are many orders of magnitude below safe levels established by the OSHA (2.5 milligrams per cubic meter for HF and 50 micrograms per cubic meter for uranium, each averaged over eight hours, see Section 3.11.2). Modeled UF_6 and HF levels at the site boundary and at the location of the nearest resident given in Table 4-17 are even lower than onsite levels. HF concentrations at any exposure location, moreover, are far below the most stringent State or Federal ambient air quality standards for the general public, for example, Washington's standard of 8.7 micrograms per cubic meter (0.011 parts per million) (ATSDR, 2003). Since these estimates are based on a continuous release, they represent a continuous exposure. Such chronic exposure modes are considered in the formulation of the aforementioned air quality standards.

HF emissions would be monitored in vent stacks (as fluoride) and would be limited by an air quality permit required for the operation of the proposed GLE Facility that would be issued by the NCDAQ and would be protective of public health. This permit would consider GLE emissions in combination with those from the existing FMO facility, which would be

Table 4-17 Predicted Airborne Concentrations of Uranium and Hydrogen Fluoride from Proposed GLE Facility Stack Releases at Different Receptor Locations

Location	Direction	Distance Meters[a]	Total Uranium ($\mu g/m^3$)[b]	HF[c] ($\mu g/m^3$)
Site Boundary	North	399	1.1×10^{-7}	2.2×10^{-4}
Site Boundary	North–northwest	573	5.2×10^{-8}	1.0×10^{-4}
Site Boundary	Northwest	924	2.7×10^{-8}	5.3×10^{-5}
Site Boundary	West–northwest	1493	1.5×10^{-8}	2.9×10^{-5}
Site Boundary	West	1717	2.2×10^{-8}	4.4×10^{-5}
Site Boundary	West–southwest	2302	1.8×10^{-8}	3.5×10^{-5}
Site Boundary	Southwest	1806	3.0×10^{-8}	5.8×10^{-8}
Site Boundary	South–southwest	1892	2.9×10^{-8}	5.7×10^{-5}
Site Boundary	South	1416	5.1×10^{-8}	1.0×10^{-4}
Site Boundary	South–southeast	1708	1.9×10^{-8}	3.7×10^{-5}
Site Boundary	Southeast	2664	1.1×10^{-8}	2.1×10^{-5}
Site Boundary	East-southeast	1270	1.9×10^{-8}	3.8×10^{-5}
Site Boundary	East	671	6.5×10^{-8}	1.3×10^{-4}
Site Boundary	East–northeast	427	1.1×10^{-7}	2.1×10^{-4}
Site Boundary	Northeast	353	1.5×10^{-7}	3.0×10^{-4}
Site Boundary	North–northeast	346	1.2×10^{-7}	2.4×10^{-4}
Onsite Member of the Public	South	250	1.9×10^{-7}	3.7×10^{-4}
Nearest Resident	East–southeast	1352	1.8×10^{-8}	3.6×10^{-5}

[a] To convert meters to feet multiply by 3.28.
[b] 10^6 micrograms = 1 gram.
[c] HF concentrations are based on dispersion of a release point concentration of 7.8 $\mu g/m^3$, or twice that estimated for the 3 million SWU proposed National Enrichment Facility (NRC, 2005b).

substantially higher because of the nature of the chemical processes conducted there (GLE, 2008). No criteria air pollutants (e.g., CO, NO_x, SO_2, or VOCs) would be produced by the GLE process, as discussed in Section 4.2.4.2.

Routine Radiological Impacts

This section describes the potential routine radiological impacts on members of the public and workers from the proposed GLE Facility. Appendix C documents the methodology used in evaluating and reviewing project information and also includes the site-specific data used.

Public Health Impacts

Operation of the proposed GLE Facility could result in radiation exposure to the public via intake (ingestion or inhalation) of uranium released from the facility or from direct external exposure to radiation emitted by the uranium present at the facility. The two potential pathways of concern potentially leading to public intake of uranium would be airborne releases and liquid releases. With respect to releases to air, any UF_6 gas released inside the proposed GLE Facility's operations building during operations and repair activities would be sent through a ventilation system employing a high-efficiency, multi-stage, emissions control system that incorporates HEPA filters for removal of particulate matter and activated carbon beds for gas absorption, minimizing outside releases. Liquid releases could result from decontamination, cleaning, and maintenance of failed equipment or equipment being serviced and any associated releases of radioactive liquids to surface water. However, these liquids would be treated and sampled to limit releases via a permitted outfall. Exposure of members of the public to direct external radiation could occur from emission of radiation from uranium in process lines, in cylinders in storage areas, and during handling, temporary storage, and transportation within and outside of the site. The direct radiation emitted by the uranium in the facility would be significantly absorbed by the walls of the storage cylinder, and building walls, process lines and equipment within the proposed GLE Facility. Additionally, any direct radiation would diminish with distance as it traveled over 1300 meters (0.8 miles) to reach the current nearest member of the public. Any direct radiation and skyshine (radiation reflected from the atmosphere) from uranium released to the air would be expected to be undetectable at offsite areas due to the very low concentrations of such releases.

Public Dose from Airborne Releases of Radioactive Materials

The proposed GLE Facility's operations building would release small amounts of uranium to the atmosphere during operation through a single rooftop stack. The modeling performed by NRC for this analysis evaluated the impact of these releases to offsite populations and to onsite populations that are not included in the site's radiological dose monitoring program (e.g., construction workers). Exposures in both of these groups would be subject to the 1 millisievert per year (100 millirem per year) public exposure limits in 10 CFR 20.1301(a)(1) and the 0.1 millisieverts per year (10 millirem per year) airborne dose limits in 40 CFR Part 61, Subpart H, the EPA's National Emissions Standards for Hazardous Air Pollutants (NESHAPs).

GLE laser-enrichment is a new technology and therefore, there are currently no test data to quantify the air emissions from the proposed GLE Facility. Monitoring data for the existing FMO facility vents that approximate the proposed GLE Facility's operations were used to approximate the proposed GLE Facility's emissions (GLE, 2008). Dispersion of uranium emitted at this estimated release rate was modeled from the design height of the rooftop vent of the proposed GLE Facility's main operations building. Table 4-18 shows the stack and vent characteristics, site-specific parameters, and annual release rates assumed in dose modeling. The stack could be higher (21–27 meters [69–89 feet]) as reported by GLE (GLE, 2009a), but the lower value of 15.24 meters (50 feet) (GLE, 2008) is used because it is conservative and the doses are small.

Table 4-18 Proposed GLE Facility Stack/Vent Characteristics, Site Characteristics, and Stack Releases Used in Modeling

Input Parameter	Value
Stack Diameter (m)	1.2
Stack Release Height (m)[a]	15.24
Velocity (m/s)	12.3
Temperature	Ambient
Uranium-234 Emission Rate (Ci/sec)[b]	1.25×10^{-13}
Uranium-235 Emission Rate (Ci/sec)[b]	4.88×10^{-15}
Uranium-236 Emission Rate (Ci/sec)[b]	5.49×10^{-17}
Uranium-238 Emission Rate (Ci/sec)[b]	1.77×10^{-14}
Ambient Temperature (°C)	17.7
Annual Precipitation (cm)	144.96

[a] Stack could be higher (21–27 meters [69–89 feet]) as reported by GLE in June 2009 (GLE, 2009a), but the lower value (GLE, 2008) is used because it is conservative and the doses are small.
[b] Emission rates are converted to Ci/yr by multiplying 3.15×10^7 sec/yr conversion factor for input in the CAP-88 code.
Source: GLE, 2008 (Tables S-1 and S-2).

EPA air modeling code CAP88-PC (Version 3) was used to assess the impacts from the proposed GLE Facility's air emissions. This code is approved by the EPA for demonstrating compliance with NESHAPs. The code calculates radiation doses from a number of exposure pathways, including inhalation, submersion, groundshine, and ingestion of contaminated food following uranium deposition on the ground. A description of the modeling approach in the CAP88-PC code for this analysis is provided in Appendix C.

Data for wind speed and direction by stability classes were taken from the Wilmington International Airport meteorological station for the years 1988 through 1992 (Rosnick, 2007). The distances from the proposed GLE Facility stack to the receptor locations were measured to the Wilmington Site boundary in each of the 16 compass directions (GLE, 2009a). Receptor dose was also calculated at 250 meters (0.16 mile) to model the nearest onsite member of the public (e.g., a construction worker) and at 1350 meters (0.84 mile) to model the nearest resident. Separate runs for the onsite member of the public, site boundary, and nearest resident were made.

The onsite member of the public was assumed to consume foodstuff produced within an 80-kilometer (50-mile) radius surrounding the proposed GLE Facility but not produced onsite (regional food pattern in the code). The rural food consumption pattern was used to estimate the dose at the site boundary and the nearest resident. The rural food consumption pattern assumes a high percentage of the foodstuff is produced at home or at the point of exposure (70 percent vegetables, 40 percent milk, and 44 percent meat), and the remainder is produced within an 80-kilometer (50-mile) radius of the release point (proposed GLE Facility). These food assumptions are very conservative, because very few people actually consume 100 percent of their diet produced within 80 kilometers (50 miles) of their residence (Hill, 2008).

Table 4-19 shows the estimated dose to hypothetical receptors residing at the site boundary in each of the 16 directions modeled in CAP88-PC (Version 3). Information about doses from natural background radiation is provided in Section 3.11.1. Table 4-19 also includes the dose to the onsite member of the public and the nearest resident. The maximum dose to a hypothetical receptor at the Wilmington Site boundary is in the northeast direction (0.35 kilometers [0.22 miles]) of the proposed GLE Facility, estimated to be 1.1×10^{-6} millisievert per year (1.1×10^{-4} millirem per year). The estimated dose to the nearest resident located at 1.35 kilometers (0.84 miles) east-southeast of the proposed GLE Facility is 1.4×10^{-7} millisievert (1.4×10^{-5} millirem per year). The maximum estimated dose for the onsite member of the public assumed to be located 250 meters (0.16 mile) to the south of the GLE stack is 3.2×10^{-7} millisievert per year (3.2×10^{-5} millirem per year). For calculating the dose for the onsite member of the public it was assumed that the member of the public was on-site for 2000 hours in one year. All of these estimated doses are well below the 1 millisievert per year (100 millirem per year) public exposure limits in 10 CFR 20.1301(a)(1) and the 0.1 millisievert per year (10 millirem per year) airborne dose limits in 40 CFR Part 61, Subpart H (NESHAPs). Therefore, impacts on members of the public from the air emissions of the proposed GLE Facility would be SMALL.

The CAP-88 PC code also calculates airborne concentrations in picocuries per cubic meter for each radionuclide at the user-defined locations. These concentrations can be converted to micrograms per cubic meter for the purpose of evaluating the chemical toxicity of uranium. Uranium exerts heavy metal toxicity, primarily to the kidney (Section 3.11.3.3). Table 4-17 provides the calculated airborne uranium (and HF) concentrations at the same receptor locations as in Table 4-19.

In summary, airborne emission of uranium from the proposed GLE operations are predicted to cause radiation doses that are well below the 1 millisievert per year (100 millirem per year) public exposure limits in 10 CFR 20.1301(a)(1) and the 0.1 millisievert per year (10 millirem per year) airborne dose limits in 40 CFR Part 61, Subpart H, the EPA's NESHAPs. The airborne concentration of uranium from the proposed GLE operations are also well below the toxicity limits established by the National Institute for Occupational Safety and Health and the American Conference of Industrial Hygienists. Therefore, the impacts from proposed GLE Facility air emission are expected to be SMALL.

Table 4-19 Annual Effective Dose from Proposed GLE Facility Stack Releases at Different Receptor Locations

Location	Direction	Distance Meters[b]	Dose mSv/yr[c]
Site Boundary	North	399	8.5×10^{-7}
Site Boundary	North–northwest	573	6.2×10^{-7}
Site Boundary	Northwest	924	2.1×10^{-7}
Site Boundary	West–northwest	1493	4.7×10^{-8}
Site Boundary	West	1717	1.7×10^{-7}
Site Boundary	West-southwest	2302	1.4×10^{-7}
Site Boundary	Southwest	1806	2.3×10^{-7}
Site Boundary	South–southwest	1892	2.2×10^{-7}
Site Boundary	South	1416	3.9×10^{-7}
Site Boundary	South–southeast	1708	2.5×10^{-7}
Site Boundary	Southeast	2664	1.8×10^{-7}
Site Boundary	East–southeast	1270	1.5×10^{-7}
Site Boundary	East	671	4.9×10^{-7}
Site Boundary	East–northeast	427	8.3×10^{-7}
Site Boundary	Northeast	353	1.1×10^{-6}
Site Boundary	North–northeast	346	9.4×10^{-7}
Onsite Member of the Public[a]	South	250	3.2×10^{-7}
Nearest Resident	East–southeast	1352	1.4×10^{-7}

[a] Onsite member of the public in the south direction got the maximum dose. For calculating the dose for the onsite member of the public it was assumed that the member of the public was onsite for 2000 hours in one year.
[b] To convert meters to feet multiply by 3.28.
[c] To convert mSv to mrem multiply by 100.

Public Dose from Direct Gamma Radiation

The presence of radioactive materials at the proposed GLE Facility would present the possibility for onsite members of the public to receive a radiation dose directly from gamma rays (photons) emitted from these materials. Isotopes of uranium could be present in quantities large enough to provide the potential for onsite members of the public to receive a measurable external radiation dose. Of the uranium onsite, only that being stored as depleted uranium would be continuously present in sufficient quantity to represent a potential source of direct radiation dose to the onsite member of the public. However, as noted above, gamma emissions would be attenuated to a large degree by container walls, structures, and through distance to receptors. There would be small amounts of other gamma emitters present onsite as sealed sources and laboratory standards, but these are not detectable at any large distance.

The measured radiation dose at various locations of interest from existing radiation sources at the Wilmington Site was used to gauge the public dose from direct gamma radiation from the proposed GLE Facility. The site conducts external gamma radiation monitoring using a network of thermoluminescent dosimeters (TLDs) positioned at various locations both on and off the Wilmington Site. The TLD readings are inclusive of any exposure caused by the presence of existing radiation sources on the Wilmington Site, including direct radiation and skyshine from the existing cylinder storage yards. None of the TLDs showed readings above the background exposure rate of 5 microentgens per hour (GLE, 2009b) at the site boundary. The distance to the nearest site boundary from the additional storage yards planned for the proposed GLE Facility is greater than 350 meters (1148 feet). Because of the shielding and the distance to the receptors, it is expected to have only a minor effect on the direct radiation exposure rate at the site boundary. Therefore, the impact from direct exposure to the public is expected to be SMALL.

Public Dose from Liquid Releases of Radioactive Material

The proposed GLE Facility would generate process and sanitary liquid effluent streams. Process wastewater generated at the proposed GLE Facility is a combination of 5000 gallons per day (18,900 liters per day) of liquid radiological waste generated from decontamination, cleaning, and laboratory activities and 30,000 gallons per day (113,600 liters per day) of cooling tower blowdown that circulates in a closed-loop system and does not come in direct contact with uranium materials. Radioactive wastewater is collected via a closed-drain system and discharged to an accumulator tank. The closed-drain system allows the liquid radioactive wastewater generated from different activities involving radioactive material to be collected at one place instead of being discharged. Liquid radioactive wastewater in the tank would be sampled on a regular basis before routing to a liquid effluent treatment system. The treated effluent would be discharged to the final process lagoon facility. Blowdown from the cooling water system would be piped directly to the final process lagoon facility (GLE, 2008). The water from the lagoon facility would be discharged through an NPDES-permitted outfall (Outfall 001) to the effluent channel. The 10,500 gallons per day (40,000 liters per day) sanitary wastewater generated would be treated in the existing sanitary wastewater treatment facility. The treated sanitary wastewater effluent would be used to replace blowdown from the cooling towers. The stormwater runoff from the proposed GLE Facility would drain to a stormwater wet detention basin before being discharged. In addition, a holding pond would be placed near the UF_6 storage pads to collect the stormwater runoff from these pads. Monitoring for gross alpha/beta activities, total uranium, and fluoride would be conducted at the holding pond before the water is discharged to the stormwater wet detention basin. If any unanticipated radioactivity is detected in the holding pond, radiological material would be allowed to settle and/or precipitate. The liquid then would be pumped from the holding pond and, if necessary, routed to the GLE liquid effluent treatment system. The effluent channel includes the discharges from all liquid effluent streams from the Wilmington Site and flows to the Northeast Cape Fear River through Unnamed Tributary #1.

For calculating the doses to the public from liquid effluent releases, the GENII code Version 2.06 (Napier, 2004) was used. The code has been developed by Pacific Northwest National Laboratory for the EPA for calculating dose and risk from radionuclide releases in the environment. GENII Version 2 incorporates internal dosimetry models recommended by the International Commission on Radiological Protection (ICRP), and the related risk factors published in Federal Guidance Report 13 (EPA, 1999). The GENII code includes a set of programs for calculating radiation dose and risk from radionuclides released to the environment. GENII implements the NRC models in LADTAP code for surface water doses.

The Northeast Cape Fear River would receive the liquid effluent discharges from the proposed GLE Facility. There are no public water intakes on the river downstream of the discharge point, so only the fish ingestion and recreational water use-related exposure pathways were analyzed (GLE, 2009g).

The radionuclide concentration in surface water was calculated at three potential exposure locations from the uranium concentrations in liquid effluent releases from the proposed GLE Facility and the dilution factor in the receiving water body (GLE, 2009g). It was assumed that a member of the public was exposed to contaminated surface water from recreational activities and ingestion of fish grown in the contaminated surface water. The recreational activities considered were swimming, boating, and use of the shoreline. The following exposure pathways were included in the dose assessment:

- external exposure from swimming

- external exposure from boating

- external exposure from contaminated shoreline sediment

- inadvertent ingestion of contaminated surface water during swimming

- ingestion of fish grown in contaminated surface water

The surface water concentrations, estimated number of people involved, specific radiological parameters, and exposure parameters for different activities used in the GENII code for radiological impact assessment are provided in Appendix C. Table 4-20 provides the estimated dose for an exposed member of the public from different surface water exposure pathways, along with the estimated population doses. Information about doses from natural background radiation is provided in Section 3.11.1.

The maximum dose that a member of a public would receive from liquid effluent releases from the proposed GLE Facility would occur just south of the Wilmington Site boundary. The maximum estimated dose for the MEI from liquid effluent releases would be 7.3×10^{-7} millisievert per year (7.3×10^{-5} millirem per year). Total estimated population dose would be 2.7×10^{-3} person-millisievert per year (2.7×10^{-1} person-millirem per year). These doses are well below the 1 millisievert per year (100 millirem per year) public exposure limits in 10 CFR 20.1301(a)(1). Therefore, impacts on members of the public from liquid effluent releases from the proposed GLE Facility would be SMALL.

Summary of Public Dose

Based on these estimates, normal operations at the proposed GLE Facility would have SMALL impacts on public health. Results are based on conservative assumptions (see Appendix C), and it is anticipated that actual exposure levels would be less than presented here. The total

Table 4-20 Estimated Doses for Liquid Effluent Releases from the Proposed GLE Facility

Exposure location	Exposure Pathway	Dose (mrem/yr) to a Member of Public	Number of People Exposed	Collective Dose (person-mrem/yr)
Confluence with Unnamed Tributary #1 to Northeast Cape Fear River	Fish ingestion	5.26×10^{-5}	1414	7.44×10^{-2}
	Water ingestion during swimming	4.37×10^{-7}	1906	8.33×10^{-4}
	External exposure from swimming	1.03×10^{-8}	1906	1.96×10^{-5}
	External exposure from boating	5.15×10^{-9}	1244	6.41×10^{-6}
	External exposure from shoreline activities	2.01×10^{-5}	1231	2.47×10^{-2}
	Total for a member of public	7.32×10^{-5}	NA	NA
Just South of GE Wilmington Site Boundary	Fish ingestion	5.26×10^{-5}	1414	7.44×10^{-2}
	Water ingestion during swimming	4.37×10^{-7}	1906	8.33×10^{-4}
	External exposure from swimming	1.03×10^{-8}	1906	1.96×10^{-5}
	External exposure from boating	5.15×10^{-9}	1244	6.41×10^{-6}
	External exposure from shoreline activities	2.01×10^{-5}	1231	2.47×10^{-2}
	Total for a member of public	7.32×10^{-5}	NA	NA
NC 133 Bridge	Fish ingestion	5.06×10^{-5}	1414	7.15×10^{-2}
	Water ingestion during swimming	4.21×10^{-7}	1906	8.02×10^{-4}
	External exposure from swimming	9.95×10^{-9}	1906	1.90×10^{-5}
	External exposure from boating	4.98×10^{-9}	1244	6.20×10^{-6}
	External exposure from shoreline activities	1.93×10^{-5}	1231	2.38×10^{-2}
	Total for a member of public	7.03×10^{-5}	NA	NA
	Total population dose	NA	NA	2.72×10^{-1}

[a] To convert millirem to millisievert, divide by 100.

[b] NA = not applicable.

annual dose from all exposure pathways would be far less than the limit of 1 millisievert per year (100 millirem per year) established in the NRC's regulations in 10 CFR 20.1301. All exposures are also expected to be significantly below the EPA limit of 0.25 millisievert per year (25 millirem per year) in 40 CFR Part 190 for dose to members of the public from uranium fuel-cycle facilities.

Occupational Exposure Impacts

Under the proposed action, the most significant contributor to occupational radiation exposure would be direct radiation from the UF_6. It is expected that the average occupational doses at the proposed GLE Facility would be similar to occupational doses at existing fuel cycle facilities in the United States. As is the case for such fuel cycle facilities, the most substantial sources of direct radiation would likely include both full Type 48Y cylinders containing either feed material or depleted UF_6 and empty Type 48Y cylinders with residual material (NRC, 2005b). Table 4-21 presents occupational doses at fuel cycle facilities within the United States for 2003–2007 (Burrows, 2005; Burrows, 2006; Lewis et al., 2008).

The existing nuclear and industrial safety program at the Wilmington Site would be expanded to include operation of the proposed GLE Facility (GLE, 2008). The program would monitor the occupational workers at the proposed GLE Facility for internal exposure from intake of uranium as well as dose from external exposure to radiation. GLE would also apply an annual administrative limit of 40 millisieverts (4000 millirem), which is below the 10 CFR 20.1201 limit of 50 millisieverts (5000 millirem) for radiation workers.

GNF-A has implemented a comprehensive exposure control program at the Wilmington Site to manage occupational radiation exposure and dose. The program maintains exposures "As Low As Reasonably Achievable" (ALARA) through the use of radiation monitoring systems, personnel dosimetry, and mitigation systems to reduce environmental concentrations of uranium. The average TEDE to workers from existing GNF-A operations at the Wilmington Site for 2003–2007 varied from 0.5–0.75 millisievert (50–75 millirem) and the maximum TEDE during the same time period varied from 4.7–5.6 millisieverts (470–560 millirem) (NRC, 2009c).

The occupational exposure analysis and the historical exposure data from the United States Enrichment Corporation facilities and the existing GNF-A operations at the Wilmington Site demonstrate that a properly administered radiation protection program at the proposed GLE Facility would maintain radiological occupational impacts below the regulatory limits of 10 CFR 20.1201. Therefore, the impacts from occupational exposure at the proposed GLE Facility are expected to be SMALL.

4.2.11.3 Mitigation Measures

Facility design features and process controls would be incorporated into the proposed GLE Facility to minimize gaseous and liquid effluent releases, and to maintain the impacts on workers and the surrounding population below regulatory limits. An ALARA program would be implemented in addition to routine radiological surveys and personnel monitoring. Best management practices associated with compliance with 29 CFR Part 1910 regarding OSHA standards would be implemented. Worker health and safety would be protected under an

Table 4-21 Annual CEDE[a] and TEDE[b] for Fuel Cycle Facilities within the United States for 2003–2007

Year	Number of Monitored Individuals	Workers with Measured TEDE	Collective TEDE (person-rem[c])	Average Measured TEDE (rem)	Workers with Measured DDE	Collective DDE[d] (person-rem)	Average Measured DDE (rem)	Workers with Measured CEDE	Collective CEDE (person-rem)	Average Measured CEDE (rem)
2003	7738	3633	556	0.15	2815	258	0.09	2255	298	0.13
2004	7562	3814	514	0.13	2933	258	0.09	2327	256	0.11
2005	7699	3371	497	0.15	2385	238	0.10	2173	259	0.12
2006	7417	3413	522	0.15	2475	283	0.11	2131	238	0.11
2007	7536	3225	429	0.13	2254	230	0.10	1983	199	0.10

[a] Committed effective dose equivalent = total radiation dose received from ingestion or inhalation of radioactive material.
[b] Total effective dose equivalent = CEDE plus DDE (deep dose equivalent from external radiation).
[c] 1 rem = 1000 mrem.
[d] To convert rems to sieverts, divide by 100.
Sources: Burrows, 2005; Burrows, 2006; Lewis, et al. 2008.

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expansion of the current GNF-A Nuclear Safety Program and the Industrial Safety Program that would comply with applicable State, NRC (10 CFR Part 20), and OSHA (29 CFR Part 1910) requirements. Appropriate safety controls would be implemented according to the nature of work and hazards presented to minimize exposure to chemicals and radionuclides.

<u>Mitigation Measures Identified by GLE</u> (GLE, 2008)

- Install a building ventilation system and maintain the majority of the process building under sub-atmospheric pressure to prevent any air effluent release inside the building from being directly vented outside the building.

- Install alarms in the Emergency Control Center to detect, alarm, and/or activate the automatic safe shutdown of process equipment in case of operational problems.

- Install radiation monitors in effluent stacks to detect, alarm, and activate the automatic safe shutdown of process equipment, should contaminants be detected in the system exhaust.

- Isolate leaks and shut down process lines to prevent damage to equipment.

- Vent exhaust-gases from the emission control system to the atmosphere through a single rooftop stack. The emission control system would have a design control efficiency of at least 99 percent for uranium particulates and UF_6 and HF vapors.

- Employ fluoride monitors and radiation monitors in vent stacks to detect, alarm, and activate the automatic safe shutdown of process equipment.

- Perform environmental monitoring and sampling to ensure compliance with regulatory discharge limits.

- Route treated process wastewater effluents to the existing final process lagoon facility at the Wilmington Site for additional treatment. Treated sanitary wastewater effluent would be used to replace blowdown from the cooling towers.

The mitigation measures proposed by GLE for worker health and safety include:

- Comply with all applicable State, NRC, and OSHA regulations concerning worker health and safety, as well as the existing Wilmington Site Nuclear Safety Program and the Industrial Safety Program.

- Comply with the Site Radiation Protection Program, the Spill Prevention Control and Countermeasure Plan, and the GLE Environmental, Health, and Safety Program.

- Conduct routine facility radiation and radiological surveys to characterize and minimize potential radiological exposure.

- Monitor all radiation workers via dosimeters and area air sampling to ensure that radiological doses remain within regulatory limits and ALARA practices.

- Conduct operations activities involving hazardous respirable effluents with ventilation control and/or respiratory protection, as required.

- Use personal protective equipment based on the nature of the work and chemical and/or radiological hazards present.

<u>Additional Mitigation Measures Identified by NRC</u>

- Move UF_6 cylinders only when cool and when UF_6 is in solid form, to minimize the risk of inadvertent release due to mishandling.

- Direct process off-gas from UF_6 purification and other operations through cold traps to solidify and reclaim as much UF_6 as possible. Pass remaining gases through high-efficiency filters and chemical absorbers to remove HF and uranic compounds.

- Separate uranic compounds and various other heavy metals in waste material generated by decontamination of equipment and systems.

4.2.12 Waste Management Impacts

This section evaluates the potential environmental impacts related to operation of the solid, hazardous, and radioactive waste management program at the proposed GLE Facility, including impacts resulting from temporary storage, conversion, and disposal of the depleted UF_6. No mixed waste (hazardous and radioactive) is expected to be generated at the proposed facility.

Due to the nature, design, and operation of a laser enrichment facility, the generation of waste materials can be categorized by three distinct facility operations: (1) preconstruction and construction, which generates typical construction wastes associated with an industrial facility; (2) enrichment process operations, which generate gaseous, liquid, and solid waste streams; and (3) generation and temporary storage of depleted UF_6 (Section 4.2.17.11 of this chapter discusses decommissioning wastes). Waste materials include radioactive waste (i.e., depleted UF_6 and material contaminated with UF_6), listed or characteristic hazardous materials (as defined in 40 CFR Part 261), and nonhazardous materials (any other wastes not identified as radioactive or hazardous). Hazardous materials include any fluids, equipment, and piping contaminated as defined in 40 CFR Part 261, such as cleaning solvents and pesticides, that would be generated due to the construction, operations, and maintenance programs.

The handling and disposing of waste materials is governed by various Federal and State regulations. To satisfy the Federal and State regulations, GLE has implemented waste minimization and pollution-prevention practices associated with the generation, collection, removal, and proper disposal of waste materials. GLE's waste management program is intended to minimize the generation of waste through reduction, reuse, or recycling (GLE, 2008). This program would assist in identifying methods to minimize the volume of regulated wastes through better segregation of materials and the substitution of nonhazardous materials as required under Resource Conservation and Recovery Act (RCRA) regulations. Using available information and waste data from similar facilities, the waste-management impacts at the proposed GLE Facility are assessed for preconstruction and construction, operations, and depleted UF_6 disposition activities.

4.2.12.1 Preconstruction and Construction Activities

Solid nonhazardous wastes generated during the preconstruction and construction phases would be typical of those for construction of industrial facilities. These wastes would be transported offsite to an approved local landfill. Approximately 3058 cubic meters (4000 cubic yards) per year of non-compacted waste is anticipated to be generated (GLE, 2009a) and would include paper, plastic, cardboard, packaging materials, wood scraps, metal building material scraps, roofing and insulation material scraps, masonry and ceramic materials, and empty paint and coatings containers. Small quantities of organic solvent-based residuals remaining from application of specialty paints, architectural coatings, sealants, and adhesives, as well as wastes from certain other materials that possibly could be used for ancillary building construction, which is one aspect of preconstruction, or construction, may be required to be managed as hazardous waste.

Nonhazardous wastes would be transported to the New Hanover County Landfill for disposal. This landfill receives approximately 151,000 tons (approximately 210,000 cubic yards [compacted]) annually (NCDENR, 2009a). Thus, proposed GLE Facility preconstruction and construction activities would generate approximately two percent of the waste that the New Hanover County Landfill receives annually from all other sources. The generation of hazardous wastes (i.e., waste oil, greases, excess paints, and other chemicals) associated with the preconstruction and construction activities for the proposed facility due to the maintenance of construction equipment and vehicles, painting, and cleaning, would be packaged and shipped offsite to licensed facilities in accordance with Federal and State environmental and occupational regulations. Table 4-22 shows the hazardous wastes that would be expected from construction of the proposed GLE Facility. The quantity of all preconstruction- and construction-generated hazardous and nonhazardous waste material would result in SMALL impacts that could be managed effectively.

Preconstruction activities such as land clearing, site grading and erosion control, installation of the stormwater system, utility placement, and parking lot and roadway construction, would account for less than two percent of the nonhazardous waste generated during preconstruction activities, with approximately 300 cubic meters (400 cubic yards) generated, compared to 3058 cubic meters per year (4000 cubic yards per year) generated during each of the following six years of building construction (GLE, 2009f). Similarly, hazardous waste generated during preconstruction activities would be expected to account for approximately two percent of the hazardous waste generated during the ensuing six years of construction. These estimates are based on GLE's assumption that construction of ancillary buildings, although authorized by the exemption allowing GLE to perform certain preconstruction activities prior to the NRC licensing decision, would not occur until after the NRC licensing decision (GLE, 2009f). Thus, the estimated volume of waste from ancillary building construction is included here in the estimated volumes of building construction waste.

4.2.12.2 Facility Operations

Normal operation of the proposed GLE Facility would result in the generation of wastewaters that would be treated onsite before discharge and solid wastes that would be treated onsite or offsite and shipped for disposal offsite. The systems used to manage the wastes generated during operations onsite are described in Section 2.1.2.4.

Table 4-22 Estimated Construction Hazardous Wastes for the Proposed GLE Facility

Waste	Annual Quantity
Paints, solvents, thinners, organics	3000 gal (11,360 L)
Petroleum products, oils, lubricants	3000 gal (11,360 L)
Sulfuric acid (battery)	100 gal (379 L)
Adhesives, resins, sealers, caulking	2000 lbs (910 kg)
Lead (batteries)	200 lbs (91 kg)
Pesticides	100 gal (379 L)

Source: GLE, 2009a.

Wastewater

Wastewater management systems are in place at the proposed GLE Facility site to handle sanitary wastewater, facility cooling tower water, stormwater, and process wastewater. The first three systems deal with nonradioactive effluents, while the last system is in place to remove any uranium or other metals left in the water as a result of the uranium enrichment process. Stormwater management is discussed in Sections 3.7.1 and 4.2.6.2. Table 4-23 summarizes the estimated quantities generated by the different systems.

Sanitary Wastewater

Sanitary wastewater at the proposed GLE Facility would be collected by a sewer system connected to the existing Wilmington Site sanitary wastewater treatment facility discussed in Section 3.12.2.1. Approximately 39,747 liters per day (10,500 gallons per day) are estimated to be generated by the proposed GLE Facility, increasing the load on the existing treatment system by about one-third (GLE, 2008). Because the Wilmington Site has secured a reuse permit for treated sanitary wastewater effluent as makeup water in cooling towers onsite, the additional 39,747 liters per day (10,500 gallons per day) discharged could be used in the proposed GLE Facility cooling tower, which is estimated to have a blowdown of about 113,562 liters per day (30,000 gallons per day) (GLE, 2008). Should discharges to surface waters be necessary in the future, the existing NPDES discharge permit of 283,906 liters per day (75,000 gallons per day) as discussed in Section 3.12.2.1 would be adequate to cover the additional volume of effluent. The NPDES discharge permit is half of the capacity of the existing treatment system. Therefore, impacts from sanitary wastewater from the proposed GLE Facility would be SMALL.

Cooling Tower Blowdown

The water removed from a cooling tower loop is referred to as “blowdown.” Water in a cooling tower loop does not come in direct contact with wastes or hazardous materials, but a portion of the cooling water in a tower’s loop is replaced periodically to maintain the concentration of dissolved solids and other impurities within specific water quality limits. At the proposed

Table 4-23 Wastewater Volume Estimates for the Proposed GLE Facility

Wastewater Type	Wastewater Source	Estimated Average Daily Quantity Generated
Process liquid radwaste	Wastewaters from proposed GLE Facility's main operations building decontamination room; process area floor drains, sinks, sumps, and mop water; laboratory area floor drains, sinks, sumps, and mop water; change room showers and sink; and aqueous process liquids that have the potential to contain uranium	18,927 lpd (5000 gpd)
Cooling tower blowdown	Proposed GLE Facility's main operations building HVAC cooling tower	113,562 lpd (30,000 gpd)
Sanitary waste	Sanitary waste from building areas used by proposed GLE Facility workers (e.g., restrooms, break rooms)	39,746 lpd (10,500 gpd)
Stormwater runoff	Stormwater runoff from proposed GLE Facility impervious surfaces (e.g., building roofs, parking lots, service roads, outdoor storage pads, and other maintained areas)	Variable depending on local precipitation

Source: GLE, 2008.

GLE Facility, approximately 113,562 liters per day (30,000 gallons per day) of blowdown would be sent directly to the Wilmington Site's final process lagoons. This volume of water represents a six percent increase handled by the process lagoons in 2006, but is only two percent of the existing NPDES permit for treated process wastewater. The impacts from cooling tower blowdown are therefore expected to be SMALL.

Process Wastewater

Daily operations at the proposed GLE Facility are estimated to generate approximately 18,927 liters per day (5000 gallons per day) of radioactive wastewater from decontamination, cleaning, and laboratory activities within the proposed GLE Facility's main operations building (GLE, 2008). This process wastewater would be collected in an accumulator tank. Uranium and other metals would be precipitated out of solution in the accumulator tank through a pH adjustment. The resulting precipitate slurry at the bottom of the tank would be isolated and disposed of as solid LLRW as discussed in the following section on Nonhazardous Solid Wastes. The resulting fluoride solution at the top of the tank would be treated to remove the fluoride also resulting in a solid waste form. The treated process wastewater effluent would then be discharged to the Wilmington Site process wastewater aeration basin and Final Process Lagoon Treatment Facility (FPLTF). Because the additional 18,927 liters per day (5000 gallons per day) from operation of the proposed GLE Facility would only be about an additional one percent over the volume treated by the FPLTF in 2006 (the latest data available) and less than 0.3 percent of the NPDES permit, the impacts from GLE process wastewater would be SMALL.

Nonhazardous/Nonradioactive Solid Wastes

Operations at the proposed GLE Facility would generate approximately 345 metric tons per year (380 tons per year) of municipal solid waste (MSW) and an additional 97 metric tons per year (107 tons per year) of other nonhazardous industrial solid wastes. Table 4-24 provides a summary of the types of wastes anticipated. The MSW would be collected on a regular basis and sent to the local New Hanover Municipal Landfill, which receives about 137,000 metric tons per year (151,000 tons per year) (NCDENR, 2009a). Impacts on the landfill operations would be SMALL, as the MSW waste would contribute approximately an additional 0.3 percent to its current receipt rate. The other nonhazardous industrial waste would either be packaged and shipped directly to Heritage Environmental Services in Indianapolis, Indiana, or routed through Heritage Environmental Services for reuse, reclamation, or treatment. Impacts are considered to be SMALL because 97 metric tons per year (107 tons per year) represents less than 0.1 percent of the waste received at Heritage Environmental in 2007 (the latest data available) (IDEM, 2008).

Hazardous Wastes

As shown in Table 4-24, approximately 11 metric tons per year (12 tons per year) of RCRA hazardous waste would be expected to be generated by the proposed GLE Facility. The waste would be packaged and shipped to Heritage Environmental Services in Indianapolis, Indiana, a RCRA-permitted Subtitle C facility, for treatment, storage, and disposal. The impact would be expected to be SMALL because disposal of 11 metric tons per year (12 tons per year) represents approximately 0.01 percent of the amount of hazardous waste, 122,091 metric tons (134,610 tons), received by Heritage Environmental Services in 2007 (the latest data available) (IDEM, 2008).

Low-Level Radioactive Waste

A variety of uranium-contaminated wastes would be expected to be generated from operation of the proposed GLE Facility, as shown in Table 4-24. With the exception of the depleted UF_6 tails, the majority of the LLRW (312 metric tons per year [344 tons per year]) would be the combustible and non-combustible portions of contaminated used items, with an additional 953 kilograms per year (2100 pounds per year) of sludge from the process wastewater treatment discussed in Section 4.2.12.2, followed by waste from feed sampling and analysis (44 kilograms per year [97 pounds per year]) (GLE, 2008). This LLRW would be packaged per DOT standards and shipped to Energy*Solutions*' Clive, Utah, facility for disposal. The impact would be considered SMALL because approximately 312 metric tons per year (344 tons per year) of waste is less than 0.08 percent of the 500,000 metric tons per year (453,600 tons per year) permitted maximum of the disposal facility (UDRC, 2009).

Depleted UF_6 Management

As discussed in Chapter 2 of this draft EIS, depleted UF_6-filled Type 48Y or 48G cylinders (depleted UF_6 cylinders) would be temporarily stored on an outdoor cylinder storage pad on the facility grounds. Storage of depleted UF_6 cylinders at the proposed GLE Facility would occur during the facility's 40-year operating lifetime, with eventual removal of depleted UF_6 from the site through one of the disposition options considered. The U.S. Department of Energy (DOE) is required by Section 311 of Public Law 108-447, which amended Section 3113 of the

Table 4-24 Operations Waste Estimates for the Proposed GLE Facility

Waste Type	Waste Source	Estimated Average Annual Quantity Generated
Municipal solid waste (MSW)	General worker operations, maintenance, and administrative activities not involving the handling of or exposure to uranium	345 Mt/yr (380 tons/yr)
Nonhazardous industrial wastes	Nonhazardous wastes from proposed GLE Facility equipment cleaning and maintenance activities (e.g., used coolant, non-hazardous caustic, and filter media) that are recyclable or not accepted by municipal solid waste (MSW) landfill	97 Mt/yr (107 tons/yr)
RCRA hazardous waste	Wastes designated as RCRA hazardous wastes from proposed GLE Facility equipment and maintenance activities (e.g., used cleaning solvents, used solvent-contaminated rags)	11 Mt/yr (12 tons/yr)
Low–level radioactive waste (LLRW)	Laboratory waste from UF_6 feed cylinder sampling and analysis	44 kg/yr (97 lbs/yr)
	Combustible, uranium-contaminated used items (e.g., worker personal protection equipment, swipes, step off pads)	93 Mt/yr (103 tons/yr)
	Noncombustible, uranium-contaminated used items (e.g., spent filters from HVAC systems, liquid effluent treatment system, and area monitors) and corrective maintenance items (e.g., defective pigtails, valves, other safety equipment that need replacement)	219 Mt/yr (241 tons/yr)
	Liquid effluent treatment system filtrate/sludge	953 kg/yr (2100 lbs/yr)
	Depleted UF_6 (UF_6 tails)	11,250 Mt/yr (12,400 tons/yr)

Source: GLE, 2008.

U.S. Enrichment Corporation (USEC) Privatization Act, to take title to and possession of the depleted uranium if requested. Furthermore, DOE provided GLE with a cost estimate for disposition of the depleted uranium and indicated that DOE would extend the operational period of its conversion plants to accommodate the additional material (GLE, 2008).

The current storage pad design is large enough (465,000 square feet) to accommodate up to 9000 cylinders, the expected inventory from 10 years of operation. Additional area is available nearby for expansion, if room for more cylinders is required. If further expansion of the pad is necessary in the future, GLE would be required to prepare a license amendment and prepare the requisite safety, and environmental analyses at that time.

Temporary Onsite Storage Impacts

Proper and active cylinder management, which includes routine inspections and maintaining the anti-corrosion layer on the cylinder surface, has been shown to limit exterior corrosion or mechanical damage to the degree necessary for the safe storage of depleted UF_6 (DNFSB, 1995a; DNFSB, 1995b; DNFSB, 1999). DOE has stored depleted UF_6 in Type 48Y or similar cylinders at the Paducah and Portsmouth Gaseous Diffusion Plants and the East Tennessee Technical Park in Oak Ridge, Tennessee, since approximately 1956. Cylinder leaks due to corrosion led DOE to implement a cylinder management program. Past evaluations and monitoring by the Defense Nuclear Facility Safety Board (DNFSB) of DOE's cylinder maintenance program confirmed that DOE met all of the commitments in its cylinder maintenance implementation plan (DOE, 1995), particularly through the use of a systems engineering process to develop a workable and technically justifiable cylinder management program (DNFSB, 1999). Thus, similar active cylinder maintenance program by GLE would assure the integrity of the depleted UF_6 cylinders for the period of time of temporary onsite storage of depleted UF_6 on the cylinder storage pad.

The principal impacts from cylinder storage would be the radiological exposure resulting from depleted UF_6 temporarily stored in 9000 depleted UF_6 cylinders (the design capacity of the GLE full tails cylinder storage pad) under normal conditions and the potential release (slow or rapid) of depleted UF_6 from the cylinders due to an off-normal event or accidents (operational, external, or natural hazard phenomena events). These radiation exposure pathways are analyzed in Sections 4.2.11.2 and 4.2.15.2, and based on these results, the impacts from temporary storage would be SMALL. The annual impacts from temporary storage would continue until the depleted UF_6 cylinders are removed from the proposed GLE Facility site.

Offsite Disposal Impacts

For the disposal of the depleted UF_6, GLE has proposed that the Type 48Y cylinders would be transported from the proposed GLE Facility to either of the DOE's conversion facilities at Paducah, Kentucky, or Portsmouth, Ohio, for conversion to triuranium octaoxide (U_3O_8). After being converted to uranium oxide (primarily dry U_3O_8), the waste would be further transported to a licensed disposal facility. The transportation of the Type 48Y cylinders from the proposed GLE Facility to either of the conversion facilities would have environmental impacts that are included in the transportation analysis presented in Section 4.2.10.2.

If the DOE conversion facility could not immediately process the depleted UF_6 upon arrival, potential impacts would include radiological impacts proportional to the time of temporary storage at the conversion facility. DOE has previously assessed the impacts of depleted UF_6 storage during the operation of a depleted UF_6 conversion facility (DOE, 2004a and 2004b). At the Paducah and Portsmouth conversion facilities, the maximum collective dose to workers (i.e., workers at the cylinder yards) would be 0.055 person-sieverts (5.5 person-rem) per year and 0.03 person-sieverts (3 person-rem) per year, respectively, considering the existing stored inventories of depleted UF_6. There would be negligible exposure to noninvolved workers or the public because of their distance from the cylinder yards and air emissions from the cylinder preparation and maintenance activities would be negligible (DOE, 2004a and 2004b).

The dose calculations presented throughout this EIS are based on the estimated composition of depleted UF_6 generated by the proposed laser-based facility. The doses from external exposure to containers of depleted uranium from the proposed facility (either as UF_6 or U_3O_8) are expected to be very similar to the doses calculated by DOE (DOE 2004a and 2004b) (i.e., within 1%). However, under accident conditions at a potential DOE facility that converts UF_6 to U_3O_8, if the depleted uranium is aerosolized and inhalation becomes the dominant pathway for exposure, the doses from depleted uranium from the proposed GLE Facility could be up to twice as large as doses calculated by DOE. Based on a comparison to doses from accidents considered by DOE (DOE, 2004a and 2004b), the resulting doses would still be well below levels that could cause acute fatalities from radiation exposure and below the levels that could cause acute radiation sickness. The lifetime increase in the probability of developing a fatal latent cancer would be less than 0.05 for the maximally exposed member of public or maximally exposed non-involved worker. For involved workers, DOE indicated that impacts under accident conditions would likely be dominated by physical forces from the accident itself. This conclusion would be the same for a potential accident with depleted uranium from the proposed GLE Facility at a potential DOE facility that converts UF_6 to U_3O_8.

To assess the impacts of depleted UF_6 generated by the proposed GLE Facility on DOE's conversion facilities, one must understand the relative amount of additional material as compared to DOE's existing depleted UF_6 inventory. The Paducah conversion facility would operate for approximately 25 years to process 436,400 metric tons (481,000 tons) that were in storage prior to the anticipated facility start-up in 2006 (DOE, 2004a). The Portsmouth conversion facility would operate for 18 years to process 243,000 metric tons (268,000 tons) (DOE, 2004b). The projected maximum amount of depleted UF_6 generated by the proposed GLE Facility (450,000 metric tons [496,000 tons]) would represent approximately 185 percent of the Portsmouth and approximately 103 percent of the Paducah starting inventories. The proposed GLE Facility would produce approximately 11,250 metric tons (12,401 tons) of depleted UF_6 per year at full production capacity (GLE, 2008), which represents approximately 62 percent of the annual conversion capacity of the Paducah facility (18,000 metric tons [20,000 tons]) and approximately 83 percent of the Portsmouth facility annual conversion capacity (13,500 metric tons [15,000 tons]). The proposed GLE Facility maximum depleted UF_6 inventory could extend the time of operation by approximately 25 years for the Paducah conversion facility or 33 years for the Portsmouth conversion facility.

With routine facility and equipment maintenance, and periodic equipment replacements or upgrades, DOE indicated that the conversion facilities could be operated safely beyond their proposed operational lifetimes to process the depleted UF_6 such as that originating at the proposed GLE Facility. In addition, DOE indicated that the estimated impacts that would occur from prior conversion facility operations would remain the same when processing depleted UF_6 such as the proposed GLE Facility's wastes. The overall cumulative impacts from the operation of the conversion facility would increase proportionately with the increased life of the facility (DOE, 2004a; DOE, 2004b).

Additional conversion processing capacity could also be achieved through increased efficiency of the Paducah and Portsmouth conversion plants and the possibility of a commercial conversion plant being constructed. International Isotopes, Inc., submitted a license application to the NRC on December 31, 2009, to construct and operate a depleted UF_6 conversion facility near Hobbs, New Mexico; the NRC staff is currently conducting environmental and safety reviews of the application (NRC, 2010a). In either case, impacts are expected to be comparable to those estimated for construction and operation of the Paducah and Portsmouth plants (DOE, 2004a; DOE, 2004b).

In order to keep up with increased demand for enriched uranium as discussed in Chapter 1, other uranium enrichment facilities are in the planning process or already under construction. These facilities would also generate depleted UF_6, in addition to the currently operating gaseous diffusion enrichment plant at Paducah, that would require conversion and disposal. Should all such facilities (NEF, ACP, and Eagle Rock Enrichment Facility [EREF]) become operational, extended storage times for the depleted UF_6 cylinders would be necessary and could result in the need for an additional conversion facility.

The above assumptions and data indicate that environmental impacts from the conversion of the depleted UF_6 from the proposed GLE Facility at an offsite location such as Portsmouth or Paducah would be SMALL.

Impacts from the transportation of the converted depleted uranium oxide from the conversion facilities to potential disposal sites at locations such as a commercial facility, Energy*Solutions* in Utah, or a DOE facility, the Nevada Test Site in Nevada, have been previously evaluated for the depleted uranium stored at the Portsmouth and Paducah sites (DOE, 2004a; DOE, 2004b). Transportation impacts for shipment of depleted uranium oxide from the Paducah or Portsmouth conversion facility to either potential disposal site for similar volumes with origins traced back to the proposed GLE Facility discussed above would be SMALL.

Depleted uranium remains source material after it ceases to possess any value for uranium enrichment purposes. Thus, if no beneficial reuse can be identified, the depleted uranium could be considered as radioactive waste for disposal. Under the current provisions of 10 CFR Part 61, depleted uranium can be considered as Class A low-level radioactive waste. The NRC is currently in the process of amending its regulations to establish new requirements for the disposal of some low-level radioactive wastes, including large quantities of depleted uranium. Considering the steps that are involved in this rulemaking, the NRC plans to publish a final rule in late 2012 (NRC, 2009d). While this rulemaking may result in additional requirements in the future, along with further restrictions that could be imposed by Agreement States, the disposal of depleted uranium, for the purpose of preparing this draft EIS, is assumed to remain within the current regulatory framework until such rulemaking actions have been finalized and the revised rules promulgated. As such, it is assumed that the DOE will transport the entire depleted uranium oxide inventory to a low-level waste disposal facility, such as EnergySolutions at Clive, Utah, for disposal as Class A low-level waste.

4.2.12.3 Mitigation Measures

Impacts from waste generation and management at the proposed GLE Facility would be minimized or eliminated by implementing a number of mitigation measures as proposed by GLE, which include (GLE, 2008):

- Select the laser enrichment process over current gaseous diffusion and gas centrifuge technologies, which would reduce the amount of waste generated for production of the same amount of enriched product.

- Minimize the quantities of waste generated by the proposed facility by implementing a Waste Minimization Plan that considers all facility processes, entails input and responsibility at the worker level on up through all levels of management, and involves recurring review cycles to measure performance and investigate new reduction measures. The plan should include potential reuse and recycling, where possible.

- Perform an integrated safety analysis (ISA) for each onsite waste storage area to identify and prevent accidental releases to the environment.

- Pre-treat radioactive liquid wastewaters in a treatment system planned for the proposed facility before the wastewater effluent is pumped to the existing NPDES-permitted final process lagoon facility for further treatment.

- Conduct onsite treatment of process and sanitary wastewaters to NPDES permit limits before discharge to receiving waters.

- Ship each waste generated by the proposed facility that requires offsite storage, treatment, or disposal to a licensed facility (as appropriate for the waste type) in compliance with EPA and NRC requirements.

- Avoid and minimize potential hazardous and radiological waste impacts from the UF_6 storage pads by implementing design elements and safety procedures during operations, including:

  – use of a storage array that permits easy visual inspection (stacked no more than two cylinders high)

  – segregation of storage pad areas from the rest of the enrichment facility by barriers (e.g., vehicle guardrails)

  – inspection of cylinders for external contamination (i.e., a “wipe test”) prior to placing on the storage pads or transporting them offsite

  – ensuring that UF_6 cylinders are not equipped with defective valves

  – allowing only designated vehicles with a limited amount of fuel in the storage pad area

  – allowing only trained and qualified personnel to operate vehicles in the storage pad area

  – monitoring the holding pond that collects stormwater from the cylinder pads

- Inspect cylinders of UF_6 initially prior to placing a filled cylinder on a storage pad and, thereafter, inspect periodically for damage or surface coating defects. Inspection criteria would include ensuring that:

  – lifting points are free from distortion and cracking

  – cylinder skirts and stiffener rings are free from distortion and cracking

- cylinder surfaces are free from bulges, dents, gouges, cracks, or significant corrosion

- cylinder valves are fitted with the correct protector and cap

- cylinder valves are straight and not distorted, two to six threads are visible, and the square head of the valve stem is undamaged

- cylinder plugs are undamaged and not leaking

• If inspections of a cylinder reveal significant deterioration or other conditions that may affect its safe use, transfer the contents of the cylinder to another cylinder and discard the defective cylinder. Investigate the cause of any significant deterioration, and if necessary, perform additional inspection of cylinders.

• Minimize onsite storage volumes and times and shipping waste destined for offsite treatment and disposal facilities as soon as practicable.

• Monitor and inspect onsite liquid waste storage tanks and containers on a periodic schedule to detect leaks or releases to the environment due to equipment malfunctions so that actions identified in the SPCC plan or other appropriate corrective action can be taken promptly.

• Conduct continuous or periodic monitoring of waste management processes and storage facilities for the detection of non-intentional releases to the environment, so that corrective actions would be taken to minimize adverse impacts on the environment. For example, directing stormwater runoff from the UF_6 storage pads to a holding pond, where it would be monitored to ensure that unexpected radioactive material releases to the wet detention basin did not occur.

• Use the existing Wilmington Site onsite wastewater treatment facilities within current regulatory permit limits to avoid the need to add new onsite waste treatment and disposal facilities for the proposed facility.

4.2.13 Socioeconomic Impacts

This section provides an analysis of the socioeconomic impacts of preconstruction activities and the proposed action, including construction activities, start-up, facility operations, and decommissioning phases.[18] Wage and salary spending and expenditures associated with

[18] As discussed in Section 4.1, the socioeconomic impacts analysis was based on the assumption that a licensing decision would be made in late 2011, construction (if authorized) would start shortly after the licensing decision was made, and license termination would occur in 2051. The analysis was also based on the assumption that initial operations would begin in 2013, final construction activities would continue from 2013 to 2017, and that full operations would be achieved in 2017. Subsequently, the Commission's *Notice of Hearing and Commission Order* (75 FR 1819) specified that a licensing decision be made within 30 months of the Order (i.e., June 2012). Thus, the NRC staff currently expects that a licensing decision will be made in 2012, construction will begin in 2012, and that termination of the 40-year license, if granted, will occur in 2052. The NRC staff expects that the dates for start-up and final construction (2013–2017) and full facility operations (2017) will remain

materials, equipment, and supplies during each phase would produce income and employment and local and State tax revenue, while the migration of workers and their families into local communities would affect housing availability and local public services such as healthcare, schools, and law enforcement. The impacts are evaluated for the region surrounding the proposed GLE Facility. This region is based on the area in which workers are expected to live and spend most of their salaries, and in which a significant portion of site purchase and nonpayroll expenditures from the construction, manufacturing, operations, and decommissioning phases of the proposed GLE Facility are expected to occur (GLE, 2008). This region, referred to in this draft EIS as the region of influence (ROI), corresponds to the Wilmington Metropolitan Statistical Area (MSA), a three-county area comprising Brunswick, New Hanover, and Pender Counties. These three counties cover an area that extends up to approximately 80 kilometers (50 miles) from the Wilmington Site.

This analysis of socioeconomic impacts includes impacts on employment, income, State tax revenues, population, housing community, and social services.

Employment impacts are evaluated by estimating the level of direct and indirect employment associated with the proposed GLE Facility; direct employment is created at the Wilmington Site during preconstruction activities, construction activities, start-up, facility operations, and decommissioning phases, while indirect employment is created in the ROI, to support the needs of the workers directly employed by the proposed GLE Facility and jobs created to support site purchase and non-payroll expenditures. The number of direct jobs created in each stage is estimated based on anticipated labor inputs for various engineering and construction activities. Impacts of preconstruction are separated from GLE construction impacts using payroll expenditure data provided by GLE (GLE, 2009g). Indirect employment is estimated using economic multipliers from the IMPLAN input-output model (MIG, 2009), which account for inter-industry relationships within regions.

State income tax revenue impacts are estimated by applying State income tax rates to GLE project-related construction and operations earnings. State and local sales tax revenues are estimated by applying appropriate State and local sales tax rates to after-tax income generated by construction and operations employees, spent within the ROI. Impacts of the proposed GLE Facility on State corporate income taxes were estimated by applying current State tax rates to projected annual facility operating revenues.

Impacts on population characteristics are evaluated by estimating the fraction of direct and indirect jobs that will be filled by in-migrating workers from outside the ROI. The average family size and age profiles of migrating families are estimated using appropriate demographic assumptions based on U.S. Census Bureau statistics. Impacts on area housing resources are estimated by comparing rental and owner-occupied vacancy statistics with estimated population in-migration into the ROI during the construction and operations phases of the project.

In addition to State income and sales taxes, tax incentives were provided to GE by the State of North Carolina and by New Hanover County. It is anticipated that these would amount to up to

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unchanged. These schedule changes, which will be reflected in the final EIS, are expected to cause slight changes to the socioeconomic impacts analysis because of seasonal effects, but are not expected to change any of the impact conclusions.

$26.6 million from the State, most of which would be payable over a 12-year period, and up to $10 million from the county, payable over a 10-year period. Both incentives are contingent on GE reaching specified investment and employment levels at the plant (GLE, 2009f).

Impacts on community and social services are assessed by estimating the number of additional local community service employees that would be required to maintain existing levels of service or education, law enforcement, and fire services, given the number of in-migrating workers expected into the ROI during the various phases of the project. Although the ROI corresponds to the Wilmington Metropolitan Statistical Area (MSA), which is expected to be the primary source of labor for the proposed GLE facility, some labor in-migration is expected during each phase of the proposed project. The number of in-migrating workers was based on interviews with local economic development officials, with estimates used in the analysis assumed to be a range. Sixty-five percent of in-migrating workers were assumed to be accompanied by their families, which would consist of an additional adult and one school-age child (GLE 2009a).

There are large differences between the indirect (offsite) impact of the proposed GLE facility during the construction phase and during other phases of the project. These differences are due to the relative magnitude of expenditures during the construction phase compared to the other phases of the project, and the important role in the economy of the ROI of suppliers of capital equipment and other materials and services provided to the project during the construction phase.

4.2.13.1 Preconstruction and Construction Activities

Preconstruction and construction activities in the peak year (2012)[19] would create 680 direct jobs at the facility site itself. An additional 3131 indirect jobs would be created in the ROI with the procurement of material and equipment and the spending of direct worker wages and salaries (Table 4-25). Facility construction would produce $139.8 million in income in the ROI in 2012.[20] Construction would produce $1.7 million in direct State income taxes and $1.2 million in direct State sales taxes. Peak year construction activities would constitute approximately 2.5 percent of total ROI employment in 2012; the economic impact of constructing the proposed GLE Facility would, therefore, be SMALL.

Although a large proportion of construction workers are expected to come from within the three-county region, given the scale of construction activities and the likelihood of local worker availability in the required occupational categories, construction of the proposed GLE Facility would require some in-migration of workers and their families from outside the ROI, with between 299 and 598 persons in-migrating into the ROI during the peak year of construction. Although in-migration may potentially impact local housing markets, the relatively small number of in-migrants and the availability of temporary accommodation (hotels, motels, and mobile home parks) would mean that the impact of facility construction on the number of vacant rental housing units is not expected to be large, with between 87 and 173 rental units expected to be occupied in the ROI during construction. These occupancy rates would represent less than

[19] The socioeconomic impacts analysis is based on the assumption that the peak construction year will be 2012, if a license is granted. The NRC staff expects this assumption remains accurate despite the six-month schedule adjustment discussed in Section 4.1.

[20] All direct income and direct sales tax impact estimates are provided in 2008 dollars.

Table 4-25 Effects of the Proposed GLE Facility on ROI Socioeconomics[a]

Parameter	Preconstruction and Construction	Start-up	Operations	Decom-missioning
Employment (number of jobs)				
Direct	680	200	350	50
Indirect	3131	218	382	33
Total	3811	418	732	83
Income ($m 2007)				
Direct	26.0	19.2	33.3	5.1
Indirect	113.8	8.7	15.1	1.0
Total	139.8	28.0	51.5	6.1
Direct tax revenues				
Income taxes ($m 2007)	1.7	1.3	2.3	0.3
Sales taxes ($m 2007)	1.2	0.9	1.7	0.2
Population (number of new residents)	299–598	92–120	161–210	115–120
Housing (number of units required)	87–173	27–47	47–61	33–35
Community service employment (number of individuals)				
Police officers	1	<1	<1	<1
Firefighters	1	<1	<1	<1
Education (number of individuals)				
School-age children	84–169	26–40	46–70	38–40
Teachers	1	<1	<1	<1

[a] Impacts are shown for the peak year of construction (2012), the first year of start-up activities (2013), the first complete year of full operations (2018), and the first year of decommissioning (2051). Although full operations are expected to begin in 2017, the first complete year of full operations is expected to be 2018.
Source: Modified from GLE, 2008.

one percent of the vacant rental units expected to be available in the ROI in 2012; the impact from construction of the proposed GLE Facility on housing would, therefore, be SMALL.

In addition to the potential impact on housing markets, in-migration would also affect local-community educational and medical services employment to maintain existing levels of service. With between 299 and 598 in-migrants expected in the ROI during preconstruction and construction activities, and existing levels of service (see Section 3.13), approximately one additional police officer and approximately one additional firefighter would be required in the peak construction year, 2012. Assuming that a certain number of workers are accompanied by their families during construction, between 84 and 169 school-age children would be expected in the ROI in 2012, meaning approximately one additional teacher would be required to maintain existing student-teacher ratios in the local school system. These staffing increases would represent less than one percent of community service employment in each employment category expected in the ROI in 2012; the impact of construction of the proposed GLE Facility on community educational and medical service employment would, therefore, be SMALL.

Based on payroll expenditure data for the two phases of the project, preconstruction activities (2011) would contribute five percent of the impacts during preconstruction and construction activities, and construction activities (2012–2017) would contribute 95 percent (GLE 2009g).

4.2.13.2 Facility Operations

Start-up

Start-up activities in 2013 would create 200 direct jobs at the proposed GLE Facility site. An additional 218 indirect jobs would be created in the ROI with the procurement of material and equipment and the spending of direct worker wages and salaries (Table 4-25). Facility start-up would produce $28.0 million in income in the ROI in 2013, and would produce $1.3 million in direct State income taxes paid by GLE employees and $0.92 million in direct State sales taxes. Start-up activities would constitute less than one percent of total ROI employment in 2013; the economic impact of start-up the proposed GLE Facility would, therefore, be SMALL.

Given the scale of start-up activities and the likelihood of local worker availability in the required occupational categories, start-up of the proposed GLE Facility would mean that some in-migration of workers and their families from outside the ROI would be required, with between 92 and 120 persons in-migrating into the ROI during the peak year of start-up. Although in-migration may potentially impact local housing markets, the relatively small number of in-migrants and the availability of temporary accommodation (hotels, motels, and mobile home parks) would mean that the impact of facility start-up on the number of vacant rental housing units is not expected to be large, with between 27 and 47 rental units expected to be occupied in the ROI during start-up. These occupancy rates would represent less than 0.1 percent of the vacant rental units expected to be available in the ROI in 2013; the impact of the proposed GLE Facility's start-up on housing would, therefore, be SMALL.

In addition to the potential impact on housing markets, in-migration would also affect local-community educational and medical services employment to maintain existing levels of service. With between 92 and 120 in-migrants expected in the ROI during start-up activities and existing levels of service (see Section 3.13), less than one police officer and less than one firefighter would be required in the peak start-up year, 2013. Assuming that a certain number of workers are accompanied by their families during start-up, between 26 and 40 school-age children would be expected in the ROI in 2013, meaning one additional teacher would be required to maintain existing student-teacher ratios in the local school system. These staffing increases would represent less than 0.1 percent of community service employment in each employment category expected in the ROI in 2013; the impact of the proposed GLE Facility's start-up on community educational and medical service employment would, therefore, be SMALL.

Operations

Operations activities in 2017 would create 350 direct jobs at the facility site itself. An additional 382 indirect jobs would be created in the ROI with the procurement of material and equipment and the spending of direct worker wages and salaries (Table 4-25). Facility operations would produce $51.5 million in income in the ROI in 2017. Operations would produce $2.3 million in direct State income taxes paid by GLE employees and $1.7 million in direct State sales taxes. Corporate income taxes would also be collected by the State during the facility operating period, and would total $49.2 million annually. Operations activities would constitute less than one percent of total ROI employment in 2017; the economic impact of operating the proposed GLE Facility would, therefore, be SMALL.

Given the scale of operations activities and the likelihood of local worker availability in the required occupational categories, operation of the proposed GLE Facility would mean that some in-migration of workers and their families from outside the ROI would be required, with between 161 and 210 persons in-migrating into the ROI during the first year of operation. Although in-migration may potentially impact local housing markets, the relatively small number of in-migrants and the availability of temporary accommodation (hotels, motels, and mobile home parks) would mean that the impact of facility operations on the number of vacant owner-occupied housing units is not expected to be large, with between 47 and 61 rental units expected to be occupied in the ROI during operations. These occupancy rates would represent less than 0.1 percent of the vacant owner-occupied units expected to be available in the ROI in 2017; the impact of the proposed GLE Facility's operations on housing would, therefore, be SMALL.

In addition to the potential impact on housing markets, in-migration would also affect local-community educational and medical services employment to maintain existing levels of service. With between 161 and 210 in-migrants expected in the ROI during operations and existing levels of service (see Section 3.13), less than one police officer and less than one firefighter would be required in the peak operations year, 2017. Assuming that a certain number of workers are accompanied by their families during operations, between 46 and 70 school age children would be expected in the ROI in 2017, meaning less than one additional teacher would be required to maintain existing student-teacher ratios in the local school system. These staffing increases would represent less than 0.1 percent of community service employment in each employment category expected in the ROI in 2017; the impact of the proposed GLE Facility's construction on community educational and medical service employment would, therefore, be SMALL.

4.2.13.3 Mitigation Measures

Because the socioeconomic impacts of the proposed GLE Facility, notably the impact of in-migrating workers on local housing markets and on local community service employment, are expected to be SMALL, it is unlikely that any specific mitigation measure would be necessary.

4.2.14 Environmental Justice Impacts

As described in Sections 4.2.1 through 4.2.13, the impacts of preconstruction activities and the proposed action, including construction activities and facility operations, are expected to be SMALL for most of the resource areas evaluated. The NRC staff has concluded that potential impacts could be SMALL to MODERATE in a number of resource areas during preconstruction activities, construction, and operations, and could potentially affect environmental justice populations. However, in each of these resources areas, the impacts would not appear to be disproportionately high and adverse for minority or low-income populations. A brief description of potential impacts on the general population follows:

- As described in Section 4.2.4, preconstruction and construction traffic, and operation of construction equipment are projected to cause a temporary increase in the concentrations of particulate matter having a mean diameter of 10 micrometers or less (PM_{10}) in the ambient air that slightly exceed the air quality standard, primarily to the north of the proposed site. These impacts are anticipated to be SMALL to MODERATE.

- As described in Section 4.2.13, the impacts on regional employment of preconstruction and construction activities would be considered SMALL. Similarly, the impacts of facility operations on regional employment would be considered SMALL. These impacts are generally considered positive.

- As described in Section 4.2.9, MODERATE impacts of increased noise would be associated with the operation of preconstruction and construction machinery, and SMALL impacts would be expected to result from operation of the proposed GLE Facility.

- As described in Section 4.2.10, increased truck and car traffic associated with preconstruction and construction activities, and with transportation of materials and product as well as employees, to and from the proposed GLE Facility, could produce SMALL to MODERATE increases in traffic congestion in the local road network.

- As described in Section 4.2.6, indirect surface water quality impacts caused by stormwater runoff from the GLE Facility site would occur, together with treated wastewater effluent discharges to the effluent channel. These impacts are anticipated to be SMALL.

- As described in Section 4.2.11, there may be trace radiological releases during facility operations. These impacts are anticipated to be SMALL.

- As described in Section 4.2.10, the probability of a severe transportation accident that releases sufficient quantities of UF_6 that could pose a health risk is low. The consequences of such an accident, should it occur, would be high. Based on this analysis, the public health impacts associated with such an accident as part of the proposed action are anticipated to be SMALL.

- As described in Section 4.2.15, accidents associated with proposed GLE operations could result in SMALL impacts on the surrounding public.

The majority of the environmental impacts associated with construction and operation of the proposed GLE Facility would be SMALL to MODERATE, and generally would be mitigated. The neighborhood immediately surrounding the proposed GLE Facility includes a mix of minority and nonminority residents, as well as a mix of low-income and more affluent residents. Specifically, the Census block group in which the proposed GLE Facility would be located has minority residents comprising 18.3 percent of its population, while low-income residents account for seven percent of its population. Because impacts on the general population would be generally SMALL to MODERATE, and because the greatest impact would be expected to occur in the immediate vicinity of the proposed GLE Facility in an area with a mix of races, ethnicities, and income levels, the various phases of facility development would not be expected to result in disproportionately high or adverse impacts on low-income or minority residents.

Even where environmental impacts would be generally SMALL, the behaviors of some population groups, such as higher participation in outdoor recreation, home gardening, or subsistence fishing, could lead to disproportionate exposure through inhalation or ingestion. One Census block group, which has a high percentage of low-income and minority residents, is located downstream of the proposed GLE Facility on the Northeast Cape Fear River. If radiation was released, residents there could face increased risk of exposure due to their fish-consumption patterns; however, the releases of total uranium and UF_6 are projected to be extremely low (see Section 4.2.11.2), and indirect exposure through fish consumption would be even lower.

Soil and vegetation samples from the existing site and from 1.6 kilometers (1 mile) away show no impact from current operations. As discussed in Section 4.2.11.2, the radiological doses to the nearest residents resulting from operation of the proposed GLE Facility and current operations are projected to be well below the EPA 10 millirem (0.1 millisieverts) per year standard (20 CFR Part 190) and the NRC total effective dose equivalent (TEDE) limit of 1 millisievert (100 millirem) per year (10 CFR Part 20).

Overall, therefore, the proposed GLE Facility would not be expected to result in disproportionately high or adverse impacts on minority or low-income populations.

4.2.15 Accident Impacts

The operation of the proposed GLE Facility would involve risks to workers, the public, and the environment from potential accidents. The regulations in 10 CFR Part 70, Subpart H, "Additional Requirements for Certain Licensees Authorized to Possess a Critical Mass of Special Nuclear Material," require that each applicant or licensee evaluate, in an Integrated Safety Analysis (ISA), its compliance with certain performance requirements. The Safety Evaluation Report (SER) for the proposed facility will include a more detailed analysis of the potential accidents identified in the GLE license application (GLE, 2009c). The accidents evaluated in this document are a representative selection of the types of accidents that are possible at the proposed GLE Facility.

The analytical methods used in this consequence assessment are based on NRC guidance for analysis of nuclear fuel-cycle facility accidents (NRC, 1990, 1991, 1998, 2001). With the exception of the criticality accident, the hazards evaluated involve the release of UF_6 vapor from process systems that are designed to confine UF_6 during normal operations. As described below, UF_6 vapor poses a chemical and radiological risk to workers, the public, and the environment. GLE has committed to various preventive and mitigative measures to significantly reduce these risks.

4.2.15.1 Accidents Considered

The GLE License Application (GLE, 2009c) describes potential accidents that could occur at the proposed GLE Facility. GLE provided accident descriptions according to facility node or operational unit, and further subdivided them by consequence, according to the severity of the accident.

The NRC staff selected, for detailed evaluation, a subset of the potential accident scenarios that is intended to encompass the range of possible accidents. The accident sequences the staff selected were all high-consequence, except for one. The representative accident scenarios selected vary in severity from high- to intermediate-consequence events and include accidents initiated by natural phenomena, operator error, and equipment failure. The accident scenarios evaluated are as follows:

- liquid fuel fire outside (Node 4100 cylinder storage and handling)

- system breach inside a low-temperature take-off system (Node 4200 feed and vaporization)

- small UF_6 release due to operator error (Node 4400 tails withdrawal)

- system breach inside a low-temperature take-off station (Node 4800 sampling)

- criticality due to uranium accumulated in decontamination and maintenance equipment (Node 5200 decontamination/maintenance)

The accident analysis does not include an estimate of the probability of occurrence of accidents, which, in combination with consequences, would reflect the overall risks of accident types; rather, analyzed accidents are assumed to occur.

4.2.15.2 Accident Consequences

Accidents involving release of UF_6 liquids or vapors were analyzed, in general, by identifying the quantity of a containerized material at risk inside the facility, the amount of material released into a room as vapor or particulates under the accident scenario, the fraction of released material that is of respirable size, and the fraction of material exhausted to the atmosphere through an available pathway, typically a building ventilation system. The dispersion of released material in the atmosphere and transport to onsite and offsite locations was then analyzed using the GENII code (Napier, 2004) with conservative inputs for release and atmospheric transport factors. The model estimated direct exposures to members of the public from an airborne plume, as well as exposures over a year's time from deposited uranium materials, to determine accident consequences to the public. Impacts on the public from a criticality accident were analyzed similarly, but for radioactive gases that would be released from a criticality event in a vessel inside the facility, including fission products and radioiodine.

The NRC performance requirements in Part 70, Subpart H, define acceptable levels of risk of accidents at nuclear fuel cycle facilities, such as the proposed facility. The regulations in Subpart H require that the applicant reduce the risks of credible high-consequence and intermediate-consequence events, and assure that under normal and credible abnormal conditions, all nuclear processes are subcritical. Threshold consequence values that define the high- and intermediate-consequence events, except for criticality events, are indicated in Table 4-26. The values in Table 4-26 are based on the requirements of 10 CFR 70.61 and the EPA's Acute Exposure Guideline Levels for chemical exposure to HF (EPA 2009f, EPA 2009g).

Receptors located at the Restricted Area Boundary within the site and at the Controlled Area Boundary represent worst-case exposures to non-radiological workers at the facility and members of the public, respectively. The NRC staff also evaluated accident consequences for releases of UF_6 for the general public offsite of the facility.

Table 4-27 summarizes the consequences from the hypothetical accidents. Consequences were evaluated against the above criteria. For the Criticality Accident at Node 5200, previous experience with this type of criticality accident indicates that a worker in close proximity (less than 4.5 meters [15 feet]) is unlikely to survive. With the increasing distance from the accident,

Table 4-26 Definition of High- and Intermediate-Consequence Events

Receptor	Intermediate Consequence	High Consequence
Worker – Radiological	>25 rem (0.25 Sv)	>100 rem (1 Sv)
Worker – Chemical (10-minute exposure)	>19 mg U/m^3 >78 mg HF/m^3 (95 ppm) (>AEGL-2 values[a])	>147 mg U/m^3 >139 mg HF/m^3 (170 ppm) (>AEGL-3 values)
Individual at the Controlled Area Boundary - Radiological	> 5 rem (0.05 Sv)	> 25 rem (0.25 Sv) 30 mg soluble uranium intake
Individual at the Controlled Area Boundary - Chemical (30 minute)	>2.4 mg U/m^3 >0.8 mg HF/m^3 (0.98 ppm) (>AEGL-1 values)	>13 mg U/m^3 >28 mg HF/m^3 (34 ppm) (>AEGL-2 values)
Environment at the Restricted Area Boundary	>24-hour average release greater than 5000 times the values in Table 2 of Appendix B of 10 CFR Part 20 (1.5×10^{-8} uCi/mL)	N/A

[a] AEGL: Acute Exposure Guideline Levels are public and private sector derived consensus values intended to describe the risk to humans resulting from once-in-a-lifetime, or rare, exposure to airborne chemicals.
Sources: EPA, 2009f; EPA, 2009g.

the radiation dose would be lower. Therefore, the NRC staff has qualitatively evaluated the accident as a high-consequence event for the worker. However, GLE has committed to various preventive and mitigative measures to significantly reduce these risks (GLE, 2008). A maximally exposed individual at the Controlled Area Boundary (CAB) would receive a radiation dose of 1.1 millisievert (0.11 roentgen equivalent man [rem]) total effective dose equivalent, which represents a Low consequence to an individual (<0.05 sievert [<5 rem]). The collective dose to the offsite population in the east–southeast direction, as determined using GENII (Napier, 2004), is estimated to be 0.6 person-sievert (60 person-rem). This population dose would cause an estimated 0.0007 lifetime cancer fatalities, or less than one fatality. Moreover, GLE would be required to maintain all processes non-critical thereby reducing the risk to the public from this type of accident. Thus, the risk of health effects to the offsite public from this accident would be SMALL

The consequences of the four accident scenarios involving a release of UF_6 vary widely, as shown in Table 4-27. Worker radiological consequences are Low (<25 rem [<0.25 sievert]) for

Table 4-27 Summary of Health Effects Resulting from Accidents

	Worker[a]		Environment at CAB	Individual at CAB		Collective Dose		
Accident (Node)	**[U], mg/m^3 (rem)[b]**	**[HF], mg/m^3 (ppm)**	**uCi/mL**	**[U], mg/m^3 (rem)**	**[HF], mg/m^3 (ppm)**	**Direction**	**Person-rem**	**LCFs**
Inadvertent Nuclear Criticality (5200)	(High[c])	NA	6.96[d]	(0.110)[e]	NA	ESE	60	7×10^{-4}
Liquid Fuel Fire Outside (Cylinder)[f] (4100)	327 (76.6)	274 (335)	4.23×10^{-12}	25 (0.1)	450 (550)	ESE	1298	1.5×10^{-2}
System Breach (Feed and Vaporization) (4200)	450 (1.2)	1595 (1950)	1.28×10^{-10}	52 (0.39)	41.1 (50.2)	ESE	264	3×10^{-3}
Small UF_6 Release (operator error) (4400)	11 (9×10^{-3})	1.35 (1.65)	2.57×10^{-14}	6 (5×10^{-3})	0.74 (0.90)	ESE	52	6×10^{-4}
System Breach (sampling) (4800)	33 (0.09)	327 (400)	2.85×10^{-12}	55 (0.15)	531 (649)	ESE	1648	2×10^{-2}

[a] Worker exits after 5 minutes in all cases.
[b] To convert rem to sievert, multiply by 0.01.
[c] High consequence could lead to a fatality.
[d] Pursuant to 10 CFR 70.61(c)(3), this value is the sum of the fractions of individual fission product radionuclide concentrations over 5000 times the concentration limits that appear in 10 CFR Part 20, Appendix B, Table 2.
[e] The dose to the individual at the CAB is the sum of internal and external doses from fission products released from the criticality.
[f] Though the consequences of the rupture of a liquid-filled UF_6 cylinder would be HIGH, sloped cylinder storage areas and combustible controls would make this event highly unlikely to occur.
CAB – Controlled Area Boundary; HF – hydrogen fluoride; LCF – latent cancer fatalities; mg/m^3 – milligrams per cubic meter; ppm – parts per million.

three of the four analyzed scenarios involving a UF_6 release and Intermediate (>25 rem [0.25 sievert] and <100 rem [1 sievert]) for the accident involving a liquid fuel fire outside (Node 4100). Worker health consequences from HF exposure are Low for the accident scenario at Node 4400, and are High for scenarios at Node 4100, Node 4200, and Node 4800. Worker consequences for uranium chemical exposure would be Low for the accident scenario at Node 4400, Intermediate for the scenario at Node 4800, and High for scenarios at Node 4100 and Node 4200.

Radiological consequences (30-minute exposure) to the maximally exposed individual at the CAB would be Low for all four UF_6 release scenarios and the criticality accident (<0.05 sievert [<5 rem]).

Uranium exposure consequences (30-minute exposure) would be Intermediate (>2.4 and <13 milligrams uranium per cubic meter [$>1.5 \times 10^{-7}$ and $<8.1 \times 10^{-7}$ pounds uranium per cubic foot]) for the accident scenario at Node 4400 and High (>13 milligrams uranium per cubic meter [$>8.1 \times 10^{-7}$ pounds uranium per cubic foot]) for the scenarios at Node 4100, Node 4200 and Node 4800. HF exposure consequences (30-minute exposure) would be Low (<0.8 milligrams HF per cubic meter [0.98 parts per million]) for the accident scenario at Node 4400 and High (>28 milligrams HF per cubic meter [34 parts per million]) for scenarios at Node 4100, Node 4200, and Node 4800.

Total consequences to the public in terms of radiation dose to the population in the ESE direction and resultant total lifetime cancer fatalities are given under Collective Dose in Table 4-27 Accident scenarios at all nodes predict less than one lifetime cancer fatality in this population.

Of the accident scenarios analyzed by the NRC staff, the most significant accident consequences to a worker would be those from scenarios involving a nuclear criticality (Node 5200), a system breach at a low-temperature takeoff station (Node 4200), and a liquid fuel fire outside resulting in a cylinder rupture and UF_6 release (Node 4100). The accident scenarios with the highest potential consequences to the public would be a system breach at a low-temperature takeoff station during sampling (Node 4800), a liquid fuel fire outside resulting in a cylinder rupture and UF_6 release (Node 4100), and a system breach at a low-temperature takeoff system (Node 4200). The potential consequences to the public from all three of these accidents would be potentially high due primarily to exposure to HF.

The NRC staff selected and evaluated a representative subset of the potential accidents that could occur at the proposed facility. The accident consequences vary in magnitude, and demonstrate that HF release is the predominant concern. The design of the proposed facility minimizes the likelihood of accidents occurring, while the facility Emergency Plan addresses all identified potential Low- to High-consequence events. The NRC staff concludes that, through the combination of plant design, passive and active engineered controls (items relied on for safety, or IROFs), and administrative controls, accidents at the proposed facility pose an acceptably low risk to workers, the environment, and the public. Thus, impacts from accidents are expected to be SMALL.

4.2.15.3 Mitigation Measures

NRC regulations (10 CFR Part 70, Subpart H) and GLE's operating procedures (GLE, 2008) for the proposed GLE Facility are designed to ensure that the high and intermediate accident scenarios would be highly unlikely. The NRC staff's SER assesses the safety features and operating procedures required to reduce the risks from accidents. The combination of responses by IROFs that mitigate or prevent emergency conditions, and the implementation of emergency procedures and protective actions in accordance with the proposed GLE Emergency Plan, would limit the consequences and reduce the likelihood of accidents that could otherwise extend beyond the proposed GLE boundaries.

Specifically, preventive and mitigative measures within the proposed facility relevant to a fire/explosion scenario would include (GLE, 2008):

- fire alarm and detection systems, possibly including a fire suppression system

- fire barriers preventing propagation of fires into and out of areas holding quantities of uranium materials

- system features that isolate combustible (process) materials and/or shut down processes to prevent or mitigate a fire

- continuous detection of a flammable gas in the laser system, with automatic isolation of process piping exceeding set limits

- structures designed to ensure that peak explosive blast loads would minimize intrusion of structural materials into UF_6 process or handling areas

- limiting combustibles in outside areas where cylinders are stored

Mitigative measures proposed by GLE relevant to radiological accidents would include (GLE, 2008):

- radiation detection and criticality monitoring systems to alert workers and isolate systems when parameters exceed set limits

- physical separation of areas within the facility designed to prevent or reduce exposure

- controlled positive or negative air pressures within designated areas to control air flow and prevent or maintain leakage between facility areas

- carbon absorbers, HEPA filters, and automatic trips on ventilation systems to prevent releases outside of affected areas

- limited building leakage paths to the outside environment through appropriate door and building design

These features are designed to contain UF_6 vapors within specified building areas and attenuate any release to the environment. Preventive controls for a nuclear criticality accident would include maintaining a safe geometry of all vessels, containers, and equipment that contain fissile material, and ensuring that the amount of such material in these vessels does not exceed set limits. Mitigative controls would include criticality monitoring and alarm systems and emergency response training (GLE, 2008).

4.2.16 Separation of Preconstruction and Construction Impacts

As described in Section 4.2, the NRC has granted an exemption (NRC, 2009a) for GLE to conduct certain preconstruction activities, and Sections 4.2.1 through 4.2.14 have provided estimates of the fraction of impacts that are attributable to preconstruction activities (conducted as part of the exemption granted by the NRC) and the fraction attributable to NRC-licensed construction activities. Table 4-28 provides a summary of the anticipated impacts for each resource area, along with the fractions of these impacts that would be attributable to preconstruction and construction activities, respectively.

4.2.17 Impacts from Decontamination and Decommissioning

This section summarizes the potential environmental impacts of decontamination and decommissioning of the site through comparison with facility construction and normal operational impacts. Decontamination and decommissioning would involve the removal and disposal of all operating equipment while leaving the structures and most support equipment decontaminated to free-release levels in accordance with 10 CFR Part 20 (since GLE does not plan to demolish the buildings). These activities would include the cleaning and removal of materials, equipment, and structures that are contaminated with radioactive and/or hazardous wastes. As discussed in Chapter 2 of this draft EIS, decommissioning activities are estimated to require 3.5 years, shorter than construction (6 years) or operations activities (40 years).

Decommissioning activities anticipated to be conducted for the proposed GLE Facility include purging and draining of process systems, dismantling and removal of equipment, decontamination of equipment and structures, waste disposal, and final radiological surveys (GLE, 2009c). GLE has also indicated that it plans to sell salvaged materials (GLE, 2009c). However, a complete description of actions taken to decommission the proposed GLE Facility at the expiration of its NRC license period cannot be determined fully at this time. In accordance with 10 CFR 70.38, GLE must prepare and submit a Decommissioning Plan to the NRC at least 12 months prior to the expiration of the NRC license for the proposed GLE Facility. GLE would submit a final decommissioning plan to the NRC prior to the start of decommissioning (GLE, 2008). This plan would be the subject of further NEPA review, as appropriate, at the time the Decommissioning Plan is submitted to the NRC. Decontamination and decommissioning activities would be conducted to comply with all applicable Federal and State regulations in effect at the time of these activities.

Depleted UF_6 (tails) that remains after the operational phase would be sold, sent to a DOE depleted UF_6 conversion facility, and/or sent to other licensed facilities for conversion. These facilities would convert the tails into a stable, non-volatile uranium compound for disposal in accordance with regulatory requirements. Low-level radioactive wastes produced during the

Table 4-28 Summary of Anticipated Impacts from Preconstruction and Construction Activities

Resource Area	Impact	Preconstruction (%)	Construction (%)
Land Use	SMALL	50	50
Historic and Cultural	SMALL to MODERATE[a]	95	5
Visual and Scenic	SMALL	25	75
Air Quality	SMALL to MODERATE[b]	75	25
Geology and Soil	SMALL	75	25
Surface Water	SMALL	75	25
Groundwater	SMALL	50	50
Ecology	SMALL to MODERATE[a]	75	25
Noise	SMALL to MODERATE[b]	75	25
Transportation	SMALL to MODERATE	NA[c]	NA[c]
Occupational and Public Health	SMALL	15	85
Waste Management	SMALL	2	98
Accidents	SMALL	NA[c]	NA[c]
Socioeconomic	SMALL	5	95
Environmental Justice	SMALL	NA[c]	NA[c]

[a] The majority of impacts on this resource occur during preconstruction. Therefore, the anticipated impacts from preconstruction activities are SMALL to MODERATE, and the anticipated impacts from construction activities are SMALL.
[b] Although the majority of overall impacts on this resource occur during preconstruction activities, the impacts vary on a daily basis, depending on the types of activities performed. Therefore, the anticipated impacts are SMALL to MODERATE for both preconstruction and construction activities.
[c] Quantitative separation of preconstruction and construction impacts is either not applicable or not appropriate for this resource.

decontamination and decommissioning process would be disposed of in a licensed low-level waste disposal facility. Hazardous wastes generated during the decontamination and decommissioning process would be treated or disposed of in permitted hazardous waste facilities. Releases to the atmosphere would be expected to be minimal. The final step in the decontamination and decommissioning process, the radiation survey, does not involve adverse environmental impacts. The proposed GLE Facility would be released for unrestricted use as defined in 10 CFR 20.1402.

The primary environmental impacts of the decontamination and decommissioning of the proposed GLE Facility include changes in releases to the atmosphere and surrounding environment, and disposal of industrial trash and decontaminated equipment. The types of impacts that may occur during decontamination and decommissioning would be similar to many of those that would occur during the initial construction of the proposed facility. Some impacts, such as water usage and the number of truck trips, could increase during the decontamination and disposal phase of the decommissioning, but would be less than the construction phase. The impacts on different resource areas from decontamination and decommissioning are discussed in detail in the following subsections.

4.2.17.1 Land Use

The location of the proposed GLE Facility is zoned for heavy industrial uses. The decontamination and decommissioning of an enrichment facility would not be expected to alter the zoning of the property or other adjacent properties. Impacts on land use from decontamination and decommissioning are expected to be SMALL.

4.2.17.2 Historic and Cultural Resources

It is unlikely that decontamination and decommissioning of an enrichment plant would have an effect on historic and cultural resources. Impacts on historic and cultural resources occur primarily during ground-disturbing activities; if decontamination and decommissioning activities require the disturbance of previously undisturbed land, then impacts could result. The need to clear previously undisturbed land is not expected as part of decontamination and decommissioning activities. The NHPA can also consider project effects on items of unique engineering. If, at the time of decommissioning, the technologies employed at the plant are considered significant to the nation for understanding nuclear technologies, some record of the plant may be required to mitigate the removal of the plant. It is not expected that this situation would arise. Therefore, the impacts on historic and cultural resources resulting from decontamination and decommissioning are expected to be SMALL.

4.2.17.3 Visual and Scenic Resources

Decontamination and decommissioning activities have the potential to impact visual and scenic resources, however, all impacts would be expected to be minimal and of short duration. Visual and scenic impacts associated with decontamination and decommissioning would result from the use of heavy equipment to dismantle the facilities and the increase in worker traffic. Once the decommissioning was complete, most of the visual impacts would cease. The vegetation screen surrounding the plant would remain, thus making changes to the plant unperceivable to all but the closest residences. Visual and scenic impacts from decontamination and decommissioning are expected to be SMALL.

4.2.17.4 Air Quality

Large-scale soil disturbances that would occur during the preconstruction phase would not be likely. Most decontamination activities would occur inside the buildings, for which emission controls would be in place to minimize atmospheric releases of radioactive materials. If decommissioning activities would include demolition of buildings, structures, and hard surface areas, heavy construction equipment, such as bulldozers, scabblers, or front-end loaders, would be used for demolishing and loading debris onto trucks. For these activities, fugitive dust emissions, potentially contaminated, would be a primary concern, and would be controlled using standard dust suppression techniques, e.g., water spraying. By employing dust suppression techniques, the demolition activities would be unlikely to violate the permit conditions. If necessary, work areas would be monitored for airborne dust, and respiratory protection may be used or a small, temporary shelter or tent with portable HEPA filtration may be used to minimize potential contaminated dust emissions. Salvaged materials for sale and wastes and debris for disposal would be hauled offsite. The number of workers during this phase would be fewer than those during construction or operations, but hauling truck traffic on the North access road would be comparable to that during construction phase. The GLE license, if issued, is expected to terminate in 2052. Around 2051, when decommissioning is expected to begin, more stringent exhaust standards may be applied to onroad and offroad engines, and zero-emission cars (e.g., electric or hydrogen fuel cell cars) may be more common. Overall, decontamination and decommissioning activities at the proposed GLE Facility would be considered comparable to or less than those during construction phase in terms of air emission rates and associated impacts. Therefore, potential impacts of decontamination and decommissioning activities on ambient air quality would be anticipated to be SMALL.

4.2.17.5 Geology and Soils

During decontamination and decommissioning of the proposed GLE Facility, the foundations, roads, and utility lines would likely be undisturbed. Erosion may increase, as portions of the site are disturbed by heavy equipment. BMPs would reduce the impact of the erosion, as discussed in Section 4.2.6.3 related to mitigation measures for surface water. Impacts on geology or soil during decontamination and decommissioning are expected to be SMALL.

4.2.17.6 Water Resources

During decontamination and decommissioning, the process wastewater flow would cease, but decontamination effluent would be generated. If sanitary discharge from the proposed GLE Facility could not be received by the Wilmington treatment and industrial reuse facility, then presumably, portable toilets would be required for the decommissioning workers. The collection, treatment, monitoring, and discharge of decontamination water would be expected to be designed to avoid significant environmental impact.

Erosion may increase, as portions of the site are disturbed by heavy equipment. BMPs would reduce the impact of the erosion, as discussed in Section 4.2.6.3 related to mitigation measures for surface water. Stormwater would continue to be gathered in a wet detention basin.

The removal of structures, utilities, materials, and products would not be expected to have an impact on site groundwater resources.

The overall impact on water resources from decontamination and decommissioning is anticipated to be SMALL.

4.2.17.7 Ecological Resources

This section evaluates the potential impacts of GLE Facility decontamination and decommissioning on ecological resources. Large-scale ecological resource impacts would not be likely, as most decontamination activities would occur inside the buildings. If decommissioning activities would include demolition of buildings, structures, or hard surface areas (e.g., cylinder storage pads and parking lots), the activities that could affect ecological resources include:

- the dismantling process
- generation of waste materials
- regrading of project areas
- revegetation activities
- accidental releases (spills) of potentially hazardous materials

Vegetation

Removal of facilities could impact vegetation adjacent to the facilities and cause offsite erosion and sedimentation. Landscaped areas used for staging of equipment or temporary storage of materials could also be impacted. Fill may be required following the removal of facilities. If Wilmington Site areas are used to supply the fill, any vegetation established at the source area would be destroyed. Following decontamination and decommissioning, affected areas would be revegetated (GLE, 2008). The plant community established where facilities are removed would depend on subsequent use of the project area.

Accidental spills of hazardous materials during decontamination and decommissioning could impact plant communities in the vicinity of the spill. Impacts would be similar to those discussed for preconstruction and construction (Section 4.2.8.1).

Wetlands

As no wetlands occur within the proposed GLE Facility area, decontamination and decommissioning activities would not directly impact wetlands.

Environmentally Sensitive Areas

As no environmentally sensitive areas occur within the proposed GLE Facility area, decontamination and decommissioning activities would not directly impact environmentally sensitive areas.

Wildlife

As decontamination and decommissioning activities would be restricted primarily to within the proposed GLE Facility, only landscaped areas and maintained lawn areas adjacent to the impervious storage pad areas would be impacted. During the decontamination and decommissioning phase, there would be a temporary increase in noise and visual disturbance to wildlife associated with vehicle, equipment, and worker activities.

Other potential environmental concerns resulting from decontamination and decommissioning would include the disposal of solid wastes and hazardous materials and the remediation of any contaminated soils. Some fuel and chemical spills could also occur, but these would be generally confined to the access road and project site area. The probability that wildlife would be exposed to such spills would be small and limited to a few individuals. After decontamination and decommissioning activities were complete, there would be no fuel or chemical spills associated with the proposed GLE Facility.

Impacts on wildlife from decontamination and decommissioning activities would be somewhat similar to those that occurred during the construction phase, but the extent of impacts would be less, as the operations building is not expected to be demolished. Minimal wildlife habitat would exist on the storage pads. If they would be removed as part of decontamination and decommissioning, their removal would have negligible direct impacts on wildlife. There would be an increase in noise and visual disturbance associated with the removal and subsequent restoration of facilities. Most wildlife would avoid the area while decontamination and decommissioning activities were taking place. Increased traffic levels during decommissioning could result in increased roadkills, but injury and mortality rates of wildlife would probably be lower than they would be during construction.

Revegetation of the removed facility areas could increase wildlife habitat diversity. Revegetation of the pad areas would probably result in habitat similar to that on other operational areas of the Wilmington Site (i.e., landscaped lawns). Wildlife species that would inhabit these areas would be the same as those that occur on other developed locations of the Wilmington Site (Section 3.8.4).

Aquatic Biota

Removal of the impervious areas, coupled with the cessation of the proposed GLE Facility's operations, would lower the amount of runoff and discharge to the stormwater detention basin and water treatment facilities. Therefore, what minimal impacts occur to water quality and thus, aquatic biota during operations, would cease. The potential would exist for fuel and chemical spills to occur. These would be confined to the access road and the proposed GLE Facility area and would not be expected to enter waterways. Once decontamination and decommissioning activities were completed, there would be no spills associated with the proposed GLE Facility.

Threatened, Endangered, and Other Special Status Species

As no threatened, endangered, or other special status species would be expected to inhabit the proposed GLE Facility, decontamination and decommissioning activities would not directly impact listed species.

Summary

In the long-term, decommissioning and reclamation would increase species diversity and habitat quality within the project area compared to that which would exist during operations.

4.2.17.8 Noise

Large-scale soil disturbances that would occur during preconstruction activities would not be likely during decontamination and decommissioning. Most decontamination activities would occur inside the buildings. If decommissioning activities would include demolition of buildings, structures, and hard surface areas, heavy construction equipment, such as bulldozers, scabblers, or front-end loaders would be used for demolishing and loading debris onto trucks. Salvaged materials for sale and wastes and debris for disposal would be hauled offsite. The number of workers during decommissioning would be fewer than those during construction or operations, but hauling truck traffic on the North access road would be expected comparable to that during construction. Due to the proximity, primary noise sources that could have impact on the nearest Wooden Shoe residential subdivision would be hauling trucks along the North access road. As discussed in Section 4.2.9, potential noise impacts on the nearest subdivision during the entire life of the project, except during the road construction phase of short duration (one month), are predicted to be SMALL. Even though cylinder pads would be removed and noisier heavy equipment would be used, noise levels at the nearest Wooden Shoe subdivision would be less than the New Hanover County Noise Ordinance and EPA guideline. Therefore, potential impacts from decontamination and decommissioning activities on the nearest Wooden Shoe residential subdivision would be expected to be SMALL.

4.2.17.9 Transportation

The initial decontamination and decommissioning activities during the last year of operations would increase the total number of workers at the proposed GLE Facility to approximately 400, a level similar to that during the construction period, with similar impacts. Approximately 50 workers are estimated to be needed during decommissioning (GLE, 2008) as shown in Table 4-10. An upper limit of fifty workers would be expected, though day-to-day numbers would vary depending on the scheduled activities as decontamination and removal of equipment and other materials progresses. The corresponding number of truck shipments to offsite locations during this time period is anticipated to be approximately the same as during construction, an average of about 35 trucks per day (GLE, 2008). Local and regional transportation impacts would be SMALL after operations are complete because of the decrease in workers from approximately 388 during construction, 350 during operations, 400 during operations and initial decontamination and decommissioning, to 50 during decommissioning.

Radioactive waste from decontamination and decommissioning would be sent to the appropriate storage, treatment, and disposal facilities as appropriate for the waste type as authorized by the NRC. Suitable disposal facilities would be identified at the time of decommissioning. All shipments would comply with existing NRC and DOT regulations. Impacts from radioactive waste shipments would be SMALL because of the low levels of external radiation and the low number of shipments.

4.2.17.10 Public and Occupational Health

The anticipated decontamination and decommissioning plans call for cleaning structures and selected facilities to free-release levels and allowing them to remain in place for future use. Allowing the buildings to remain in place would minimize the potential number of workers required for decontamination and decommissioning, which would reduce the number of injured workers compared to building removal. Occupational injuries would be of similar nature to those incurred during construction of the facility (Section 4.2.11.1), but would be reduced in number in accordance with the reduced effort required for decontamination and decommissioning. According to current estimates, such efforts would require about 23 percent of the worker level for construction: 450 FTEs versus 1938 FTEs for construction (GLE, 2008, Table 4.10-3). If residual contamination is discovered, it would be decontaminated to free-release levels or removed from the site and disposed of in a low-level radioactive waste facility.

It is estimated that the annual occupational dose during decontamination and dismantling activities would be in the range of 5–150 millirem (GLE, 2009a). The dose estimate is based on the time spent at different work locations and the dose rates in the non-affected and major processing areas. The dose rate assumed in the non-affected areas was 0.01 millirem per hour, and in the major processing areas it was up to 0.5 millirem per hour (GLE, 2009a). The highest dose is comparable to the average dose from the operating fuel facilities of 130-150 millirem (Table 4-21). Therefore, it is expected that the occupational dose during decontamination and decommissioning would be bounded by potential exposures during operations. Similar uranium handling would be involved (i.e., UF_6 in Type 48Y cylinders and UF_6 in the laser-enrichment lines) during the portion of operations that purges the laser-enrichment lines. Although purging operation is different from the normal operation, the number of UF_6 workers would be exposed in the laser-enrichment lines would not be much different. Once this decontamination operation is completed, the remaining quantity of UF_6 would be residual and significantly less than handled during operations. Because systems containing residual UF_6 would be opened, decontaminated (with the removed radioactive material processed and packaged for disposal), and dismantled, an active environmental monitoring and dosimetry (external and internal) program would be conducted to maintain ALARA doses to workers and to individual members of the public as required by 10 CFR Part 20. Chemical exposures would be similarly limited. Therefore, the impacts on public and occupational health would be SMALL.

4.2.17.11 Waste Management

The waste management facilities used during operations would be used during decontamination and decommissioning. With the ongoing drop in workers from operations to decommissioning, the sanitary wastewater treatment volumes would decline. Materials and equipment eligible for recycling or nonhazardous disposal would be sampled or surveyed to ensure that contaminant levels are below release limits. Buildings and other structures would be decontaminated and the debris shipped offsite for disposal. Radioactive material from decontamination and contaminated equipment would be packaged and shipped offsite to an appropriately licensed facility. Staging and laydown areas would be segregated and managed to prevent contamination of the environment and creation of additional wastes. Waste management impacts are expected to be SMALL.

4.2.17.12 Socioeconomics

Decontamination and decommissioning activities in the first year would create 50 direct jobs at the facility site. An additional 23 indirect jobs would be created in the ROI with the procurement of material and equipment and the spending of direct worker wages and salaries (Table 4-25). Decontamination and decommissioning of the proposed GLE Facility would produce $6.1 million in income in the ROI in the first year of decommissioning. Facility decommissioning would produce less than $0.3 million in direct State income taxes and less than $0.2 million in direct State sales taxes. With decommissioning activities constituting less than one percent of total ROI employment in the first year, the economic impact of decommissioning the proposed GLE Facility would be SMALL.

Given the scale of decommissioning activities and the likelihood of local worker availability in the required occupational categories, decontamination and decommissioning of the proposed GLE Facility would require some in-migration of workers and their families from outside the ROI, with between 115 and 120 persons in-migrating into the ROI during the first year of decommissioning. Although in-migration may potentially impact local housing markets, the relatively small number of in-migrants and the availability of temporary accommodation (hotels, motels, and mobile home parks) would mean that the impact of facility decommissioning on the number of vacant rental housing units is not expected to be large, with between 33 and 35 rental units expected to be occupied in the ROI during decommissioning. These occupancy rates would represent less than one percent of the vacant rental units expected to be available in the ROI; the impact of the proposed GLE Facility's decontamination and decommissioning on housing would, therefore, be SMALL.

In addition to the potential impact on housing markets, in-migration would also affect local community, education, and medical services employment to maintain existing levels of service. Accordingly, less than one police officer and less than one firefighter would be required in the peak decommissioning year. Assuming that a certain number of workers are accompanied by their families during decommissioning, between 38 and 40 school-age children would be expected in the ROI, meaning less than one additional teacher would be required to maintain existing student-teacher ratios in the local school system. These staffing increases would represent less than one percent of community service employment in each employment category expected in the ROI; the impact of the proposed GLE Facility's decontamination and decommissioning on community, educational, and medical service employment would, therefore, be SMALL.

4.2.17.13 Environmental Justice

As described in Sections 4.2.17.1 through 4.2.17.12, the potential impacts of the proposed action during decontamination and decommissioning are expected to be SMALL for all of the resource areas evaluated. Impacts would affect primarily residents in the immediate vicinity of the proposed GLE Facility, which would include a mix of minority and nonminority residents, as well as a mix of low-income and more affluent residents. Specifically, the Census block group in which the proposed GLE Facility is located has minority residents comprising 18.3 percent of its population, while low-income residents account for seven percent of its population. These percentages are below both county and State percentages for the same population groups. Because impacts on the general population are expected to be SMALL, and because the greatest impact is expected to occur in the immediate vicinity of the proposed GLE Facility in an area with a mix of ethnicities and income levels, the various phases of facility development would not be expected to result in disproportionately high or adverse impacts on low-income or minority residents, and would not, therefore, produce any environmental justice concerns.

Even where environmental impacts are generally SMALL, the behaviors of some population groups, such as higher participation in outdoor recreation, home gardening, or subsistence fishing, may lead to disproportionate exposure through inhalation or ingestion. One Census block group, which has a high percentage of low-income and minority residents, is located downstream of the proposed GLE Facility on the Northeast Cape Fear River. If radiation was released, residents there could face increased risk of exposure due to their fish-consumption patterns; however, the releases of total uranium and UF_6 are projected to be extremely low (see Section 4.2.11.2), and indirect exposure through fish consumption would be even lower.

Soil and vegetation samples from the existing site and from a mile away show no impact from current operations. As discussed in Section 4.2.11, the radiological doses to the nearest residents resulting from operations of the proposed GLE Facility and the current operations are projected to be well below the EPA 10 millirem (0.1 millisievert) per year standard (20 CFR Part 190) and the NRC total effective dose equivalent (TEDE) 100-millirem (1-millisievert) per year limit (10 CFR Part 20).

Overall, therefore, the proposed GLE Facility is not expected to result in disproportionately high or adverse impacts on minority or low-income populations.

4.2.17.14 Summary

For most resource areas, the adverse environmental impacts of decontamination and decommissioning of the proposed GLE Facility could be SMALL to MODERATE; similar to the construction impacts, except in reverse order. The notable exception would be cultural resources, where the impacts of preconstruction and construction activities would be significant in comparison to those of decontamination and decommissioning. The facilities and land could be released for restricted or unrestricted use, and releases to the environment from the proposed GLE Facility would stop. In addition, depending on the future use of the site, consumption of water and electricity and vehicular traffic to and from the site could be reduced. Decommissioning impacts would be localized in the immediate proposed GLE Facility-developed site. No disposal of waste, including radioactive waste, would occur at the proposed GLE Facility site.

4.2.18 Carbon Dioxide and Other Greenhouse Gas Impacts

This section presents an assessment of the effect construction, operations, and decommissioning activities for the proposed GLE Facility would be expected to have on carbon dioxide and greenhouse gas emissions.

4.2.18.1 Greenhouse Gases

Greenhouse gases include those gases, such as water vapor (H_2O), carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6), that are transparent to incoming short-wave radiation from the sun but opaque to outgoing long-wave (infrared) radiation from the earth's surface. The net effect over time is a trapping of absorbed radiation and a tendency to warm the planet's surface and the boundary layer of the earth's atmosphere, which constitute the "greenhouse effect." Some direct GHGs (CO_2, CH_4, and N_2O) are both naturally occurring and the product of industrial activities, while others such as the hydrofluorocarbons are created and are present in the atmosphere exclusively due to human activities. Each GHG has a different radiative forcing potential (the amount of thermal energy [in watts] trapped by the gas per square meter of the earth's surface). The radiative efficiency of a GHG is directly related to its concentration in the atmosphere. As a way to compare the radiative forcing potentials of various GHGs without directly calculating changes in their atmospheric concentrations, an index known as the Global Warming Potential (GWP) has been established with carbon dioxide, the most abundant of GHGs released to the atmosphere (after water vapor),[21] established as the reference point.

GWPs are calculated as the ratio of the radiative forcing that would result from the emission of 1 kilogram (2.2 pounds) of a GHG to that which would result from the emission of 1 kilogram (2.2 pounds) of CO_2 over a fixed period of time. GWPs represent the combined effect of the amount of time each GHG remains in the atmosphere and its ability to absorb outgoing thermal infrared radiation. As the reference point in this index, CO_2 has a GWP of 1. On the basis of 100-year time horizon, GWPs for other key GHGs are as follows: 21 for CH_4, 310 for N_2O, 11,700 for trifluoromethane (HFC-23), and 23,900 for SF_6 (IPCC, 2007).

Indirect GHGs, including CO, NO_x, nonmethane volatile organic compounds (NMVOCs), and SO_2, indirectly affect terrestrial solar radiation absorption by influencing the formation and destruction of tropospheric and stratospheric ozone or, in the case of SO_2, by affecting the absorptive characteristics of the atmosphere.

4.2.18.2 Greenhouse Gas Emissions and Sinks in the United States

The EPA is responsible for preparation and maintenance of the official U.S. Inventory of Greenhouse Gas Emissions and Sinks to comply with existing commitments under the United Nations Framework Convention on Climate Change (UNFCCC). GHG emissions are reported in sectors, using the GWPs established in the Second Assessment Report of the Intergovernmental Panel on Climate Change (IPCC).[22]

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[21] Water vapor is the most abundant and most dominant greenhouse gas in the atmosphere. However, it is neither long-lived nor well mixed in the atmosphere, varying spatially from 0 to 4 percent by volume. Compared to natural processes, human activities are not believed to have a significant direct effect on the average global concentration of water vapor; however, increased concentrations of other greenhouse gases released, in part, through human activities may indirectly affect the hydrologic cycle. Despite its substantial radiative forcing potential (primarily through the formation of clouds which can both absorb and reflect solar and terrestrial radiation), water vapor is not typically included in GHG inventories.

[22] IPCC assessment reports are a compilation of separate reports of the various working groups that are established by the Panel. IPCC periodically updates assessment reports to incorporate newly established data, including revisions to GWPs and radiative forcing potentials of GHGs. The latest is the Fourth Assessment Report, published in 2007. Revised GWPs are contained in the report of Working Group I (IPCC, 2007). However, to provide for the analysis of trends of GHG emissions and sinks over time, nations responsible for GHG inventories continue to use the GHG GWPs established in the Second Assessment Report published in 1996.

In 2007, total GHG emissions in United States were 7150.1 teragrams CO_2 equivalent,[23] an increase of 17 percent from 1990 (EPA, 2009c). In 2007, CO_2 emissions in U.S. were about 20 percent of worldwide emissions (EIA, 2009b). However, net emissions (considering sources and sinks) were estimated to be 6087.5 teragrams CO_2 equivalent. The primary GHG sinks functional in 2007 included carbon sequestration in forests, trees in urban areas, agricultural soils, and landfilled yard trimmings and food scraps, all of which, in aggregate, offset 14.9 percent of the total GHG emissions in 2007. The primary GHG emitted by human activities in the United States was CO_2, representing approximately 85.4 percent of the total GHG emissions (6103.4 teragrams CO_2 equivalent). The largest source of CO_2 for 2007 was the result of fossil fuel combustion (80.2 percent of total GHG emissions), primarily electricity generation (33.5 percent), transportation (26.4 percent), industrial applications (11.8 percent), residential heating (4.8 percent), and commercial applications (3.0 percent). Methane emissions in 2007, which declined from 1990 levels, were about 585.3 teragrams CO_2 equivalent, which represented about 8.2 percent of total GHG emissions. Major contributors to CH_4 emissions included enteric fermentation associated with domestic livestock, decomposition of wastes in landfills, and natural gas systems. Emissions of N_2O in 2007 were about 311.9 teragrams CO_2 equivalent (4.4 percent of total GHG emissions), for which agricultural soil management accounts for two-thirds of total N_2O emissions, followed by mobile fuel combustion (about 10 percent of total N_2O emissions). Emissions of HFCs in 2007 were 125.5 teragrams CO_2 equivalent (about 1.8 percent of total GHG emissions), most of which was associated with substitution of ozone-depleting substances. PFC and SF_6 emissions in 2007 were a small fraction of total GHG emissions (about 0.1 and 0.2 percent, respectively). Contributions to PFC emissions were comparable between aluminum production and semiconductor manufacturing, while three-quarters of SF_6 emissions in 2007 resulted from electrical transmission and distribution.[24] Albeit small emissions relative to other principal GHG emissions, emissions of HFCs, PFCs, and SF_6 were significant because many of them have extremely high GWPs and, in case the of PFCs and SF_6, long atmospheric lifetimes (e.g., PFC-14 with about 50,000 years).

Emissions of indirect GHGs in 2007 included about 14.25 teragrams for NO_x, 63.88 teragrams for CO, 13.7 teragrams for NMVOCs, and 11.73 teragrams for SO_2. Mobile fossil fuel combustion accounted for half of total NO_x emissions, followed by stationary fossil fuel combustion. CO emissions resulted primarily from mobile fossil fuel combustion, while SO_2 emissions resulted primarily from stationary fossil fuel combustion (e.g., coal-fired power plants). Mobile fossil fuel combustion and solvent use accounted for about 41 and 28 percent of NMVOCs emissions, respectively.

4.2.18.3 Greenhouse Gas Emissions and Sinks in North Carolina

Among States, North Carolina ranks 12th with respect to emissions of GHGs and 11th in population (based on 2003 data) (NextGenerationEarth, 2009). In 2005, North Carolina produced about 192 teragrams CO_2 equivalent gross emissions, an amount equal to 2.7 percent of total gross U.S. GHG emissions (Peterson et al., 2007). The principal source of North

[23] GHG emissions are expressed as CO_2 equivalent (or CO_2 Eq.), which is the product of the mass of a gas and its associated GWP. One teragram is equal to 10^{12} grams, or one million metric tons (1.12 million tons).

[24] SF_6 is a gas at standard conditions and is used as a dielectric medium in high-voltage electrical equipment.

Carolina's GHG emissions is consumption-based electricity use (electricity production netting out electricity exports), accounting for 39.5 percent of total State gross GHG emissions in 2005. The next largest contributors to total gross GHG emissions are the transportation sector (30.9 percent) and residential, commercial, and industrial fossil fuel combustion (16.6 percent). Note that electricity production is predominated by coal, which accounted for over one-third of State gross GHG emissions in 2005. Typically, coal-fired power plants produce as much as twice the CO_2 emissions per kilowatt-hour of electricity as natural gas-fired power plants. As a result of these factors, North Carolina's power plants are the greatest single source of GHG emissions in the State. Agricultural activities, industrial processes, and waste management account for the remainder of State GHG emissions (about 13 percent). Considering carbon sequestered and released from biomass throughout the State, net emissions would be about 169 teragrams CO_2 equivalent, an amount equal to 2.8 percent of total net U.S. GHG emissions. During the period 1990 to 2005, gross and net GHG emissions in North Carolina increased by about 42 and 57 percent, respectively, while gross and net national GHG emissions increased by only 17 and 14 percent, respectively.

4.2.18.4 Projected Impacts from the Construction, Operation, and Decommissioning of the Proposed GLE Facility on Carbon Dioxide and Other GHG Emissions

Construction and operation of the proposed GLE Facility can be expected to contribute to CO_2 and other GHG emissions through various mechanisms, primarily from combustion of fossil fuels in both mobile and stationary sources during construction, operations, and decommissioning. Individual contributions are discussed below. Regional transportation volumes used in the analysis below were established in Section 4.2.10.

Gasoline combustion is expected to occur at 99 percent efficiency, each gallon releasing 8.8 kilograms (19.4 pounds) of CO_2 (EPA, 2005). Likewise, diesel fuel burned at the same combustion efficiency would release 10.1 kilograms (22.2 pounds) of CO_2 per gallon. In this analysis, only CO_2 emissions were estimated. Gasoline and diesel engine combustion also generate small amounts of other GHG emissions, such as CH_4, N_2O, and HFCs. However, CO_2 emissions account for about 93–94 percent of total GHG emissions for automobiles and about 99 percent for heavy-duty trucks on a CO_2 equivalent basis (EPA, 2009c). Accordingly, estimation of CO_2 emissions only could underestimate total GHG emissions by a few percent.

CO_2 emissions source categories are similar during access road construction, land clearing, and building construction activities. The final start-up and final construction phase would include concurrent indoor construction activities with staged testing and start-up of process units as completed. Accordingly, CO_2 emission source categories during this phase are similar to those during operations. This discussion addresses these two phases together.

<u>Impacts During Access Road Construction, Land Clearing, and Building Construction</u>

Access road construction and land clearing activities were assumed in this analysis to include road construction for one month, followed by land clearing for eight months, and building construction for two years. During these activities, GHG emission sources would include heavy construction equipment, as well as commuting to and from the site by the construction workforce, and locally by delivery vehicles bringing materials and equipment to the site and removing construction-related non-radiological wastes from the site to area landfills and treatment/disposal facilities. Annual total fuel consumption for offroad heavy construction equipment is estimated using a fuel consumption rate of 0.065 gallons per horsepower-hour (SME, 1992). During access road construction and land clearing activities, an estimated 95 workers would work onsite, while during the building construction phase, an estimated 680 workers would work onsite. For onroad vehicles, a total of 200 daily local trips for access road construction and land clearing activities and 1428 daily local trips for building construction activities are assumed, 90 percent of which are from gasoline engine automobiles and 10 percent of which are from heavy-duty diesel trucks. Average vehicle miles traveled (VMT) offsite per trip by automobiles and trucks are assumed 10 and 100 miles, respectively. In addition, these vehicles would travel another 1.64 miles onsite from the gate to the proposed GLE Facility. Fuel economy factors of 24.1 and 7.2 miles per gallon were assumed for automobiles and trucks, respectively.

Annual total fuel consumption and CO_2 emissions are estimated, as shown in Table 4-29. During access road construction and land clearing activities, annual total CO_2 emissions would be around 3281 metric tons (3617 tons), which accounts for about 0.0017 percent of North Carolina GHG emissions in 2005 and 0.00005 percent of U.S. GHG emissions in 2007 (the most recent publically reviewed data). During the building construction phase, annual total emissions are estimated to be about 10,525 metric tons (11,602 tons), about 0.0055 percent of North Carolina GHG emissions and 0.00015 percent of U.S. GHG emissions. CO_2 emissions during this period are over three times more than those for access road construction and land clearing activities due to increased workforce and delivery activities.

<u>Impacts During Start-up and Final Construction, and Operations</u>

Start-up and final construction activities would occur for five years from 2013 to 2017, and operations would continue until 2051. During start-up and final construction, an estimated 743 workers would work onsite, while during the operations phase, an estimated 350 workers would work onsite. For onroad vehicles, a total of 1559 daily local trips for start-up and final construction and 735 daily local trips for operations are assumed. Compared with the previous two phases, auxiliary diesel generators, onsite transfer vehicles (OSTVs), possibly diesel-powered forklifts, and onsite diesel trucks used for cylinder transfer are added instead of offroad heavy construction equipment. To support facility operations, regional deliveries would be anticipated: UF_6 feedstock coming to the proposed GLE Facility and UF_6 product, depleted UF_6 tails, empty 48Y cylinders, and LLRW leaving the facility. Detailed discussion including the destination and total distance traveled by delivery trucks is available in Section 4.2.10. It is assumed that separate shipments would be initiated to return empty cylinders and waste containers to their points of origin. It is further assumed that, during start-up and final construction, the production level on average would be 50 percent of that during operations.

During start-up and final construction, the proposed GLE Facility is estimated to release 12,852 metric tons (14,166 tons) of CO_2, which is equivalent to 0.0067 percent of North Carolina GHG emissions and 0.00018 percent to U.S. GHG emissions in 2007. During operations, CO_2 emissions are projected to be 9934 metric tons (10,950 tons), approximately 0.0052 percent of the North Carolina Statewide output in 2005 or 0.00014 percent of nationwide emissions in 2007. The start-up and final construction phase would release the highest CO_2 emissions during the lifespan of the GLE project, followed by building construction and operations. During start-up and final construction, CO_2 emissions from local traffic are predicted to predominate

Table 4-29 Annual CO_2 Emissions from Access Road Construction, Land Clearing, Building Construction, Start-up and Final Construction, and Operation of the Proposed GLE Facility

Phase	Air Emission Source	Fuel		CO_2 Emission Factor (lbs/gal)[b]	CO_2 Emissions	
		Type	Consumption rate (gals/yr)[a]		(tons/yr)	(MTs/yr)[c]
Access Road Construction and Land Clearing	Offroad construction equipment	Diesel	229,249	22.2	2546.0	2309.7
	Automobiles (local)	Gasoline	23,415	19.4	226.6	205.6
	Diesel trucks (local)	Diesel	76,039	22.2	844.5	766.1
	Total				3617.1	3281.4
Building Construction	Offroad construction equipment	Diesel	126,744	22.2	1407.6	1277.0
	Automobiles (local)	Gasoline	222,844	19.4	2156.8	1956.6
	Diesel trucks (local)	Diesel	723,694	22.2	8037.1	7291.3
	Total				11,601.5	10,524.9
Start-up and Final Construction	Auxiliary diesel generator units[d]	Diesel	–	–	10.4	9.4
	OSTVs used for cylinder transfer	Diesel	6299	22.2	70.0	63.5
	Onsite diesel truck used for cylinder transfer	Diesel	29	22.2	0.3	0.3
	Automobiles (local)	Gasoline	247,426	19.4	2394.7	2172.5
	Diesel trucks (local)	Diesel	803,525	22.2	8923.7	8095.6
	Diesel trucks (regional)[e]	Diesel	249,175	22.2	2767.3	2510.5
	Total				14,166.4	12,851.7
Operations	Auxiliary diesel generator units[d]	Diesel	–	–	10.4	9.4
	OSTVs used for cylinder transfer	Diesel	6299	22.2	70.0	63.5
	Onsite diesel truck used for cylinder transfer	Diesel	29	22.2	0.3	0.3
	Automobiles (local)	Gasoline	116,616	19.4	1128.7	1023.9
	Diesel trucks (local)	Diesel	378,715	22.2	4205.9	3815.6
	Diesel trucks (regional)[e]	Diesel	498,349	22.2	5534.5	5020.9
	Total				10,949.8	9933.6

[a] See Appendix E for detailed information on underlying assumptions.
[b] Source: EPA, 2005.
[c] MTs/yr = metric tons/year. To convert to tons/year, divide by 0.9072.
[d] Emissions are estimated using the NCDENR calculator spreadsheet (NCDENR, 2010).
[e] Includes UF_6 feed coming to proposed GLE Facility and UF_6 product, depleted UF_6 tails, empty 48Y cylinders, and LLRW leaving the facility.

over regional traffic. However, during operations, CO_2 emissions from local and regional traffic would be comparable.

Impacts During Decommissioning

As discussed in Section 4.1, because decommissioning will take place well in the future, detailed plans for decommissioning the proposed GLE Facility are not known at this time. Consequently, the impacts of decommissioning are discussed qualitatively in this document.

The main sources of CO_2 and other GHG emissions during the decommissioning phase are expected to be shipment of waste (LLRW and nonhazardous/nonradioactive waste) to appropriate disposal facilities and shipment of any remaining depleted UF_6 on site to a conversion facility. In addition, heavy equipment use at the site and travel to and from the site by the decommissioning workers would contribute to CO_2 and other GHG emissions during decontamination and decommissioning.

The emissions from shipments of waste and depleted UF_6 would depend on the locations of selected disposal and conversion facilities. Because GLE does not plan to demolish buildings during decommissioning (see Section 4.2.17), the quantity of nonhazardous/nonradioactive waste generated during this phase of the project would be relatively small as compared to the quantity generated during operations. With respect to LLRW, GLE estimates that it would generate approximately 18,800 cubic meters (664,000 cubic feet) of LLRW during the entire decommissioning period (GLE, 2009c). Assuming that LLRW generated during decommissioning has a density of 2 kilograms per liter (125 pounds per cubic foot), GLE would generate approximately three times more LLRW, by mass, during decommissioning than it would during operations. Assuming LLRW is disposed of in the same facility during decommissioning as it is during operations, this difference would represent approximately 3,000 more shipments of approximately 3,940 kilometers (2,450 miles) during the entire decommissioning period as compared to the operations period. However, the emissions from these LLRW shipments would be less than the emissions from other shipments that would occur during operations but not during decommissioning, including approximately 900 shipments per year of unenriched UF_6 feed to the facility (470 to 1400 kilometers [290 to 870 miles]), 50 shipments per year of enriched UF_6 product (480 to 4780 kilometers [300 to 2970 miles]), and 50 shipments per year to return empty depleted UF_6 cylinders (1320 kilometers [820 miles]).

Available storage space on the cylinder storage pads would limit the number of depleted UF_6 cylinders that could be stored on site at any one time to 9,000. Upon cessation of facility operations, it is likely that less than 9,000 cylinders would be stored on-site. However, assuming 9,000 cylinders would be stored on site and awaiting shipment to a conversion facility during decommissioning, there would be approximately three times as much depleted UF_6 shipped to a conversion facility during operations as there would be during decommissioning.

As a result, CO_2 emissions associated with shipments of materials, including LLRW, nonhazardous/nonradioactive waste, and depleted UF_6, during decontamination and decommissioning would be less than the 221,000 tons (200,000 metric tons) of CO_2 emissions that are associated with use of diesel trucks at the regional scale during 40 years of facility operations (see Table 4-29).

As discussed in 4.2.17.4, large-scale soil disturbances are not likely during decommissioning. In addition, GLE does not currently plan to demolish buildings associated with the proposed GLE Facility during decommissioning. Therefore, significantly less heavy equipment use would be expected during decontamination and decommissioning than during access road construction and land clearing, and the CO_2 emissions from heavy equipment use during decontamination and decommissioning would be bounded by the offroad construction vehicle CO_2 emissions during access road construction and land clearing listed in Table 4-29. Similarly, because the number of employees during operations is significantly greater than during decontamination and decommissioning, the GHG emissions associated with employee traffic during decontamination and decommissioning would be bounded by the emissions provided in Table 4-29 for local automobile use during operations.

Based on the considerations of the expected CO_2 emissions attributable to shipment of depleted UF_6 to a conversion facility, shipment of LLRW for disposal, heavy equipment use, and employee traffic as described in this section, the total quantity of GHGs emitted during decontamination and decommissioning is expected to be less than the amount emitted during operations.

Indirect Positive Impacts from Operation of the Proposed GLE Facility

Nuclear power generation with fuel fabricated from the proposed GLE Facility would indirectly displace GHG emissions that would otherwise be released from fossil-fuel power plants. Accordingly, enriched UF_6 produced at the proposed GLE Facility can be thought of as an indirect GHG sink. It is estimated that, at full production, the proposed GLE Facility would produce approximately 2047 metric tons (2257 tons) of enriched UF_6 annually, which would be equivalent to 1570 metric tons (1731 tons) of uranium dioxide (UO_2) fuel.[25] A typical 1100-megawatt pressurized water reactor (PWR) would have approximately 98 metric tons (108 tons) of UO_2 in its core (Nero, 1979). Thus, annual production of the proposed GLE Facility could replace the fuel cores of 16 PWRs. Operating at a capacity factor of 95 percent, each PWR would be capable of producing 9154 gigawatt-hours per year, so the total amount of power associated with GLE-enriched UF_6 production would be 146,654 gigawatt-hours per year.

Carbon Dioxide and Other GHG Emissions Summary

In summary, over the lifespan of construction and operation of the proposed GLE Facility, the start-up and final construction phase was projected to generate the highest emissions. These direct emissions would be about 0.0067 percent of North Carolina GHG emissions in 2005 and 0.00018 percent of U.S. GHG emissions in 2007 (the most recent publicly reviewed data). The NRC staff concludes that potential impacts from the construction, operation, and decommissioning of the proposed GLE Facility on climate change would be SMALL.

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[25] AREVA Enrichment Services, LLC, (AES) estimated that, at full production, EREF would produce approximately 2252 metric tons (2482 tons) of enriched UF_6 annually, which would be equivalent to 1727 metric tons (1904 tons) of UO_2 fuel (NRC, 2010b). The capacity of the proposed GLE Facility would be 6 million SWU and the total production volume of enriched UF_6 annually is estimated in proportion to production capacity of EREF (6.6 million SWU).

4.3 Cumulative Impacts

The Council on Environmental Quality regulations implementing NEPA define cumulative effects as "the impact on the environment which results from the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 CFR 1508.7). Cumulative impacts are presented below for resource areas in which there are anticipated changes related to other activities that may arise from single or multiple actions and may result in additive or interactive effects (e.g., other new facilities that are planned at the Wilmington Site).

Impacts from preconstruction activities for the proposed GLE Facility are addressed as cumulative impacts in this draft EIS, as these actions are not part of the proposed action. These impacts are discussed within the various resource area discussions in Section 4.2 so that they can be presented alongside similar impacts from construction of the facility that are included in the proposed action. In Section 4.2.16, impacts resulting from preconstruction are identified as a percentage of total impacts estimated to occur prior to facility operations. In this sense, site preconstruction activities would be considered past activities for the purposes of cumulative impacts.

Consultation with local development boards and agencies with which proposed new projects are filed identified other actions or activities in the area that could affect the same resources as the proposed GLE Facility, contributing to cumulative effects.

Identified activities include several that exist or will exist at the Wilmington Site. Onsite and adjacent offsite activities are summarized below:

- Existing facilities on the Wilmington Site. These include the existing FMO facility and other existing facilities.

- Facilities planned for the Wilmington Site. Two new facilities, which could contribute to cumulative effects, are planned for the Wilmington Site – the Advanced Technology Center (ATC) II complex and the Tooling Development Center (see Figure 4-1). In addition, it is reasonably foreseeable that a security-related feature, independent of security measures specific to the proposed facility, may be developed on the Wilmington Site (GLE, 2009d). Additional information about this feature and the cumulative impacts of the proposed action in combination with this feature are provided in Appendix H.

- New processes planned for the Wilmington Site. Sanitary wastewater from the existing FMO facility is currently treated for reuse for industrial purposes. This process would be expanded to include similar sanitary wastewater from the proposed GLE Facility for industrial reuse.

- Offsite industrial development. (1) The Carolinas Cement Company has submitted an application for an air permit to construct a new cement manufacturing plant in northeastern Hanover County, roughly six miles northeast of the proposed GLE Facility. (2) The River Bluffs residential development has been proposed to be built on 95 hectares (237 acres) adjacent to the southern boundary of the Wilmington Site.

- Offsite UF_6 transportation and local traffic increases. Increased transport of UF_6 feed and waste materials could increase doses to the public over those from current transport of such materials from operation of the FMO facility. Increased traffic from workers at the proposed GLE Facility would contribute to traffic congestion on local roads and highways.

The following sections present assessments of the potential cumulative impacts of the proposed action in combination with above activities by resource area. Cumulative impacts associated with the no-action alternative on the various resource areas would be generally less than those for the proposed action, except in terms of local job creation. Therefore, except for socioeconomic impacts, the cumulative impacts of the no-action alternative are not discussed in detail.

4.3.1 Land Use

Cumulative impacts on land use would result if the proposed action in combination with other projects prohibited other land uses from occurring or were incompatible with current zoning. The proposed GLE Facility site is located on property currently owned by GE. The eastern portion of the property already contains the GNF-A and GE AE/SCO plant. The proposed GLE Facility is consistent with the current zoning. Additional industrial development is expected

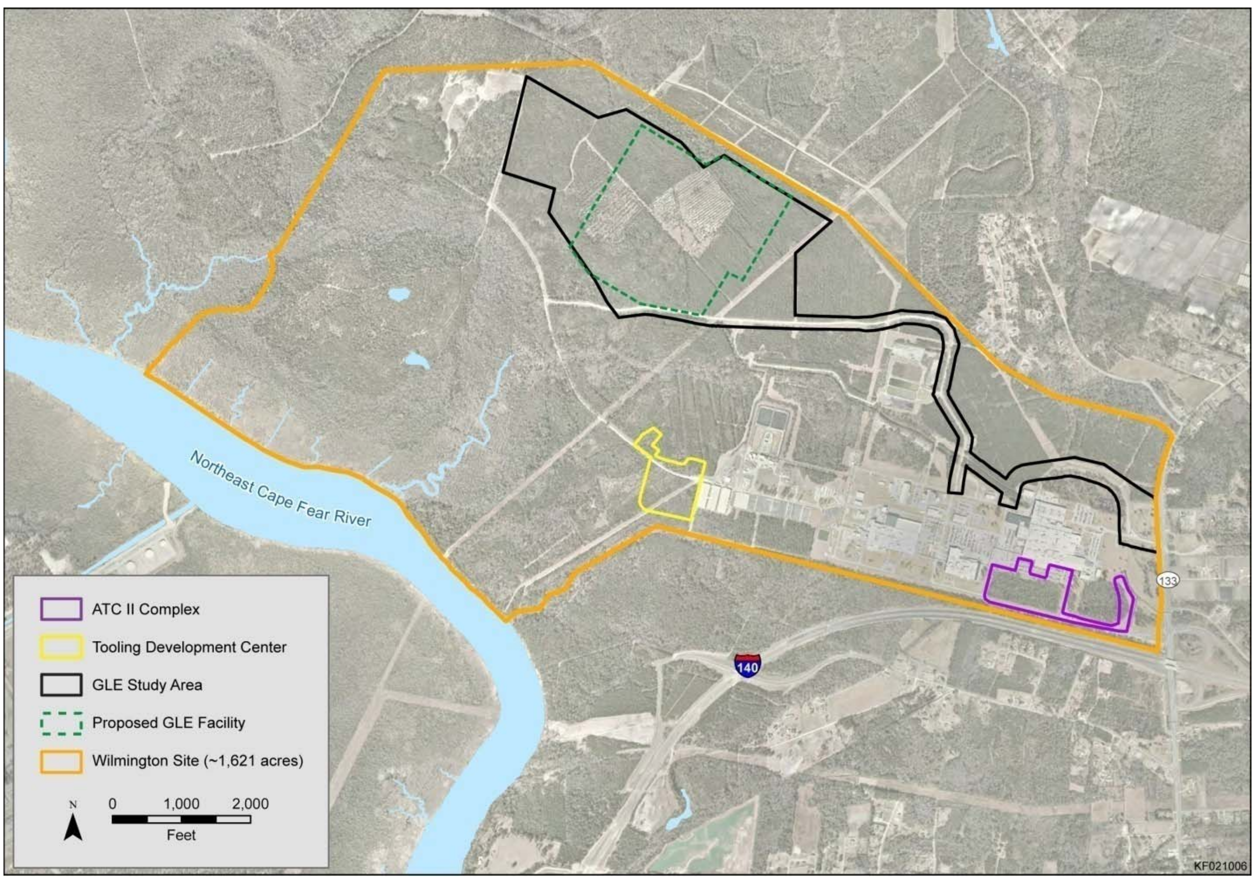

Figure 4-1 Planned Projects at the Wilmington Site (Modified from GLE, 2008)

in the area including the Titan Cement plant. Other developments include several new housing complexes. The construction and operation of the plant would alter the current land use of mixed pine forest, however, it would not be expected to affect land use in the surrounding area. Therefore, cumulative impacts on land use are expected to be SMALL.

4.3.2 Historic and Cultural Resources

The NRC has concluded that the impacts of constructing and operating the proposed GLE Facility could range from SMALL to MODERATE on historic and cultural resources. Cumulative impacts on historic and cultural resources can result from the incremental loss of unique site types. It is unclear what, if any, historic and cultural resource types would be affected by the proposed action. Site types known to exist in the vicinity of the project area contain evidence of Middle Woodland Cultures as well as other prehistoric sites of unknown age. Historic remains are also found in the vicinity dating to the colonial periods as well as later American era sites. Without knowing the full range of sites that could be impacted by the proposed action, it is unclear if cumulative impacts could result. However, most impacts on cultural resources would occur during preconstruction activities, because the majority of ground-disturbing activities would occur at this time. The security-related feature discussed in Appendix H could impact several NRHP-eligible sites. However, because the proposed action is situated in a different location and is not expected to affect the NRHP-eligible sites that could be affected by the security-related feature, the proposed action is expected to have little incremental impact in combination with the security-related feature. In the event that sites are found, proper mitigation would be developed by GLE in consultation with the North Carolina SHPO. Cumulative impacts could range from SMALL to MODERATE.

4.3.3 Air Quality

As discussed in Section 3.5.3, New Hanover County, in which the proposed GLE Facility would be located, and neighboring Brunswick and Pender Counties, are currently designated as being in attainment for all criteria pollutants (40 CFR 81.334).

As discussed in Section 4.2.4.2, potential incremental air quality impacts of the proposed GLE Facility would be SMALL and localized. Accordingly, the proposed GLE Facility operations would make a small contribution to cumulative impacts for other actions planned in the New Hanover County. In addition to the proposed GLE Facility, a number of onsite and offsite projects are planned in the New Hanover County as discussed below (GLE, 2008).

Additional projects planned at the Wilmington Site include the Advanced Technology Center (ATC) II complex and the Tooling Development Center. These projects would not use radioactive materials or include manufacturing operations. Neither of the projects would be a major source of air emissions as defined under EPA or NCDAQ air permit requirements. Emission sources for these projects would be limited to small natural gas-fired boilers for space heating, emergency diesel generators, and other small operating units.

As an offsite industrial development, the Carolinas Cement Company LLC, has submitted an air permit application to construct a new Portland cement manufacturing plant on 757-hectare (1868-acre) parcel, which is located about 10 kilometers (6 miles) east-northeast of the proposed GLE Facility (EQM, 2008). Per the “potential to emit” section in the air permit application, the facility can be classified as a major source. This plant would also emit toxic air pollutants (TAPs) including a trace amount of fluorides. Air dispersion modeling indicated that maximum concentrations are less than applicable ambient air quality standards and all maximum impacts occurred within a few kilometers of the facility boundaries. Potential cumulative impacts in public health associated with fluoride emissions are discussed in Section 4.3.8.

Another offsite development is new River Bluffs residential and mixed-use project planned on 96 hectares (237 acres) bounded by the Wilmington Site's southern boundary, I-140, and Northeast Cape Fear River. This project would not include any large stationary sources, and thus, would not be considered as a major source of criteria pollutants under EPA or NCDAQ air permit requirements. This project along with three proposed projects at the Wilmington Site could draw more automobiles and trucks on Castle Hayne Road (NC 133) and I-140, and thus increase air emissions along these routes.

Overall, all of these projects planned in the New Hanover County would increase air emissions over the current levels. However, incremental impacts of individual projects would be predicted to be limited to the immediate vicinity of their property lines, and thus, would not be additive due to the distances between them. It is unlikely that potential impacts from all of these projects combined would be high enough to significantly deteriorate ambient air quality or reverse current attainment status. Accordingly, potential cumulative impacts on ambient air quality in New Hanover County would be expected to be SMALL.

4.3.4 Geology and Soils

Two other construction projects planned for the Wilmington Site could result in 60 additional acres of disturbed land. These projects are the ATC II complex and the Tooling Development Center. Construction impacts would involve activities similar to those of the proposed alternative, namely clearing, grading, and excavation for building foundations and a stormwater detention pond. Best management practices would avoid or limit the impact on soil. Operational impacts on soil would be negligible. Preconstruction activities at the proposed GLE Facility site would create a similar situation in terms of disturbed land, with approximately 91 hectares (226 acres) of cleared, regraded land. Proposed developments in the Wilmington area include a cement plant 32 kilometers (20 miles) upstream of the site, and several residential developments, including a 600-lot development with nursing home facilities, proposed for siting adjacent to the Wilmington Site's south boundary (New Hanover County, 2009a). A speculative possibility is 1000 acres of mixed development near the Wilmington Site, east of Castle Hayne Road (New Hanover County, 2009a). In these offsite areas, BMPs are expected to be required by New Hanover County to control soil erosion (New Hanover County, 2007).

Geologic resources are not expected to be impacted by Wilmington-area activities. Cumulative impacts on soil from the proposed action and the additional construction projects are expected to be SMALL due to county involvement, presumed BMPs, and schedules that likely are not all simultaneous.

4.3.5 Water Resources

Other facilities in New Hanover County are permitted to discharge to the Northeast Cape Fear River or the tributary Prince George Creek (EPA, 2009b). These include municipal wastewater treatment plants and various industries. Discharges from these facilities have State oversight through the NPDES permitting system and reporting of monitoring results.

Two other new facilities at the Wilmington Site, the ATC II and the Tooling Development Center, would convey stormwater to wet detention basins en route to discharge to surface water bodies. These basins, as with the proposed facility's basin, would have clay liners to limit the infiltration of stormwater to the groundwater system. The construction of the ATC II would not coincide with the proposed GLE Facility, so impacts that arise from disturbed ground, such as turbidity and sediment loading, would not occur from both sites simultaneously. The Tooling Development Center's construction runoff would run through wooded land, which would provide sediment attenuation beyond that provided by following BMPs.

As described in Section 4.3.4, offsite development for residential and industrial purposes is expected to occur, resulting in additional disturbed land. The timing of possible construction is unknown, but it could provide cumulative detrimental effect of turbidity and sediment load to the Northeast Cape Fear River. Wastewater effluent and stormwater effluent flowing to the river would increase once any residential community or industrial facility was built. Surface water monitoring stations in between the Wilmington Site and the proposed cement facility would provide a basis for determining the relative impact of the site. Enforced adherence to county-level ordinances regarding erosion control and stormwater management (e.g. New Hanover County, 2007; New Hanover County, 2009c) would limit the impact of new developments.

Effective in April 2008, the Wilmington Site's treated sanitary wastewater is used in processes and as makeup water for its cooling tower systems, rather than discharged at Outfall 002. After reuse, wastewater is treated at the Wilmington Site's final process lagoon, and the effluent is discharged to the effluent channel at Outfall 001. The low hardness of the treated sanitary wastewater increases the efficiency of Wilmington Site cooling towers. This reuse of water decreases the need for pumping of groundwater for process needs. The relative increase in groundwater pumping for the proposed GLE Facility includes 11,000 gallons per day additional for potable water and 75,000 gallons per day additional for process water (GLE, 2008). However, the net cumulative amounts of groundwater pumping, including proposed site facilities ATC II and Tooling Development Center, and also factoring in the reuse of treated sanitary effluent, are an increase of 29,500 gallons per day for potable water, and a decrease of 44,600 gallons per day for process water (GLE, 2008). While appreciable, the potable water need is small compared to the current groundwater withdrawal at the site of 656,640 gallons per day (see Section 3.7.4.2), a rate that has been sustained over a long period of time.

Based on the potential impacts on surface water that are controlled by the NPDES permitting and county ordinances, and based on anticipated groundwater withdrawals that are not significant, the overall cumulative impact on water resources is anticipated to be SMALL.

4.3.6 Ecology

Many of the natural terrestrial and wetland habitats of New Hanover County have been modified, fragmented, or replaced by commercial, residential, and industrial developments (including silviculture and agriculture) (LeBlond and Grant, 2003). Similarly, extensive areas of natural upland and wetland forests on the Wilmington Site have been modified to pine plantations and operational (industrial) areas. The proposed GLE Facility, other projects to be developed on the Wilmington Site (i.e., the ATC II complex, the Tooling and Development Center, and a security-related feature discussed in Appendix H), and unrelated projects to be constructed near the Wilmington Site (e.g., residential, industrial, and commercial developments) would contribute to the cumulative impact to ecological resources of the county (GLE, 2008; New Hanover County, 2009a). Overall, cumulative impacts on ecological resources from the proposed action in combination with the security-related feature discussed in Appendix H are SMALL. Impacts from the other projects to be developed on or near the Wilmington Site are discussed in the following paragraphs.

Impacts on ecological resources from construction of the ATC II complex and the Tooling and Development Center projects would result from activities similar to those for preconstruction and construction activities for the proposed GLE Facility, namely site clearing and grading. The ATC II complex has impacted about 8.4 hectares (20.8 acres) of pine forest and less than 0.01 hectare (0.01 acre) of pine-hardwood forest; while the Tooling and Development Center would impact about 0.1 hectare (0.3 acre) of pine forest, 2.9 hectares (7.2 acres) of pine-hardwood forest, and 2.6 hectares (6.4 acres) of pine plantation forest (GLE, 2009e). As discussed in Section 4.2.8.1, about 81 hectares (201 acres) of habitat would be impacted by preconstruction and construction activities for the proposed GLE Facility. The majority of this (65 hectares [160 acres]) would be pine plantation, pine forest, or pine-hardwood forest. Overall, these three projects would change over 79 hectares (195 acres) of these forest habitat types on the Wilmington Site to operations area habitat (e.g., buildings, other facilities, and landscaped lawns). An additional 1.2 hectares (3 acres) of alluvial, pocosin/bay, and swamp forest would be impacted by the proposed project (Table 4-4, Section 4.2.8.1). The loss of forested habitat from the three construction projects within the Wilmington Site would be more than 20 percent greater than from the proposed GLE Facility alone; and would total about 15.5 percent of the forest habitat on the Wilmington Site. Overall, the cumulative impacts on vegetation on the Wilmington Site from preconstruction activities for the proposed GLE Facility and construction of the ATC II complex and the Tooling and Development Center would be MODERATE. The contribution to cumulative impacts from the remaining construction of the proposed GLE Facility and operation of the three facilities would be SMALL.

Negligible direct impacts on wetlands within New Hanover County in general or specifically on the Wilmington Site are expected from any of the proposed construction projects on the Wilmington Site (the access road to the proposed GLE Facility may cause the loss of up to 0.021 hectare (0.052 acre) of jurisdictional wetlands and 0.02 hectare (0.06 acre) of an isolated wetland); while indirect (but mitigable) impacts on wetlands from erosion and sedimentation may occur from the proposed GLE Facility and the ATC II complex (GLE, 2008; GLE, 2009e; GLE, 2009f). Past drainage of over 120 hectares (298 acres) of wetlands occurred on the Wilmington Site; while over 198 hectares (490 acres) of wetlands would be impacted by the proposed cement manufacturing plant and quarry to be located east of the Town of Castle Hayne (Benjamin, 2008). The contribution of the proposed GLE Facility, ATC II Complex, and the Tooling and Development Center to cumulative impacts on wetlands within New Hanover County and on the Wilmington Site would be SMALL.

No environmentally sensitive areas occur within the proposed GLE Facility area. Any indirect impacts on environmentally sensitive areas from preconstruction activities, construction, and operation of the proposed GLE Facility would be SMALL (Section 4.2.8). Therefore, any cumulative impacts on environmentally sensitive areas due to the proposed GLE Facility would be SMALL.

Impacts on wildlife from construction and operation of the ATC II complex and the Tooling and Development Center would be similar to those discussed for the proposed GLE Facility (Section 4.2.8). The main impacts on wildlife that occur from a construction project are habitat disturbance (i.e., habitat loss, alteration, and fragmentation). Habitat fragmentation would be potentially less for the ATC II complex and Tooling and Development Center, as they would be more closely situated within the main operations area in the Eastern Site Sector of the Wilmington Site than would the proposed GLE Facility. Past actions that have impacted wildlife habitat on the Wilmington Site have involved primarily the drainage of over 120 hectares (298 acres) of forested wetlands, and alteration of natural habitats (e.g., pine and pine-hardwood forests) for pine plantations, power line corridors, or operations areas. These habitat alterations have affected 255 hectares (631 acres), nearly 39 percent, of the Wilmington Site (GLE, 2008). Overall, the cumulative impacts on wildlife on the Wilmington Site from preconstruction activities for the proposed GLE Facility and construction of the ATC II complex and the Tooling and Development Center would be MODERATE. The contribution to cumulative impacts from the remaining construction of the proposed GLE Facility and operation of the three facilities would be SMALL.

As discussed in Section 4.3.5, cumulative impacts on water resources are expected to be SMALL. As a result, cumulative impacts on aquatic biota due to the proposed GLE Facility would also be SMALL.

Federally threatened and endangered species are not known to occur in the area of the proposed ATC II complex and the Tooling and Development Center (GLE, 2008). Therefore, cumulative impacts on Federally threatened and endangered species from these facilities and the proposed GLE Facility would be SMALL. Similarly, cumulative impacts on a number of the Federal species of concern or State-listed species that occur within New Hanover County would be SMALL, because they are not expected to inhabit the areas within which these three facilities would occur. For those species that may be present within areas that would be impacted by one or more of these facilities (i.e., those species assessed in Section 4.2.8.1), cumulative impacts from preconstruction activities for the proposed GLE Facility and/or construction of the other two facilities would be SMALL to MODERATE, depending on how many individuals could be impacted and possible mitigation measures that would be undertaken to protect those individuals. Cumulative impacts from remaining GLE construction and from the operation of all three projects to those species would be SMALL.

4.3.7 Transportation

The additional 300 to 400 workers for the proposed GLE Facility are about a 10 percent to 15 percent increase from the 2800 workers currently employed at the Wilmington Site.

Furthermore, approximately 1000 more employees (GLE, 2008) may be added to the site with the addition of the ATC II complex and the Tooling Development Center noted in Section 4.3. However, the additional 1000 workers would be using the existing site entrances, not the one to be dedicated for GLE Facility use.

A foreseeable event in the vicinity of the site is a planned retirement community project that would use Chair Road, which intersects Castle Hayne Road about one-quarter mile south of the I-140 interchange (GLE, 2008). This project is anticipated to generate 3700 average daily trips in the local area. Combined with the increased employment at the Wilmington Site, the local incremental transportation impacts associated with the construction and operation of the proposed GLE Facility are anticipated to be MODERATE as the annual average daily trips could increase approximately 50 percent (about 1000 from GLE; 2000 from ATC II and the TDC; 3700 from the retirement community) from the current value of 12,000 on Castle Hayne Road near the site entrance.

Approximately 2086 radioactive material shipments annually to or from the Wilmington Site would be added in support of the proposed GLE Facility (GLE, 2008). These shipments would roughly triple the number of radioactive material shipments occurring at the site, with about 996 annual shipments currently supporting site activities (GLE, 2009a). The additional radiological impact on those in the vicinity of the additional shipments would be SMALL. If the same person were to be present for all current shipments, that person would receive approximately 0.01 millisievert per year (1 millirem per year) from these shipments if they were by the road (such as a security guard) 2 meters (6.6 feet) from the side of each shipment as it passed by at a speed of 24 kilometers per hour (15 miles per hour). That same person would only receive approximately 0.002 millisievert per year (0.2 millirem per year) from the GLE shipments because the expected external dose rates are much lower on average than those from current operations at the site. Thus, any expected exposure would only increase approximately 20 percent at the most over current conditions, despite three times the number of current shipments.

4.3.8 Public and Occupational Health

This section describes the cumulative impacts on public and occupational health associated with preconstruction activities, construction, and operation of the proposed GLE Facility on the Wilmington Site in combination with other past, present or foreseeable actions in the region that may affect the same resources as the proposed facility. The focus of the discussion is on radiological cumulative effects, and when appropriate, cumulative non-radiological effects are described.

4.3.8.1 Preconstruction and Construction Activities

The cumulative impacts associated with preconstruction and construction activities on public and occupational health could be received by some workers during the four-year overlap of the six-year construction period and the first years of operations. Accordingly, the potential annual radiological exposure to an onsite construction worker (3.85×10^{-4} millisievert per year [3.85×10^{-2} millirem per year]) would be well below the applicable dose limits for the general public of 1 millisievert per year (100 millirem per year) limit listed at 10 CFR 20.1301(a)(1).

During the preconstruction and construction activities, the potential dose to offsite personnel would not increase.

4.3.8.2 Operations

The cumulative radiological and non-radiological impact of uranium emissions from the proposed GLE Facility and existing FMO facility at the Wilmington Site were evaluated.

The yearly average TEDE to involved workers for 2003–2007 at the Wilmington Site from FMO operations varied from 0.50–0.75 millisievert per year (50–75 millirem per year), which is less than the applicable dose limits for the general public of 1 millisievert per year (100 millirem per year) limit listed in 10 CFR 20.1301(a)(1) and well below the 10 CFR 20.1201 limit of 50 millisieverts (5000 millirem) for involved workers (i.e., workers in radiologically controlled areas) (NRC, 2009c). The average estimated dose to involved workers at the proposed GLE Facility is expected to be less than 1.5 millisieverts per year (150 millirem per year), which is well below the regulatory thresholds. Because the workers at the FMO facility and the proposed GLE Facility would not be working at both facilities, there would not be a cumulative exposure and even considering the overall collective dose to workers from existing conditions, and ongoing and anticipated operations at the Wilmington Site, the cumulative radiological impacts on workers from existing conditions and ongoing and anticipated site operations will be SMALL.

To assess the cumulative impacts on public health, the potential cumulative impacts of radiological air emissions from the existing FMO facility and the proposed GLE Facility were analyzed. Radiological releases to air from both facilities would be routinely monitored to ensure that releases are at or below the expected and regulated levels. In addition, the North Carolina Division of Radiation Protection collects data from a monitoring network of six ambient air samplers (GLE, 2008). The monitoring network is intended to assess whether the radiological air emissions from the FMO facility affect air quality in the surrounding area. Data are collected both onsite and in the area surrounding the Wilmington Site. A background ambient air monitoring station is located approximately 1.6 kilometers (1 mile) west of the site. The analytical results from air sampling stations closer to the plant are compared to background measurements (GLE, 2008). Based on the predicted emission rates associated with the FMO facility and the proposed GLE Facility, and on current data from the comprehensive site monitoring program, the cumulative radiological emissions would result in a SMALL impact on air quality.

Currently there is an insignificant contribution to direct radiation exposure at the site boundary from FMO facility operations. None of the TLDs used to monitor such exposures showed readings above the background exposure rate of 5 microroentgens per hour at the site boundary (GLE, 2009b). The additional storage planned for the proposed GLE Facility is expected to have a similar minor effect on the direct radiation exposure rate at the site boundary. Therefore, the cumulative impact from direct exposure to the public is expected to be SMALL.

The cumulative effect of operating the existing FMO facility and the proposed GLE Facility may result in some increase of dose at the fenceline of the Wilmington Site from air emissions. The estimated maximum dose due to air emissions from the FMO facility at the fenceline is approximately 4×10^{-4} millisievert per year (4×10^{-2} millirem per year) (Section 3.11.1.2). The operation of the proposed GLE Facility would introduce new source of radiological emissions. The estimated maximum dose due to air emissions from the proposed GLE Facility at the fenceline is 1.4×10^{-6} millisievert per year (1.4×10^{-4} millirem per year) (Section 4.2.11.2). The estimated doses from both the FMO facility and proposed GLE Facility are far less than the applicable dose limits for the general public of 1 millisievert per year (100 millirem per year) limit listed at 10 CFR 20.1301(a)(1) and would result in a SMALL cumulative impact.

Non-radiological cumulative impacts on occupational and public health could accrue from the airborne emissions of UF_6 and HF from the proposed GLE Facility (Section 4.2.11.2) in combination with those from the adjacent FMO facility. However, as noted in Section 4.2.11.2, the estimated emissions of these chemicals from the proposed GLE Facility would be well below levels of concern. Fluoride emissions from the FMO facility between 1995 and 2005 were typically a fraction of their permitted levels of 0.29 kilograms per day (0.63 pounds per day), while measured air concentrations were a small fraction of the recommended workplace exposure limit of 2.5 milligrams per cubic meter (NRC, 2009c). Additional fluoride emissions from the proposed GLE Facility are expected to be much lower than those from the FMO facility and would not materially increase the total levels of fluorides in the air onsite or at the site boundary. Fluoride emissions from the proposed Carolinas Cement facility, the only other significant potential source of fluoride emissions in the region, which would be located about six miles to the north, would not adversely impact ambient air quality outside the boundary of that plant, according to analysis prepared to support its permit application (EQM, 2008). Impacts from mercury emissions from the same facility would be minor and would not contribute to adverse health effects in the region, as discussed in Section 3.11.3.4. In addition, health impacts from mercury, a neurological toxin, would not combine cumulatively with those from HF, a respiratory irritant. Given the distance between the contributing facilities, the required fluoride emission permits for the facilities, and the relatively minor contributions of the proposed GLE Facility, the cumulative impacts of fluoride and other toxic chemical emissions in the region would be SMALL.

Uranium emissions, as UF_6, from the FMO facility, evaluated in terms of radiological effects, were estimated be a tiny fraction of the applicable dose limit for members of the public (GLE, 2008). Because predicted uranium and HF emissions would produce air concentrations that are far below levels of health concern, it is expected that effects of chemical toxicity of uranium and HF from the facility would also be minor. Thus, the expected low-level uranium and HF emissions from the proposed GLE Facility would not contribute to material increases in public or worker exposure, while the cumulative effects of both uranium and HF emissions would be SMALL.

4.3.9 Waste Management

Potential average daily process and sanitary wastewater flow rates from existing facilities, the proposed GLE Facility, and potential future facilities at the Wilmington Site are summarized in Table 4-30. As shown in the table, the total site process and sanitary wastewater flow rates, without taking credit for reuse in the site cooling towers, are approximately 1,956,000 liters per day (516,200 gallons per day) and 236,000 liters per day (62,300 gallons per day), respectively, which are well below the NPDES permit levels of 6.8 million liters per day (1.8 million gallons

Table 4-30 Cumulative Wastewater Generation at the Wilmington Site

Wilmington Site Wastewater Source	Total Average Daily Wastewater Flow Rate (gpd)		
	Process Wastewater	Sanitary Wastewater	Combined Wastewater Flow Rate
Existing Wilmington Site facilities[a]	476,200	33,300	509,500
Proposed GLE Facility[b]	35,000	10,500	45,500
Other planned onsite projects[c]	5000	18,500	23,500
Total projected treated wastewater effluent (not including industrial reuse of treated sanitary wastewater effluent)	516,200	62,300	578,500
Effects of industrial reuse of treated effluent from the Wilmington Site sanitary wastewater treatment facility[d]	−62,300[e]	−62,300[f]	−124,600
Projected NPDES-permitted discharges of wastewaters to the onsite effluent channel	453,900[e]	0[f]	453,900

[a] Total averaged daily volumes based on measured flow for 2006.
[b] Total averaged daily volumes based on estimated flow rates for GLE operations (see Table 4-23).
[c] Total averaged daily volumes based on estimated flow rates for ATC II complex and Tooling Development Center.
[d] Although the reuse of treated sanitary wastewater effluent from the Wilmington Site sanitary wastewater treatment facility as Site process water commenced in April 2008, it is included in the cumulative impacts assessment because it postdates the 2006 baseline set of conditions.
[e] Because the treated sanitary wastewater effluent has such low hardness, its addition to the Wilmington Site cooling towers increases efficiencies. Each gallon of reuse water introduced into a cooling tower offsets 2 gallons of process makeup water, which reduces the amount of process water to be treated in the final process lagoons and discharged to the effluent channel.
[f] The effluent reuse process water resulted in a 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. The effluent reuse process also reduces the requirement to withdraw groundwater to meet the Wilmington Site process-water requirement.
Note: Total wastewater quantities presented in this table are lower than the process-water and potable-water demands due to consumptive losses. To convert gallons to liters, multiply by 3.8.
Source: GLE, 2008.

per day) and 284,000 liters per day (75,000 gallons per day), respectively. Thus, cumulative impacts from wastewater generation would be SMALL.

Current disposal of hazardous and solid wastes from the Wilmington Site is expected to continue, and disposal of hazardous, nonhazardous solid, and solid LLRW from the proposed GLE Facility at appropriate facilities is shown in Section 4.2.12.2 to comprise a small fraction of the disposal rates and capacities at these disposal facilities. The majority of waste expected from the future ATC II complex and the Tooling Development Center at the Wilmington Site would be municipal solid waste destined for disposal at the New Hanover County Landfill (GLE, 2008). Based on available capacities at LLRW and hazardous waste treatment and disposal sites in conjunction with the anticipated expansion of the New Hanover County Landfill (see Section 3.12.4.1), the cumulative impacts from hazardous and solid waste generation are anticipated to be SMALL.

4.3.10 Socioeconomics

Preconstruction and construction activities in the peak year would create 680 direct jobs at the facility site itself. An additional 3131 indirect jobs would be created in the ROI with the procurement of material and equipment and the spending of direct worker wages and salaries (Table 4-25). Facility construction would produce $139.8 million in income in the ROI. Beginning in 2013, start-up activities would create 200 direct jobs annually at the facility itself, with an additional 218 indirect jobs created in the ROI, producing $28.0 million in income in the ROI. During the period 2013 to 2016, construction and start-up activities would occur at the same time. Direct construction impacts during this period would vary from 485 direct workers, 2718 indirect workers and $99.7 million in income in 2013, to 155 direct workers, 869 indirect workers and $31.9 million in income in 2016. The cumulative impact of construction and start-up during this period would range from the creation of 685 direct and 2936 indirect jobs and $127.7 million in income in 2013, to 355 direct and 1087 indirect jobs and $59.9 million in income in 2016.

Operations activities beginning in 2017 would create 350 direct jobs at the facility site, with an additional 382 indirect jobs created in the ROI, and would constitute less than one percent of total ROI employment. Facility operations would produce $51.5 million in income in the ROI in 2017. During 2017, construction and operations activities would occur at the same time. Facility construction would produce 136 direct, 762 indirect jobs and $28.0 million in income. The cumulative impact of construction and operations in 2017 would create 486 direct and 1144 indirect jobs and $79.5 million in income. Compared to existing employment levels in the ROI, the economic impact of construction and operations activities associated with the proposed GLE Facility would be SMALL.

Construction would produce $1.7 million in direct State income taxes and $1.2 million in direct State sales taxes in the peak construction year, while start-up activities would produce $1.3 million in income taxes and $0.9 million in sales taxes annually, beginning in 2013 and continuing through 2017. During the period 2013 to 2016, construction and start-up activities would occur at the same time. Income taxes associated with construction activities during this period would range from $0.4 million to $1.2 million, while sales taxes would range from $0.3 million to $0.9 million. The cumulative impact of construction and start-up activities between would therefore range from $1.7 million and $2.5 million in income taxes, and between $1.2 million and $1.8 million in sales taxes. Operations would produce $2.3 million in direct State income taxes and $1.7 million in direct State sales taxes. During 2017, construction and operations activities would occur at the same time, with a total of $2.6 million in income taxes and $1.9 million in sales taxes produced by the proposed GLE Facility. Compared to current State total income and sales tax revenues, the impact of constructing and operating the proposed GLE Facility on sales and income taxes would be SMALL.

Given the duration and scale of activities and the likelihood of local worker availability in the required occupational categories, construction of the proposed GLE Facility would require some in-migration of workers and their families from outside the ROI, with between 299 and 598 persons moving into the ROI during the peak year of construction (2012) and between 92 and 120 persons migrating into the area during start-up activities. During the period 2013 to 2016, construction and start-up activities would occur at the same time. In-migration associated with construction activities during this period would vary from 207 and 304 in 2013 and between 141 and 172 in 2016. Cumulatively, between 99 and 424 persons would move into the ROI in 2013 and between 233 and 292 persons in 2016. Between 161 and 210 persons would move into the ROI during the first year of full operations (2017). During 2017, construction and operations activities would occur at the same time, with a total of between 167 and 194 persons in-migrating into the ROI in that year. Although in-migration may potentially impact local housing markets, the relatively small number of in-migrants and the availability of temporary accommodation (hotels, motels, and mobile home parks) would mean that the impact of facility construction on the number of vacant rental housing units is not expected to be large. Between 87 and 173 rental units in the ROI would be required during construction and between 27 and 47 rental units would be required during start-up activities. During the period 2013 to 2016, construction and start-up activities would occur at the same time. The cumulative demand for rental housing during the period 2013 to 2016, when construction and start-up activities would occur at the same time, would range between 99 and 424 units in 2013 and between 233 and 292 units in 2016. Between 47 and 61 owner-occupied units would be required during operations. These occupancy rates would represent less than one percent of the vacant rental units expected to be available in the ROI; the impact of GLE Facility construction and operations on housing would, therefore, be SMALL.

In addition to the potential impact on housing markets, in-migration would also affect local-community educational and medical services employment to maintain existing levels of service. These staffing increases would represent less than one percent of community service employment in each employment category expected in the ROI; the impact of GLE Facility construction and operations on community educational and medical service employment would, therefore, be SMALL.

Two other projects are currently under construction or planned at the Wilmington Site, in addition to the proposed GLE Facility (GLE, 2008). The ATC II complex is anticipated to employ approximately 500 workers once in operation. The Tooling Development Center, construction of which is projected to occur in 10 years, would employ approximately 500 workers annually when operational. Construction of the ATC II complex will be completed before construction of the proposed GLE Facility is under way, while the timing, workforce requirements, and worker residential locations of the Tooling Development Center would overlap with the operation of the proposed GLE Facility.

Elsewhere in the ROI area, additional projects anticipated include the Carolinas Cement Company LLC, proposal to construct a cement plant in New Hanover County, which would employ approximately 800 workers. Operations are expected to begin in 2013 (GLE, 2008), overlapping slightly with the construction phase of the proposed GLE Facility. Assuming in-migration of workers for this project would occur at the same level as would likely occur with the proposed GLE Facility, relatively SMALL annual increases are expected in ROI population, and would not significantly increase employment in medical services and public safety. Housing growth trends in New Hanover County and plans for new school construction suggest that additional demands on these resources in the ROI resulting from the Carolinas Cement project construction would be SMALL. The cumulative socioeconomic impact of the construction of the proposed GLE Facility and the Carolinas Cement Company plant are anticipated to be SMALL to MODERATE.

4.3.11 Environmental Justice

Although minority and low-income populations occur in the vicinity of the Wilmington Site (see Section 3.14), construction and operation of the proposed GLE Facility and other proposed projects onsite and offsite would not affect such populations disproportionately. Accordingly, there would be no cumulative impacts on minority and low-income populations.

4.4 Impacts of the No-Action Alternative

As presented in Section 2.2 of this draft EIS, the no-action alternative would be to not construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina. As discussed in Section 1.4.1 and the introduction to Section 4.2, the NRC has granted an exemption for GLE to conduct certain preconstruction activities in advance of a formal licensing decision. If the NRC does not grant a construction and operating license for the proposed GLE Facility, approximately one year of preconstruction activities will likely have already occurred (preconstruction activities are expected to begin in early 2011, but construction cannot begin until a licensing decision is made, which is not expected to occur until June 2012). It follows that the impacts associated with these preconstruction activities, as described in Section 4.2, will also have occurred. There may be additional activities occurring at the site in the future under the no-action alternative that may have adverse or beneficial impacts on the environment. The impacts associated with these activities would depend on what GLE would decide to do with the site or any administrative buildings already constructed on the site. However, the impact conclusions presented in this section address the impacts of denying the license and do not include the impacts of preconstruction activities.

Utility customers would continue to depend on existing suppliers (e.g., existing uranium enrichment facilities, foreign sources, and the “Megatons to Megawatts” program) to fulfill uranium enrichment needs. In addition, new domestic supply sources are currently under construction (NEF and ACP) or planned and seeking a license from NRC (EREF). Current U.S. demand for low-enriched uranium is about 12 to 14 million SWU annually (EIA, 2008; EIA, 2009a). USEC is currently the only domestic supplier of enrichment services, providing enriched uranium to both domestic and foreign users. Existing USEC enrichment activities include operation of the aging Paducah Gaseous Diffusion Plant (GDP), the downblending of highly enriched uranium under the “Megatons to Megawatts” program that is managed by USEC and scheduled to expire in 2013, and the import of foreign-enriched product. By combining its domestic enrichment facilities and the downblending of foreign highly enriched uranium, USEC can provide for approximately 56 percent of the U.S. enrichment market needs (USEC, 2004) while foreign suppliers provide the remaining 44 percent.

As discussed in Section 1.3.1 of this draft EIS, three future domestic sources of enriched uranium supply are planned, and all three have applied to NRC for a license to construct and operate. The efforts by these prospective suppliers for technology research and development, licensing, construction, and operation of their facilities are unrelated to the proposed GLE Facility.

Under the no-action alternative, there is only one currently operating domestic enrichment facility, the Paducah GDP, which could continue to serve as a source of low-enriched uranium into the foreseeable future or until replaced by one the new or planned facilities. The "Megaton to Megawatts" program managed by USEC would continue to provide low-enriched uranium until 2013. After cessation of this program in 2013 – if not renewed by the United States and Russia – the availability of low-enriched uranium through the downblending of highly enriched uranium is uncertain. Reliance on only one domestic source for enrichment services could result in disruptions to the supply of low-enriched uranium, and consequently, to reliable operation of U.S. nuclear energy production, should there be any disruptions to foreign supplies and/or the operations of domestic suppliers (i.e., failure to construct and operate the ACP, NEF, or EREF and failure to extend the "Megatons to Megawatts" program beyond 2013).

If the license is denied, nuclear electricity generation using the enriched uranium from the proposed GLE Facility could be replaced with other power generation sources (e.g., fossil-fuel plants), or enriched uranium could be provided by sources constructed at other locations (such as ACP, NEF, or EREF). Therefore, impacts similar to those quantified in this draft EIS would simply occur at a different location.

4.4.1 Land Use

Under the no-action alternative, preconstruction activities would have occurred. The discussion of impacts from preconstruction activities for land use is presented in Section 4.2.1.1. The baseline for the no-action assessment is a cleared property with utilities and administrative structures extant.

Under the no-action alternative, the proposed GLE Facility would not be licensed, and therefore, not constructed on the land that was cleared and prepared for the facility. Because denying the license would not preclude other uses of the land, the land use impacts would be SMALL.

4.4.2 Historic and Cultural Resources

Under the no-action alternative, preconstruction activities would have occurred, but the proposed GLE Facility would not be constructed or operated. The discussion of the impacts resulting from preconstruction activities on historic and cultural resources is provided in Section 4.2.2.1.

Because denying the license would not result in additional land disturbance at the Wilmington Site, anticipated impacts on historic and cultural resources in New Hanover County from the no-action alternative are expected to be SMALL. If an alternate site was chosen for construction of the enrichment plant, a consideration of the historic and cultural resources at the alternate location would be reviewed in consultation with the appropriate SHPO.

4.4.3 Visual and Scenic Resources

Under the no-action alternative, preconstruction activities would have occurred. The baseline for the no-action alternative is a property cleared of vegetation with utilities and support structures in place. A discussion of the impacts of preconstruction activities on visual resources is provided in Section 4.2.3.1.

The vegetation screen that surrounds the property would be intact under the no-action alternative. Because denying the license would not introduce any additional visual disturbance at the Wilmington Site, local visual impacts of the no-action alternative are expected to be SMALL.

4.4.4 Air Quality

Under the no-action alternative, air emission sources for the existing Wilmington Site would continue to operate according to the allowable emission limits and emission control requirements set forth in the current two “synthetic minor” operating permit issued by the North Carolina Division of Air Quality (NCDAQ). As discussed in Section 3.5.3.1, point source emissions from current operations at the Wilmington Site are negligible compared with the annual total emissions in New Hanover County.

If the license is denied, nuclear electricity generation using the enriched uranium from the proposed GLE Facility would be replaced with other power generation sources, e.g., fossil-fuel plants. This could increase a substantial amount of criteria pollutants, and HAPs, emissions elsewhere and contribute to air pollution, acid rain, and visibility degradation. Use of power generation sources could also lead to GHG emissions elsewhere.

Because denying the license would not directly result in local air quality impacts from additional vehicle emissions, land disturbance, or facility emissions, potential impacts of no-action alternative on ambient air quality would be expected to be SMALL.

4.4.5 Geology and Soils

Under the no-action alternative, preconstruction activities such as grading, wet retention basin construction, and drainage changes would have occurred at the proposed GLE Facility site and along site roads. If a no-action alternative is selected, additional ground-disturbing activities, such as excavation for foundations and for buried infrastructure may or may not take place (depending on GLE’s future plan for the site). Erosion control measures on the land disturbed during preconstruction (such as seeding) would limit soil loss due to erosion.

Because denying the license would not lead to additional land disturbance, the no-action alternative would be expected to have SMALL geological or soil impacts.

4.4.6 Water Resources

As described in Section 4.4.5, preconstruction would require measures for control of soil erosion on land disturbed during preconstruction activities. By taking steps to minimize erosion, the impact on turbidity of surface water can likewise be limited. Additional water use may or may not occur under the no-action alternative (depending on GLE's future plan for the site).

Under the no-action alternative, and assuming another site development is not pursued, groundwater use would not increase. Groundwater quality would not be reduced at the GLE site, but rather, would be gradually improved sitewide due to continued use and improvement of the site remediation systems and also due to some degree of natural attenuation.

Because denying the license would not directly result in additional water use or changes to surface or groundwater quality, the overall impact of the no-action alternative on water resources is expected to be SMALL.

4.4.7 Ecological Resources

Under the no-action alternative, preconstruction activities would have occurred. The discussion of impacts on ecological resources resulting from preconstruction activities is presented in Section 4.2.8.1. The baseline for the no-action alternative is an area cleared of vegetation with administrative structures, utilities, and north access road in place.

Because denying the license would not result in additional land disturbance on the Wilmington Site, anticipated impacts on ecological resources from the no-action alternative are expected to be SMALL. If an alternative site was chosen for construction and operation of the enrichment plant, impacts on ecological resources at the alternative site would be evaluated in a separate NEPA document.

4.4.8 Noise

Under the no-action alternative, noise levels associated with operations at the existing Wilmington Site would be expected to remain unchanged. As discussed in Section 3.9, a sound survey indicated that noise levels at the nearest residences were well below the New Hanover County Noise Ordinance and EPA guideline.

Because denying the license would not directly result in additional noise sources on the site, potential noise impacts of no-action alternative on surrounding communities would be expected to be SMALL.

4.4.9 Transportation

Under the no-action alternative, preconstruction activities would have occurred and there would be no additional traffic entering and leaving the Wilmington Site from operation of the proposed GLE Facility. Additional national impacts from the transportation of radioactive materials to and from the Wilmington Site would also not occur in the short term.

Should the nation's need for enriched uranium continue to increase, the demand would need to be satisfied using existing or new capacity. In such a case, local traffic impacts at a similar existing facility may increase, or additional traffic similar to that estimated for the proposed GLE Facility would be added to another area, which may or may not have the same impacts depending on the existing road network and traffic patterns. National impacts from radioactive material transportation would also increase, depending on the nation's demand for additional enriched product. There is also the potential for increased traffic supporting the FMO facility, should additional enriched product be needed to satisfy increased demand for reactor assemblies.

Because denying the license would not directly result in additional traffic on the site, potential impacts of the no-action alternative on transportation resources near the Wilmington Site are expected to be SMALL.

4.4.10 Public and Occupational Health

Under the no-action alternative, impacts on workers associated with preconstruction activities (as discussed in Section 4.2.11.1) would have occurred, while impacts due to construction would not occur. Exposure to the public outside the site boundary would remain the same as described in Section 3.11. Any additional impacts from the use of the site by GLE after denial of a license would not be part of the proposed action.

Other domestic enrichment capacity might be constructed instead of the proposed GLE Facility to meet national needs. The public and occupational health impacts of any new facility would be expected to be appropriately controlled through engineering design, best management practices, and regulatory controls similar to those described in this draft EIS for the proposed GLE Facility. Therefore, the public and occupational health impacts of the no-action alternative would be expected to be SMALL.

4.4.11 Waste Management

Under the no-action alternative, preconstruction activities would have occurred, the proposed GLE Facility would not be constructed or operated, and there would be no additional waste generated at the Wilmington Site beyond the waste generated by ongoing activities.

Should the nation's need for enriched uranium continue to increase (e.g., at the FMO facility) due to increased demand for nuclear fuel assemblies, waste management impacts at enrichment facilities and the FMO facility would increase. Waste management impacts at new or existing facilities may be expected to be SMALL to MODERATE, depending on the amount of demand and the facility in question.

4.4.12 Socioeconomic Impacts

Under the no-action alternative, population and employment in the ROI (Brunswick County, New Hanover County, and Pender County) are expected to grow in accordance with current projections. Total population in the region is projected to be approximately 368,000 in 2010 and 444,000 in 2020 (NCOSBM, 2009). Employment in Brunswick, Columbus, New Hanover, and Pender counties is projected to grow approximately 1.7 percent per year, from 150,648 workers in 2004 to 178,714 workers in 2014. Assuming growth continues at this rate after 2014, total employment would reach 198,005 by the year 2020 (NCOSBM, 2009). As discussed in Section 4.2.13, completion of preconstruction activities is not expected to have a noticeable effect on these trends or on county services.

Because denying the license would not directly result in changes to current county services or growth projections, the socioeconomic impact of the no-action alternative is expected to be SMALL.

4.4.13 Environmental Justice

Under the no-action alternative, preconstruction activities with associated land clearing, equipment noise, and traffic impacts would occur. These effects are expected to be limited to the immediate vicinity of the proposed GLE Facility site. These impacts would not be disproportionately high and adverse to minority and low-income populations.

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5 MITIGATION

This chapter addresses potential means to mitigate adverse environmental impacts from the proposed action as required by Appendix A of Title 10, Part 51, of the U.S. *Code of Federal Regulations* (10 CFR Part 51). Under Council on Environmental Quality regulation 40 CFR 1500.2(f), Federal agencies shall, to the fullest extent possible, “use all practicable means consistent with the requirements of the *National Environmental Policy Act* (NEPA) and other essential considerations of national policy to restore and enhance the quality of the human environment and avoid or minimize any possible adverse effects of their actions on the quality of the human environment.” The Council on Environmental Quality regulations defines mitigation to include activities that (1) avoid the impact altogether by not taking a certain action or parts of an action; (2) minimize impacts by limiting the degree or magnitude of the action and its implementation; (3) repair, rehabilitate, or restore the affected environment; (4) reduce or eliminate impacts over time by preservation or maintenance operations during the life of the action; or (5) compensate for the impact by replacing or substituting resources or environments. This definition has been used in identifying potential mitigation measures. As such, mitigation measures are those actions or processes (e.g., process controls and management plans) that would be implemented to control and minimize potential adverse impacts from construction and operation activities for the proposed Global Laser Enrichment (GLE) Facility.

General Electric (GE)-Hitachi Global Laser Enrichment LLC (GLE) must comply with applicable laws and regulations, including obtaining all appropriate construction and operating permits. A complete discussion of applicable laws and regulations is included in Chapter 1 of this draft Environmental Impact Statement (EIS). The mitigation measures proposed by GLE, many of which are compliance related, are discussed in Section 5.1 (GLE, 2008).

Based on the potential impacts identified in Chapter 4 of this draft EIS (Environmental Impacts), the U.S. Nuclear Regulatory Commission (NRC) staff has identified additional potential mitigation for the proposed GLE Facility. These mitigation measures are described in Section 5.2.

The proposed mitigation measures provided in this chapter do not include environmental monitoring activities. Environmental monitoring activities are described in Chapter 6 of this draft EIS.

5.1 Mitigation Measures Proposed by GLE

GLE identified mitigation measures in its Environmental Report (ER) (GLE, 2008) that would reduce the environmental impacts associated with preconstruction activities and the proposed action. Table 5-1 lists the mitigation measures proposed for each impact area. Because many of GLE’s proposed mitigation measures apply to preconstruction and construction activities as well as facility operation, they are listed together in the table.

Table 5-1 Summary of Mitigation Measures Proposed by GLE

Impact Area	Activity	Proposed Mitigation Measures
Land Use	Land disturbance	Use existing service road routes and utility rights-of-way (ROWs) to the fullest extent practicable to minimize the need for clearing additional wooded areas. Use existing wastewater treatment and solid waste management infrastructure to the fullest extent practicable to reduce the total area needed for construction and operation of the proposed facility.
Historic and Cultural Resources	Disturbance of prehistoric archaeological sites eligible for listing on the *National Register of Historic Places*	To prevent disturbance of site 31NH801, maintain conditions of the bank at the side of the existing gravel road unchanged from its current graded and vegetated state. Signs are posted to prevent unauthorized excavation.
Visual and Scenic Resources	Potential visual intrusions in the existing landscape character	Locate the proposed facility in a sector of the Wilmington Site away from site boundaries bordering existing development along NC 133 and I-140. To the fullest width practicable, maintain the existing tree buffer along the northeast Wilmington Site boundary to limit visibility of the proposed facility structures and access road traffic from offsite viewpoints in nearby residential neighborhoods. Use exterior building colors and landscaping that would soften the visual impact of the proposed facility.
Air Quality	Fugitive dust and construction equipment emissions	Water the facility site and unpaved roads to reduce dust. Remove dirt from truck tires by driving over a gravel pad prior to leaving the facility site or unpaved access road to avoid spreading sediments on paved roads. Cover trucks carrying soil and debris to reduce dust emissions from the back of trucks driving on roadways. Pave access road and parking lots as soon as practicable. Conduct uranium-enrichment operations inside an enclosed building using a closed-system process with no routine venting of process gases. Install and operate leak-detection monitors for process equipment. In the event a leak is detected due to an equipment component malfunction or other reason, safety interlocks will isolate the section of the process where the leak is detected, limiting the potential quantity of gaseous material that could be released inside the proposed facility operations building.

Table 5-1 Summary of Mitigation Measures Proposed by GLE (Cont.)

Impact Area	Activity	Proposed Mitigation Measures
Air Quality (Cont.)	Fugitive dust and construction equipment emissions (Cont.)	Maintain process areas inside the operations building under continuous negative pressure relative to atmospheric pressure. In the event of a gaseous release in one of these process areas, the negative pressure conditions would prevent outflow of the air from the process areas, effectively containing the released gaseous material to the affected process area.
		Ventilate the operations building with a high-efficiency, multi-stage air emissions control system. Components of the air emissions control system planned for the operations building consist of high-efficiency particulate arresting (HEPA) filters for removal of solid particulate matter and activated carbon beds for adsorption of HF. Exhaust gases from this emission-control system would be vented to the atmosphere through a single stack.
		Implement a periodic inspection and maintenance program for uranium hexafluoride (UF_6) cylinders stored in outdoor areas.
		Burn low-sulfur fuel oil in the auxiliary diesel generators.
		Store organic solvents, paints, and other volatile organic compound–containing liquids in containers covered with tightly fitting lids.
Geology and Soil Resources	Soil disturbance and contamination	Minimize the construction footprint to the extent possible.
		Engineer design plans that minimize soil disturbance during construction activities.
		If additional soil is necessary for construction purposes, use soils from onsite borrow pits that are accessible via existing roadbeds, to minimize disturbance to other areas of the Wilmington Site outside of the GLE study area.
		Manage construction activities so that only designated areas within the GLE study area are disturbed and so that no heavy equipment or construction operations are allowed to affect areas outside the study area unless specifically designated, such as potential use of existing onsite borrow areas.
		Use adequate containment methods during excavation and/or similar operations.

Table 5-1 Summary of Mitigation Measures Proposed by GLE (Cont.)

Impact Area	Activity	Proposed Mitigation Measures
Geology and Soil Resources (Cont.)	Soil disturbance and contamination (Cont.)	Use site-stabilization practices (i.e., placing crushed stone on top of disturbed soil in areas of concentrated runoff).
		Use silt berms, dikes, and sediment fences.
		Stabilize drainage culverts and ditches by lining surface with rock aggregate/rip-rap to reduce flow velocity and prohibit scouring.
		Reuse and/or appropriately place excavated materials to decrease exposed soil piles.
		Place gravel construction pads at the entrances/exits of construction acres.
		Stabilize site with low-maintenance landscaping and pavement.
Surface Water Resources	Runoff	Select a non-wetland, non-floodplain area for the proposed facility.
		Follow proper construction Best Management Practices (BMPs) as specified by the *New Hanover County Erosion and Sedimentation Control Ordinance* (New Hanover County, 2007).
		Construct an access road perpendicular to the Unnamed Tributary #1 to minimize the area impacted.
		Design and construct the upgrade of the crossing over Unnamed Tributary #1 following procedures required by the *New Hanover County Flood Damage Prevention Ordinance* (New Hanover County, 2006).
		Limit cut/fill slopes to a horizontal-vertical ratio of 3:1 or less.
		Use silt fencing and covering of soil stockpiles to prevent sediment runoff.
		Suspend general construction activities during storms and impending precipitation.
		Construct stream crossings (i.e., installation of culverts) following at least 48 hours of dry weather.
		Divert stream flow during stream-crossing construction to minimize excavation in flowing water.
		Maintain construction equipment so that equipment is in good repair and without visible leaks of oil, greases, or hydraulic fluids.
		Restore disturbed areas to original surface elevations, where possible.

Table 5-1 Summary of Mitigation Measures Proposed by GLE (Cont.)

Impact Area	Activity	Proposed Mitigation Measures
Surface Water Resources (Cont.)	Runoff (Cont.)	Comply with all National Pollutant Discharge Elimination System (NPDES) stormwater and wastewater permit requirements.
		Route stormwater from the proposed facility to a new stormwater wet detention basin, designed in accordance with the North Carolina Department of Environment and Natural Resources (NCDENR) *Stormwater Best Management Practices Manual* (NCDENR, 2007).
		Perform onsite treatment of process and sanitary wastewaters to NPDES-permit limits before discharge to receiving waters.
		Routinely monitor and inspect onsite liquid waste storage tanks and containers to detect any leaks or releases to the environment due to equipment malfunctions to ensure that actions according to the Spill Prevention Control and Countermeasure (SPCC) plan or other appropriate corrective action can be taken promptly.
		Discharge stormwater runoff from UF_6 storage pads area to a holding pond for monitoring prior to discharge to the stormwater wet detention basin.
		Perform periodic visual inspections of the stormwater wet detention basin to verify proper function, at a frequency sufficient to allow for identification of basin high-water-level conditions and implementation of corrective actions to restore the water level prior to overflow.
		Ensure easy access to the stormwater wet detention basin to allow the prompt, systematic sampling of runoff.
	Floodplain disturbance	Construct a stormwater wet detention basin and implement a Wilmington Site stormwater management plan to mitigate a portion of the increased floodwaters from extreme storm events and all stormwater from smaller storm events.
Groundwater Resources	Infiltration	Implement hazardous material and waste-handling procedures and secondary containment, as required by applicable laws and regulations.
	Water use	Provide water necessary during construction via tanker truck from off-site potable water sources.
		Reuse treated sanitary wastewater effluent as makeup water in Wilmington Site cooling towers.

Table 5-1 Summary of Mitigation Measures Proposed by GLE (Cont.)

Impact Area	Activity	Proposed Mitigation Measures
Groundwater Resources (Cont.)	Water use (Cont.)	Routinely monitor sitewide groundwater levels, and continue to analyze the groundwater monitoring-well and pumping-well networks to confirm that changes in groundwater levels associated with the proposed action are minimal.
		Readjust pumping well rates and/or perform well maintenance or rehabilitation, as appropriate, in the event of unexpected changes in groundwater levels.
		Use low-water-consumption landscaping.
		Install low-flow toilets, sinks, and showers.
		Perform localized floor washing using mops and self-contained cleaning machines to reduce water usage compared to conventional washing techniques.
Ecological Resources	Disturbance of habitats	Minimize the construction footprint to the extent possible and limit habitat disruption.
		Perform surveys of trees greater than 61 centimeters (24 inches) in diameter before beginning preconstruction and construction activities, and plant one 61-centimeter (24-inch) diameter tree, two 30.5-centimeter (12-inch) diameter trees, or three 20.3-centimeter (8-inch) diameter trees elsewhere on the Wilmington Site.
		Restrict preconstruction activities and the harvesting of trees to periods when the ground is dry.
		If trenches are necessary, ensure that they are closed overnight; inspect trenches left open overnight and remove animals prior to backfilling. Place escape ramps in trenches at less than 45-degree angles to provide exit strategies for animals.
		Sod, seed, and/or landscape disturbed areas of the study area in accordance with the Sediment and Erosion Control Permit.
		Install animal-friendly fencing around the proposed facility site so that wildlife cannot be injured by or entangled in the site's security fence.
		Plant native plant species (i.e., not invasive species) to revegetate disturbed areas and for landscaping.
		Use nectar- and berry-producing plants for landscaping plants.
		Conduct site-stabilization practices to reduce the potential for erosion and sedimentation.

Table 5-1 Summary of Mitigation Measures Proposed by GLE (Cont.)

Impact Area	Activity	Proposed Mitigation Measures
Ecological Resources (Cont.)	Disturbance of habitats (Cont.)	Place bluebird boxes throughout the study area.
		Establish food plots along roadways and under power lines.
		Consider the recommendations of appropriate State and Federal agencies, including the U.S. Fish and Wildlife Service (FWS) and NCDENR.
	Wetland disturbance	Select a non-wetland, non-floodplain area for the proposed facility.
		Use existing service road routes and utility ROWs to the fullest extent practicable to minimize the need for additional wetlands crossings.
		Construct access road perpendicular to wetland to minimize the area impacted.
		Limit cut/fill slopes to a horizontal-vertical ratio of three to one or less.
		Avoid temporary storage of materials in wetlands during construction.
		Maintain the hydrological connectivity of wetlands to surface waters.
		Place fencing/barriers and use signs around wetland areas.
		Use silt fencing and cover soil stockpiles to prevent sediment runoff.
		Restore disturbed areas to original surface elevations.
		Revegetate disturbed areas with native plant species.
Noise	Exposure of workers and the public to noise	Prohibit heavy truck and earth-moving equipment usage after twilight and during early morning hours.
		Equip construction equipment with the manufacturer’s noise-control devices, and maintain these devices in effective operating condition.
		When possible, use quiet equipment or methods to minimize noise emissions.
		For equipment with internal combustion engines, operate equipment at the lowest operating speed to minimize noise emissions, when possible and practical.
		Close engine-housing doors during operation of equipment to reduce noise emissions from the engine.
		Avoid equipment engine idling.

Table 5-1 Summary of Mitigation Measures Proposed by GLE (Cont.)

Impact Area	Activity	Proposed Mitigation Measures
Noise (Cont.)	Exposure of workers and the public to noise (Cont.)	Use quieter, less-tonal devices that comply with all applicable safety restrictions (e.g., Occupational Safety and Health Administration [OSHA] standards) on back-up alarms for construction equipment. Use a quieter, high-efficiency transformer to mitigate noise from the proposed electrical substation.
Transportation	Traffic volume	Locate the proposed facility near an interstate highway interchange to minimize the distance that truck traffic must travel on local surface streets and to facilitate employee commuter traffic. Increase the number of entry gates onto the Wilmington Site from NC 133 (Castle Hayne Road), including one dedicated to worker entrance/exit. Add roadway improvements (e.g., a turn lane) to NC 133 as required by the North Carolina Department of Transportation (NCDOT) for issuance of a driveway permit for connections of the new entrance. Work with NCDOT to evaluate driveway- and roadway-improvement options to minimize impacts. Schedule worker shift intervals so that shift start and end times are staggered from peak periods of worker-commuting traffic for existing site facilities and other planned operations. Promote carpooling among construction and operations workers to help reduce congestion by minimizing the additional number of vehicle trips necessary during peak commuting periods. Route truck shipments of radioactive materials around cities by using a U.S. Interstate Highway System bypass or beltway (when available). Schedule truck deliveries and shipments for off-peak traffic periods to reduce potential congestion on local roadways during peak worker commuting periods. Encourage carpooling for construction workers and employees commuting to the proposed facility.
Public and Occupational Health	Effects from facility operation	Install a building ventilation system to maintain the majority of the interior of the process building under sub-atmospheric pressure. Install alarms in the Emergency Control Center to detect, alarm, and/or activate the automatic safe shutdown of process equipment in the event of operational problems.

Table 5-1 Summary of Mitigation Measures Proposed by GLE (Cont.)

Impact Area	Activity	Proposed Mitigation Measures
Public and Occupational Health (Cont.)	Effects from facility operation (Cont.)	Isolate leaks and shut down process lines to prevent damage to equipment.
		Vent exhaust gases from the emission control system to the atmosphere through a single rooftop stack.
		Install radiation monitors in effluent stacks to detect, alarm, and activate the automatic safe shutdown of process equipment, should contaminants be detected in the system exhaust.
		Comply with all applicable State, NRC, and OSHA regulations concerning worker health and safety, as well as the existing Wilmington Site Nuclear Safety Program and the Industrial Safety Program.
		Comply with the Site Radiation Protection Program, the SPCC plan, and the GLE Environmental, Health, and Safety Program.
		Conduct routine radiological surveys to characterize and minimize potential radiological exposure.
		Monitor all radiation workers via the use of dosimeters and area air sampling to ensure that radiological doses remain within regulatory limits and As Low As Reasonably Achievable (ALARA).
		Conduct operations activities involving hazardous respirable effluents with ventilation control and/or respiratory protection, as required.
		Use personal protective equipment based on the nature of the work and chemical and/or radiological hazards present.
		Perform environmental monitoring and sampling to ensure compliance with regulatory discharge limits.
		Route treated process wastewater effluents to the existing final process lagoon facility for additional treatment.

Table 5-1 Summary of Mitigation Measures Proposed by GLE (Cont.)

Impact Area	Activity	Proposed Mitigation Measures
Waste Management	Generation of industrial, hazardous, radiological, and mixed wastes (air emissions are addressed under Air Quality and liquid emissions are addressed under Groundwater and Surface Water Resources)	Select the laser enrichment process to reduce the amount of waste generated for production of the same amount of enriched product.
		Minimize the quantities of waste generated by the proposed facility by implementing the *Waste Minimization Plan*.
		Perform an integrated safety analysis (ISA) for each onsite waste storage area to identify and prevent accidental releases to the environment.
		Monitor and inspect onsite liquid waste storage tanks and containers on a periodic schedule to detect leaks or releases to the environment due to equipment malfunctions so that actions identified in the SPCC plan or other appropriate corrective action can be taken promptly.
		Use the existing Wilmington Site onsite wastewater treatment facilities within current regulatory permit limits to avoid the need to add new onsite waste treatment and disposal facilities for the proposed facility.
		Pre-treat radioactive liquid wastewaters in a treatment system planned for the proposed facility before the wastewater effluent is pumped to the existing NPDES-permitted final process lagoon facility for further treatment.
		Ship each waste generated by the proposed facility that requires offsite storage, treatment, or disposal to a licensed facility (as appropriate for the waste type) in compliance with U.S. Environmental Protection Agency (EPA) and NRC requirements.
		Minimize onsite storage volumes and times and shipping waste destined for offsite treatment and disposal facilities as soon as practicable.
		Conduct onsite treatment of process and sanitary wastewaters to NPDES permit limits before discharge to receiving waters.

Table 5-1 Summary of Mitigation Measures Proposed by GLE (Cont.)

Impact Area	Activity	Proposed Mitigation Measures
Waste Management (Cont.)	Generation of industrial, hazardous, radiological, and mixed wastes (Cont.)	Avoid and minimize potential hazardous and radiological waste impacts from the UF_6 storage pads by implementing design elements and safety procedures during operation, including: – Use of a storage array that permits easy visual inspection (stacked no more than two cylinders high); – Segregation of storage pad areas from the rest of the enrichment facility by barriers (e.g., vehicle guardrails); – Inspection of cylinders for external contamination (i.e., a "wipe test") prior to placing on the storage pads or transporting them offsite; – Ensuring that UF_6 cylinders are not equipped with defective valves; – Allowing only designated vehicles with a limited amount of fuel in the storage pad area; – Allowing only trained and qualified personnel to operate vehicles in the storage pad area; and – Monitoring the holding pond that collects stormwater from the cylinder pads. Inspect cylinders of UF_6 initially prior to placing a filled cylinder on a storage pad and, thereafter, inspect periodically for damage or surface coating defects. Inspection criteria would include ensuring that: – Lifting points are free from distortion and cracking; – Cylinder skirts and stiffener rings are free from distortion and cracking; – Cylinder surfaces are free from bulges, dents, gouges, cracks, or significant corrosion; – Cylinder valves are fitted with the correct protector and cap; – Cylinder valves are straight and not distorted, two to six threads are visible, and the square head of the valve stem is undamaged; and – Cylinder plugs are undamaged and not leaking.

Table 5-1 Summary of Mitigation Measures Proposed by GLE (Cont.)

Impact Area	Activity	Proposed Mitigation Measures
Waste Management (Cont.)	Generation of industrial, hazardous, radiological, and mixed wastes (Cont.)	If inspections of a cylinder reveal significant deterioration or other conditions that may affect its safe use, transfer the contents of the cylinder to another cylinder and discard the defective cylinder. Investigate the cause of any significant deterioration, and if necessary, perform additional inspection of cylinders. Conduct continuous or periodic monitoring of waste management processes and storage facilities for the detection of non-intentional releases to the environment, so that corrective actions would be taken to minimize adverse impacts on the environment. For example, directing stormwater runoff from the UF_6 storage pads to a holding pond, where it would be monitored to ensure that unexpected radioactive material releases to the wet detention basin did not occur.
Accidents	Accident prevention and consequence management	Incorporate the following features into facility design to mitigate fire and explosion accidents: – Fire alarm and detection systems, including suppression capability; – Fire barriers to prevent propagation of fire in and out of areas containing uranic material; – System and component design features that isolate combustible material and/or shut down affected systems; – Continuous detection of a flammable gas in the laser systems, for automatic isolation in the event of high readings; – Structural design features that ensure peak explosive blast loads and eliminate or minimize propagation of structural material into a UF_6 process or handling area; and – Limit combustibles in outside areas where cylinders are stored.

Table 5-1 Summary of Mitigation Measures Proposed by GLE (Cont.)

Impact Area	Activity	Proposed Mitigation Measures
Accidents (Cont.)	Accident prevention and consequence management (Cont.)	Incorporate the following features into facility design and operating procedures to mitigate criticality accidents, and to contain UF_6 gas within specified building areas and attenuate any release to the environment: – Maintain safe geometry of all vessels, containers, and equipment containing fissile material and ensure that the concentration and/or mass of fissile material is limited to a specified amount; – Install radiation detection and criticality monitoring systems to quickly alert personnel and isolate systems when parameters exceed expected limits; – Physically separate areas within the facility to prevent or reduce exposure; – Control positive or negative air pressures within designated areas to prevent or maintain leakage between facility areas; – Install carbon adsorbers, HEPA filters, and, where necessary, automatic trips for ventilation systems to help minimize the potential for a release outside the affected area; and – Implement appropriate door and building design features to limit leakage paths to the outside environment.

5.2 Potential Mitigation Measures Identified by NRC

The NRC staff has reviewed the mitigation measures proposed by GLE and has identified additional mitigation measures that could potentially reduce impacts (Table 5-2). While the NRC cannot impose mitigation outside its regulatory authority under the *Atomic Energy Act*, the NRC staff has identified mitigation measures in Table 5-2 that could potentially reduce the impacts of the proposed action. These additional mitigation measures are not requirements being imposed upon GLE. For the purposes of NEPA per 10 CFR 51.71(d) and 51.80(a), the NRC is disclosing measures that could potentially reduce or avoid environmental impacts of the proposed action.

Table 5-2 Summary of Potential Mitigation Measures Identified by NRC

Impact Area	Activity	Proposed Mitigation Measures
Land Use	Land disturbance	Construction BMPs required under the New Hanover County Soil Erosion and Sedimentation Ordinance are listed under Geology and Soil. Following those measures would help moderate the short-term land use effects associated with preconstruction and construction activities. Use BMPs to control waste disposal, erosion, and runoff to help restrict the effect of facility operation on surrounding land use.
Historic and Cultural Resources	Disturbance of prehistoric archaeological sites and sites eligible for listing on the *National Register of Historic Places*	Follow internal procedural guidance for unexpected archaeological discoveries, including the unexpected discovery of human remains. The procedures include notification of certain local and state agency representatives, including the State Archaeologist.
Visual and Scenic Resources	Potential visual intrusions in the existing landscape character	Plant additional vegetation on the perimeter of the facility site to help screen the study area.
Air Quality	Fugitive dust and construction equipment emissions	Post speed limits (e.g., 10 miles per hour) visibly within the construction site, and enforce them to minimize airborne fugitive dust. Limit access to the construction site and staging areas to authorized vehicles only, through the designated treated roads. Stage construction to limit the exposed/disturbed area at any given time, when practical. Train workers to comply with the speed limit, use good engineering practices, minimize drop height of materials, minimize disturbed areas, and employ other BMPs as appropriate. To the extent practicable, conduct soil-disturbing activities and travel on unpaved roads during periods of favorable meteorological conditions, as conducting these activities during periods of unfavorable meteorological conditions may result in exceedances of air quality

Table 5-2 Summary of Potential Mitigation Measures Identified by NRC (Cont.)

Impact Area	Activity	Proposed Mitigation Measures
Air Quality (Cont.)	Fugitive dust and construction equipment emissions (Cont.)	standards. Unfavorable meteorological conditions are infrequent and include 1) periods of low winds and stable weather conditions (primarily encountered around sunrise in winter) and 2) periods of high winds. All heavy equipment should meet emission standards specified in the *State Code of Regulations*, and routine preventive maintenance, including tuneup to the manufacturer's specification, should be implemented to ensure efficient combustion and minimum emissions. Fuel all diesel engines used in the facility and auxiliary diesel generator units with ultra-low sulfur diesel with a sulfur content of 15 parts per million or less. Limit idling of diesel equipment to no more than 10 minutes, unless idling must be maintained for proper operation; for example, drilling, hoisting, and trenching. Implement more aggressive dust control measures during road construction and land clearing, such as more frequent water spraying and the application of an appropriate dust suppressant.
Geology and Soil	Soil disturbance and contamination	Implement erosion control BMPs by following the New Hanover County Erosion and Sedimentation Control Ordinance. Implement BMPs for storage, handling, spill prevention, and spill response to reduce the impact of soil contamination associated with fuels, oils, and grease from equipment used onsite or from other chemicals or wastes managed onsite.
Surface Water Resources	Runoff	Implement BMPs for storage, handling, spill prevention, and spill response to reduce the impact of surface water contamination associated with the runoff of fuels, oils, and grease from equipment used onsite or from other chemicals or wastes managed onsite.
Groundwater Resources	Infiltration	Implement BMPs for storage, handling, spill prevention, and spill response to reduce the impact of groundwater contamination associated with the accidental release of fuels, oils, and grease from equipment used onsite or from other chemicals or wastes managed onsite. If the proposed action results in measurable onsite changes in groundwater levels, expand groundwater level monitoring to appropriate offsite areas. If the proposed action results in measurable onsite changes in groundwater levels, expand groundwater level monitoring to appropriate offsite areas.

Table 5-2 Summary of Potential Mitigation Measures Identified by NRC (Cont.)

Impact Area	Activity	Proposed Mitigation Measures
Ecological Resources	Disturbance of habitats	Reduce or prevent the collection, harassment, or disturbance of plants, wildlife, and their habitats (particularly threatened, endangered, and sensitive species) through employee and contractor education on applicable State and Federal laws. Additionally, instruct all personnel to avoid harassment and disturbance of local plants and wildlife; make personnel aware of the potential for wildlife interactions around facility structures; and ensure that food refuse and other garbage are not available to scavengers.
		Establish a trash abatement program that focuses on containing trash and food in closed containers and removing them periodically to reduce their attractiveness to opportunistic species, such as bears, coyotes, and feral dogs.
		Avoid known locations of listed plant species and habitats of listed wildlife species and establish a setback distance (minimum 60 meters [200 feet]) to prevent any destructive impacts associated with construction and decommissioning activities.
		Minimize the number of areas where wildlife could hide or be trapped (e.g., open sheds, pits, uncovered basins, and laydown areas).
		If any Federally threatened or endangered species such as the roughleaf loosestrife or the red-cockaded woodpecker are encountered, consult with FWS (as required by Section 7 of the *Endangered Species Act* [ESA]) and determine an appropriate course of action to avoid or mitigate impacts.
		Observe all trees >61 centimeters (24 inches) identified during GLE's surveys for potential compensatory tree plantings for the potential presence of red-cockaded woodpecker cavities. If any cavity trees are observed, consult the FWS (as required by Section 7 of the ESA) and determine an appropriate course of action to avoid or mitigate impacts.
		Develop an integrated vegetation management plan for the control of noxious weeds and invasive plant species.
		Minimize the area disturbed by preconstruction activities and the installation of facilities (pipelines, transmission towers, pump stations, substations, laydown areas, assembly areas) to retain native vegetation and minimize soil disturbance.

Table 5-2 Summary of Potential Mitigation Measures Identified by NRC (Cont.)

Impact Area	Activity	Proposed Mitigation Measures
Ecological Resources (Cont.)	Disturbance of habitats (Cont.)	Backfill open trenches as quickly as is reasonable. To the extent practicable, avoid the use of guy wires, which pose a collision hazard for birds. Maintain areas left in a natural condition during construction (e.g., wildlife crossings) in as natural a condition as possible within safety and operational constraints. To minimize habitat loss and fragmentation, reestablish as much habitat as possible after construction is complete by maximizing the area reclaimed or re-vegetated during operations. Prevent the establishment and spread of invasive species and noxious weeds within the transmission line ROW, along the access road, and in associated areas of ground surface disturbance or vegetation cutting. Monitor the area regularly and eradicate invasive species immediately.
Noise	Exposure of workers and the public to noise	When possible, schedule different noisy activities to occur at the same time. Less-frequent but noisy activities would generally minimize overall noise disturbance than lower-level noise occurring more frequently. Implement noise control measures (e.g., erection of temporary wooden noise barriers) if noisy activities would be expected near sensitive receptors. Operate all vehicles traveling within and around the project area in accordance with posted speed limits. Post warning signs in high noise areas and implement a hearing protection program for work areas in excess of 85 dBA. Because complaints about noise may occur even when noise levels from the facility do not exceed regulatory or guideline levels, implement a noise complaint process and hotline for the surrounding communities, including documentation, investigation, evaluation, and resolution of all legitimate project-related noise complaints.

Table 5-2 Summary of Potential Mitigation Measures Identified by NRC (Cont.)

Impact Area	Activity	Proposed Mitigation Measures
Public and Occupational Health	Effects from facility operation	Move UF_6 cylinders only when cool and when UF_6 is in solid form, to minimize the risk of inadvertent release due to mishandling.
		Direct process off-gas from UF_6 purification and other operations through cold traps to solidify and reclaim as much UF_6 as possible. Pass remaining gases through high-efficiency filters and chemical absorbers to remove hydrogen fluoride and uranic compounds.
		Separate uranic compounds and various other heavy metals in waste material generated by decontamination of equipment and systems.

No additional mitigation measures were identified for the resource areas of:

- Transportation
- Waste Management
- Accidents
- Decontamination and Decommissioning
- Socioeconomics
- Environmental Justice

5.3 References

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6 ENVIRONMENTAL MEASUREMENT AND MONITORING PROGRAMS

This chapter describes the proposed environmental measurements and monitoring program to characterize the effect of radiological and nonradiological releases from the proposed General Electric (GE)-Hitachi Global Laser Enrichment LLC (GLE) Facility in New Hanover County, North Carolina, on human health and environment. The proposed monitoring program includes monitoring of radiological and physiochemical gaseous and liquid effluents from facility operations, and monitoring and measurement of ambient air, surface water, groundwater, stormwater, soil, sediment, and direct radiation in the vicinity of the proposed GLE Facility.

The proposed GLE Facility would be located on the existing Wilmington Site that currently includes the Global Nuclear Fuels-America (GNF-A) Fuel Manufacturing Operation (FMO) facility, Wilmington Field Services Center (WFSC), and the GE Aircraft Engines/Services Components Operation (AE/SCO) facility. For the last 40 years, the FMO facility possessed nuclear materials for the conversion of low-enriched uranium hexafluoride (UF_6) to uranium dioxide (UO_2). The FMO facility fabricates and constructs nuclear assemblies for commercial light water reactors. There is an existing monitoring program for the Wilmington Site. The environmental monitoring program for the proposed GLE Facility is based on the experience and data accumulated at the Wilmington Site. The existing monitoring program would be expanded to include and account for the proposed GLE Facility (GLE, 2008); this program is referred to throughout this chapter as the Expanded Monitoring Program. The existing monitoring program would provide the baseline for air quality, surface water, sediment, treated sanitary wastewater effluent, and treated process wastewater effluent (GLE, 2008). The baseline data for groundwater and soil would be collected before the proposed GLE Facility becomes operational. The baseline uranium concentration in shallow soil across the 100-acre (40-hectare) proposed GLE Facility site would be established through statistical sampling program before the construction of the proposed GLE Facility (GLE, 2008). Table 6-1 (GLE, 2008) provides a summary of the proposed monitoring program for the proposed GLE Facility, including the types, frequency, and sampling locations in addition to locations currently monitored by GNF-A.

In addition to routine sampling, provisions would be in place to respond to emergency situations, accidents, or increased emission levels found in routine sampling. Sampling frequency and locations would be determined by GLE environmental staff in accordance with the permit requirements, to demonstrate compliance. All liquid and solid hazardous and radioactive wastes related to operation of the proposed GLE Facility would be analyzed for chemical and radiological properties to determine appropriate disposal methods or treatment requirements.

Effluent compliance levels would be set primarily in the respective permits issued and administered by the North Carolina Division of Air Quality (NCDAQ) and under National Pollutant Discharge Elimination System (NPDES) permits. To ensure that the permit requirements are met, administrative action levels would be established at levels below compliance levels for all measured parameters. Response actions for elevated measurements would be set in documented procedures at increasing levels of priority, ranging from (1) increasing monitoring frequency, (2) to adjusting operations, and (3) performing corrective actions to prevent exceedances of regulatory compliance levels.

Table 6-1 Summary of GLE Environmental Monitoring Program

Medium	Additional Sample Locations[a]	Sample Type	Analyte/Parameter Frequency[b]
Direct radiation	Personnel dosimetry	Continuous film badges, TLDs, and pocket dosimeters	• Gamma and neutron activity
	UF_6 storage pads area and other outdoor storage areas	Continuous film badges or TLDs	• Gamma and neutron activity
Air	Main GLE process building stack (see Figure 6-1)	Continuous air particulate filter	• Gross alpha activity – Weekly • Fluoride – Weekly
	Around the proposed GLE Facility. Site boundary point of highest potential impact, and ambient (background) (see Figure 6-1)	Continuous air particulate filter	• Gross alpha activity – Weekly • Uranium isotopes – Weekly
Surface Water	None in addition to the current effluent channel location at the Site dam and Northeast Cape Fear River locations upstream and downstream of the Site	Grab sample	• Gross alpha/beta activities – Monthly • Total uranium – Monthly • LCFRP physical, chemical, and biological monitoring
Treated process wastewater effluent	None in addition to the current monitoring at the wastewater treatment and reclamation facility	Continuous, composite, or grab samples, per permit	• Total uranium – Daily composite • Gross alpha/beta activities – Weekly composite • Technetium-99 – Quarterly composite • NPDES permit requirements
Treated sanitary wastewater effluent	None in addition to the current monitoring at NPDES Outfall 002	Continuous proportional sample of liquid effluent	• NPDES permit requirements
Groundwater	21 monitoring wells	Grab sample after typical 3-well purge	• Total uranium – Quarterly • Gross alpha/beta activities – Only if total uranium concentration in previous sample >0.02 mg/L • Fluoride – Quarterly

Table 6-1 Summary of GLE Environmental Monitoring Program (Cont.)

Medium	Additional Sample Locations[a]	Sample Type	Analyte/Parameter Frequency[b]
Stormwater	Stormwater wet detention basin	Stormwater grab samples	• NPDES permit requirements
	UF_6 storage pads area holding pond	Stormwater grab sample	• Gross alpha/beta activities – Before transfer of held water to detention pond • Total uranium – Before transfer of held water to detention pond • Fluoride – Before transfer of held water to detention pond
Soil	4 locations	Shallow soil grab sample	• Total uranium – Semiannual
Sediment	None in addition to current monitoring locations	Sediment grab sample	• Total uranium – Semiannual

[a] Sampling locations for the proposed action in addition to locations currently monitored by GNF-A (GNF-A, 2007).

[b] Initial monitoring frequencies may be evaluated and adjusted. UF_6 = uranium hexafluoride; TLDs = thermoluminescent dosimeters; LCFRP = Lower Cape Fear River Program; NPDES = National Pollutant Discharge Elimination System.

Source: Adapted from GLE, 2008.

The following sections describe the monitoring program in detail.

6.1 Radiological Measurements and Monitoring Program

The U.S. Nuclear Regulatory Commission (NRC) requires that the proposed GLE Facility establish a radiological monitoring and measurement program to monitor and report quantities of the radionuclides released to the environment from gaseous and liquid effluents. These requirements are specified in Title 10, "Energy," of the *U.S. Code of Federal Regulations* (10 CFR) Part 20 Appendix B and 10 CFR 70.59. The U.S. Environmental Protection Agency (EPA) specifies additional monitoring requirements for air and liquid (40 CFR 70.6(a)(3), 40 CFR 122.48, and 40 CFR 123.25). The corresponding requirements from the State of North Carolina are specified in 15A North Carolina (NC) Administrative Code 02Q.0508 and 15A NC Administrative Code 2B.0500. The radiological monitoring and measurement program for the proposed GLE Facility was developed based on the above regulatory requirements, the existing GNF-A monitoring program, and NRC guidance documents listed in Table 6-2.

The expanded monitoring program at the proposed GLE Facility would demonstrate compliance with effluent release requirements in 10 CFR Part 20 Appendix B, and would be implemented by the GNF-A and GLE Environmental, Health, and Safety (EHS) functions. The expanded radiological monitoring program would start when the proposed GLE Facility begins operation and would remain operational during the decommissioning phase. The monitoring during the decommissioning phase may be reduced as the contaminants are removed from the site.

The following sections describe radiological air monitoring, direct radiation monitoring, radiological sampling and monitoring for wastewater and stormwater discharge, surface water and sediment monitoring, groundwater monitoring, and soil sampling.

Table 6-2 Guidance Documents That Apply to the Radiological Monitoring Program

Document	Applicable Guidance
Regulatory Guide 4.15[a] "Quality Assurance for Radiological Monitoring Programs (Inception through Normal Operations to License Termination) – Effluent Streams and the Environment."	This guide describes a method acceptable to the NRC for designing a program to ensure the quality of the results of measurements for radioactive materials in the effluents and the environment outside of nuclear facilities during normal operations.
Regulatory Guide 4.16[b] "Monitoring and Reporting Radioactivity in Releases of Radioactive Materials in Liquid and Gaseous Effluents from Nuclear Fuel Processing and Fabrication Plants and Uranium Hexafluoride Production Plants."	This guide describes a method acceptable to the NRC for submitting semiannual reports that specify the quantity of each principal radionuclide released to unrestricted areas to estimate the maximum potential annual dose to the public resulting from effluent releases.

[a] NRC, 2007.
[b] NRC, 1985.

6.1.1 Air Monitoring

Radioactive airborne releases from the proposed GLE Facility would be discharged primarily from the stack on the main process building. Figure 6-1 shows the proposed location of the stack, which would be about 21.3 meters (70 feet) above the ground. Airborne release monitoring procedures for this source would be designed in a manner to determine the quantities and concentrations of radionuclides discharged to the environment, in accordance with 10 CFR 70.59. Uranium isotopes anticipated to be released as airborne emissions would include uranium-234, uranium-235, uranium-236, and uranium-238. The stack would be sampled continuously. During initial operation, the collection filter would be removed daily and analyzed for gross alpha activity. If, during normal operations, the monitoring results show continued low alpha activity, the removal frequency for the collection filter would eventually be decreased to weekly.

In addition to stack monitoring for compliance with regulatory requirements, ambient air monitoring for radioactive emissions would take place around the proposed GLE Facility, to ensure that the facility is operating properly. A total of 11 active air monitors would be used for analysis of a weekly composite sample for gross alpha activity and concentrations of uranium isotopes, resulting primarily from the GLE stack emissions and activities from UF_6 cylinder pads. As shown in Figure 6-1, nine monitors would be placed around the proposed GLE Facility. Considering prevailing wind directions, three monitors each would be placed to the north and south. Three monitors to the south would be placed to monitor for levels of radioactive material from the UF_6 storage pads and the stack under prevailing northerly winds. Three monitors would be placed to the north and northeast to monitor levels of radioactive materials under prevailing southwesterly winds. Additionally, one monitor would be placed to the east of the UF_6 storage pads, and two monitors would be placed on the western side of the facility to cover potential impacts from all wind directions. Finally, one monitor would be placed where the highest potential impact was predicted to occur, on the Wilmington Site property boundary about 0.5 kilometers (0.3 miles) to the northeast of the proposed GLE Facility stack.

An active air monitor would be placed approximately 0.8 kilometers (0.5 miles) to the west–northwest of the proposed GLE Facility stack. The monitor is located in the least-prevailing wind direction from the proposed GLE Facility and thus, considered as an onsite background monitor associated with the operation of the proposed GLE Facility.

6.1.2 Direct Radiation Monitoring

Direct radiation monitoring would be conducted to demonstrate compliance with the NRC requirements in 10 CFR Part 20 and North Carolina State requirements for radiation protection (GLE, 2008). Direct gamma radiation in offsite locations from processes inside the proposed GLE Facility main process building would be expected to be minimal, because the low-energy gamma radiation associated with uranium would be shielded by the building structure, process piping, and equipment. Personal dosimetry would be used to evaluate the dose to the workers. Thermoluminescent dosimeters (TLD) or film badges would be used for direct radiation monitoring for the cylinder pads and other outdoor storage areas and would be placed at strategic locations along the boundaries of the cylinder storage pads. TLDs would be placed at locations where there is higher employee traffic, such as near the access gates for each cylinder storage pad. TLDs would also be placed on the three fencelines that do not have

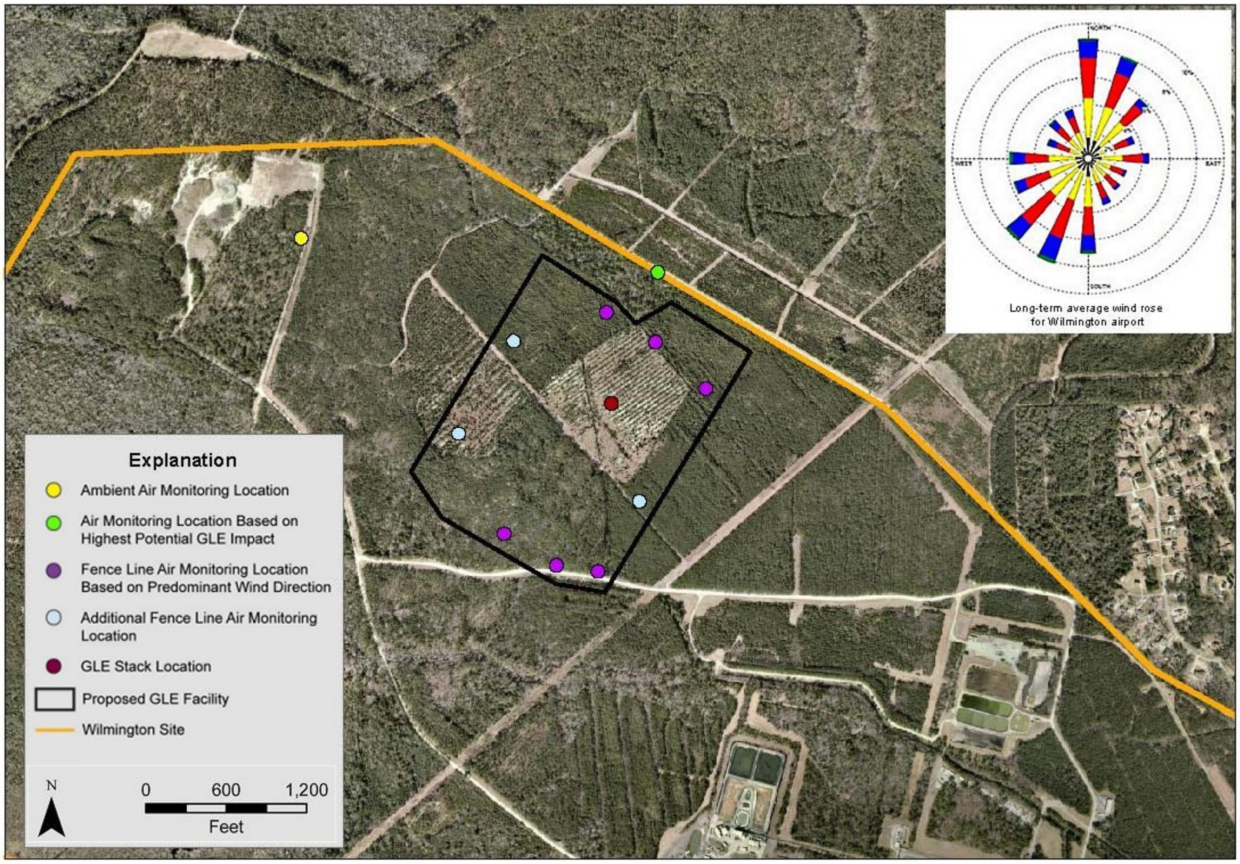

Figure 6-1 GLE Air Monitoring Locations[1] (GLE, 2008)

access gates. TLDs would be replaced and analyzed every six months. Periodic surveys using portable survey meters would be performed monthly in the general storage pad area and along the boundary of the storage pads (GLE, 2009a).

6.1.3 Wastewater and Stormwater Discharge Monitoring

The proposed GLE Facility would generate and treat liquid process wastewater containing uranium and fluoride. A treatment process would remove uranium through pH adjustment and fluoride through addition of a salt to precipitate the fluoride (GLE, 2008). Either filtration or evaporation would then take place on the fluoride precipitate. The treatment process would be very similar to what is currently in effect at the FMO facility, and effluent concentrations of uranium are expected to be similar or lower compared to the existing process (GLE, 2009b). The treated wastewater would be conveyed to the existing Wilmington Site final process lagoon facility for further treatment. From the lagoon, treated effluent is discharged under NPDES permit to the effluent channel via Outfall 001. Continuous proportional samples of the treated wastewater are collected at Outfall 001 (see Figure 3-20). The monitoring would include daily composite samples for uranium; weekly composite samples of the daily samples for gross alpha

[1] The locations shown are approximate.

and gross beta activity; and quarterly composite samples of the weekly composites for technetium-99.

Stormwater runoff from the UF_6 storage area would travel to a new holding pond for monitoring for uranium, gross alpha, and gross beta (GLE, 2008, 2009b). Afterwards, the stormwater would be released to a stormwater wet detention basin. The purpose of the holding pond would be to detain stormwater from the UF_6 storage area in the event of an incident involving the release of uranium on the storage pad. Treatment of the stormwater would not, therefore, normally take place. If such an incident occurred, water in the holding pond would be retained and monitored until uranium stabilized through precipitation or was subjected to active treatment. Afterwards, the holding pond liner would be sampled to assess the need for remediation (GLE, 2009b).

Wilmington Site stormwater basins are not currently monitored during rainfall events. The NPDES stormwater permit states that no analytical sampling is required if a basin is designed to discharge only in response to a 10-year storm (GLE, 2009b).

GLE intends to consult with the North Carolina Division of Water Quality (NCDWQ) to develop a monitoring plan for the UF_6 storage area stormwater holding pond (GLE, 2009b). Per 10 CFR Part 70 Appendix A(c), any release that is reportable to the State would also be reported to NRC.

6.1.4 Surface Water and Sediment Monitoring

The current monitoring program would be expanded to account for the proposed GLE Facility (GLE, 2008). As part of this Expanded Monitoring Program, GLE would continue the surface water monitoring activities that are currently conducted under the GNF-A monitoring program at the Wilmington Site. Gross alpha, gross beta, and uranium are monitored in the effluent channel, the Northeast Cape Fear River 27 kilometers (17 miles) upstream of the Wilmington Site, and the Northeast Cape Fear River at the Wilmington Site dock, which is downstream of the discharge of the effluent channel to the river (via a tributary), as described in Section 3.7.1. Monitoring consists of monthly grab samples.

Current sediment sampling under the GNF-A Environmental Monitoring Program includes semiannual uranium samples in the effluent channel downstream of Outfall 001 (GLE, 2008). Because the proposed GLE Facility's process wastewater would follow the same route, the current sediment sampling program would provide relevant samples.

6.1.5 Groundwater Monitoring

Current groundwater monitoring for radiological contaminants involves monitoring wells across the Wilmington Site. Thirteen more wells would be installed at the proposed location to complement the existing eight wells already in the North-Central Site Sector (GLE, 2008). This set of 21 wells would become part of the Expanded Monitoring Program. They would be arranged in seven clusters with wells installed at three depths in each cluster (at or near the water table in the surficial aquifer, in the upper portion of the Peedee Sand, and in the intermediate Peedee Sand).

Quarterly sampling for uranium would take place from the 21 wells. If a result exceeded 0.02 milligrams per liter (1.7×10^{-7} pounds per gallon), then subsequent quarterly samples from that well would also include analysis for gross alpha and gross beta activity (GLE, 2008). After sufficient data were gathered for a statistical trend analysis, the sampling frequency for each well would be reviewed, and adjusted if necessary. Quarterly monitoring would begin prior to GLE operations to establish baseline conditions, and the Expanded Monitoring Program would continue through the operations and decommissioning phases.

6.1.6 Soil Sampling

The existing soil sampling and analysis program at the Wilmington Site would be supplemented with four additional sampling locations; two to the north and two to the south of the proposed GLE Facility (GLE, 2008). The sampling at these new locations would begin before startup of the proposed GLE Facility to establish the baseline condition. In addition, uranium baseline concentration in shallow soil across the 100-acre (40-hectare) proposed GLE Facility site would be established before preconstruction and construction of the proposed GLE Facility (GLE, 2008).

6.2 Nonradiological Measurements and Monitoring Program

This section describes the proposed physiochemical, ecological, and industrial health and safety monitoring for the proposed GLE Facility. Discussions of physiochemical monitoring cover effluent monitoring of chemical constituents to meet permit requirements, and environmental media sampling to detect impacts from site operations.

6.2.1 Physiochemical Monitoring

A physiochemical monitoring program would be conducted during the construction and operation of the proposed GLE Facility as part of an environmental protection program to control chemical and other nonradiological exposures to workers, the public, and the environment. During the preconstruction and construction phases, worker and public exposure to dust would be monitored as required under GNF-A’s Industrial Safety Program and Occupational Safety and Health Administration (OSHA) requirements. Stormwater would be monitored during construction under the provisions of an NPDES General Permit for Construction Stormwater. The specific monitoring requirements under the permit would be specified in an Erosion and Sedimentation Control Plan submitted to and approved by the North Carolina Division of Land Resources.

During facility operation, the primary objective of monitoring would be to confirm that effluent controls for gaseous and liquid effluents are working properly, and if not, to alert operators when actions, including corrective measures, need to be taken. Physiochemical sampling of effluent streams and of environmental media potentially affected by the effluents, including soil, sediments, groundwater, surface water, and biota would be conducted. Specific parameters monitored would include uranium, fluoride, and any other chemicals or parameters specified in facility or site permits.

In addition, environmental media samples would be collected periodically and analyzed for chemicals present in effluents. Much of this sampling is already conducted for the existing facilities at the Wilmington Site, including sampling of uranium at various surface water locations; uranium and fluoride in groundwater at 21 site perimeter monitoring wells, and in sediments at various site locations. In addition to current sampling, four new soil sampling locations would be sampled near the boundaries of the proposed GLE Facility (GLE, 2008). Soil and sediment samples would be collected semiannually.

Groundwater sampling would be performed quarterly as described in Section 6.1.5, and would include analysis for fluoride and measurements of pH, temperature, and specific conductance. Water levels would be measured at each sampling event and in semiannual comprehensive measurement events across the Wilmington Site.

6.2.1.1 Effluent Monitoring

Hydrogen fluoride (HF), as fluoride ion, would be collected continuously on particulate filters in vent stacks and analyzed weekly in accordance with an NCDAQ air permit that would be required for the facility. Uranium isotopes would be collected continuously on particulate filters in air samplers located around the proposed GLE Facility. These filters would likewise be analyzed weekly. Fluoride and uranium would be monitored in liquid effluents along with any other chemicals required under the Wilmington Site's NPDES permits. Effluents would be sampled at outfalls from treatment systems for process wastewater and sanitary wastewater and in stormwater retention basins, including the holding pond for UF_6 storage pads.

The Expanded Monitoring Program would include continued monitoring at effluent outfalls under the current NPDES permit as described in Section 3.7.1.

Outfall 001 (Figure 3-20) is for process wastewater. It is monitored prior to discharge to the effluent channel for various parameters and has limitations on total suspended solids (TSS), total nitrogen, fluoride, cyanide, pH, metals (total cadmium, lead, chromium, copper, nickel, silver, zinc), oil and grease, and total toxic organics. The permit lists a number of equipment systems that contribute flow to the outfall, including treatment tanks, lime slurry system, hydrofluoric acid equipment, etc. The permitted maximum flow at the outfall is 6.8 million liters per day (1.8 million gallons per day).

Outfall 002 (Figure 3-20) was used for treated domestic (sanitary) wastewater until April 2008. Permit limitations included biochemical oxygen demand (BOD), TSS, and fecal coliform, and a maximum allowed flow of 280,000 liters per day (75,000 gallons per day). Because the new sanitary wastewater treatment facility does not release effluent, the outfall is unused; however, the permit is in place if discharge is necessary in the future. Effluent limits for both monthly average and daily maximum values include turbidity, nitrogen, BOD, TSS, and fecal coliform.

Monitoring of pH at the site dam is also described in Section 3.7.1.

Surface water monitoring would continue to be monitored by GLE, the NCDWQ, and the Lower Cape Fear River Program, as described in Section 3.7.1 of this draft EIS. The NCDWQ maintains two monitoring stations along the Northeast Cape Fear River; one is 27 kilometers (17 miles) upstream of the site and the other is 10 kilometers (6 miles) downstream. A third station near the Wilmington Site's south border is monitored by the Lower Cape Fear River Program. GE monitors water quality parameters along with gross alpha, gross beta, and uranium concentrations in the effluent channel at the Wilmington Site dam, the Northeast Cape Fear River significantly upstream of the Wilmington Site, and the Northeast Cape Fear River just downstream of the Wilmington Site.

6.2.1.2 Stormwater Monitoring

A stormwater permit would be required for the proposed GLE Facility (GLE, 2008). Stormwater would be monitored, as described in Section 6.1.3.

6.2.2 Ecological Monitoring

The current ecological monitoring program for the Wilmington Site consists of a forestry management plan to improve natural habitats on the Wilmington Site. This program would also provide appropriate monitoring and habitat management for the proposed GLE Facility. Monitoring would include ecological surveys to identify potential issues and habitat areas that need improvement. GLE would consider survey recommendations made by appropriate Federal and State agencies (e.g., U.S. Fish and Wildlife Service and the North Carolina Department of Environment and Natural Resources) (GLE, 2008). Such actions could include surveys for listed species or their suitable habitat, particularly the roughleaf loosestrife (*Lysimachia asperulaefolia*) and red-cockaded woodpecker (*Picoides borealis*) (FWS, 2009).

To mitigate losses of more mature trees, GLE would conduct surveys for trees >61 centimeters (24 inches) in diameter in areas that would be affected by preconstruction activities and construction of the proposed GLE Facility, in order to determine compensatory requirements for tree plantings that would be performed elsewhere on the Wilmington Site. If trenches are required, any that would be left open overnight would be inspected for animals prior to backfilling.

Any nonradiological ecological monitoring prescribed through the various environmental permits for the preconstruction, construction, and operation of the proposed GLE Facility are expected to be sufficient to evaluate any nonradiological ecological impacts.

6.2.3 Industrial Health and Safety Monitoring

The existing industrial health and safety program at the Wilmington Site would be expanded to include the activities of the proposed GLE Facility (GLE, 2008). This would include monitoring of indoor air quality and noise in work places. It would also include training of workers in safe work practices and monitoring of workplace safety-related occurrences and taking appropriate corrective actions. An ergonomic program would also be included as part of the industrial health and safety program to reduce or eliminate worker injuries (GLE, 2008).

6.2.4 Cylinder Surveillance and Monitoring

Surveillance and monitoring of depleted UF_6 cylinders would be conducted prior to placement on the storage pad (and periodically thereafter, including prior to transportation) to ensure cylinder integrity and prevent or minimize the potential release of UF_6 (GLE, 2008). GLE's cylinder monitoring program would include inspection criteria to ensure that lifting points, skirts, and stiffener rings are free from distortion and cracking; surfaces are free from bulges, dents, gouges, cracks, and significant corrosion; valves are fitting with correct protector and cap; valves are not distorted and valve stems are undamaged; and cylinder plugs are undamaged and not leaking. If inspections reveal significant deterioration or other conditions that may affect safe use of a cylinder, the contents of the affected cylinder would be transferred to another cylinder and the defective cylinder would be discarded. Investigation of the cause of the deterioration would be performed, and if necessary, additional cylinder inspections would be performed (GLE, 2008). In addition, radiological surveys would be conducted to ensure that cylinders are not externally contaminated and to help ensure that radiation exposures during cylinder handling and storage comply with the regulatory limits in 10 CFR Part 20 (GLE, 2008).

6.3 Quality Assurance

The Expanded Monitoring Program (which would incorporate the proposed GLE Facility) would fall under the oversight of the Wilmington Site Quality Assurance Program and would be managed by a qualified quality assurance officer. The program would employ written procedures for the collection of representative environmental samples, appropriate sampling methods and equipment, selection of sampling points, and sample preservation, transport, handling, storage, and custody. Additional written procedures would be used to ensure that sampling and monitoring equipment is properly maintained, calibrated, and is in good working order.

Onsite and contractor analytical laboratories would similarly implement a formal quality assurance/quality control program to monitor, assess, and control the performance of radiological and chemical analysis so that required performance standards specified in permits and within the standard analytical procedures are met. Good laboratory practices would be employed in all aspects of analysis. Laboratories would participate in third-party comparison studies to validate their performance.

Quality assurance measures employed in sampling and analysis would be adequate to produce valid analytical results. Procedures would require the use of calibration standards traceable to a primary National Institute of Standards and Technology (NIST) standard, as appropriate. Industry-accepted, regulatory agency-approved sampling, analysis, and reporting methods would be employed, such as those endorsed by the National Environmental Laboratory Accreditation Conference (NELAC).

The quality assurance program would specify an adequate set of quality assurance samples to validate field samples. Both field and laboratory quality control samples would be analyzed, including appropriate blank, duplicate, and spiked samples, as well as laboratory calibration and sample recovery standards. Performance standards would be set to meet the requirements of specific measurement programs, and would include standards for minimum detectable concentrations (MDCs), sample recovery, and analysis reproducibility. MDCs would be sufficient to meet action level, regulatory, and permit requirements, as well as the requirements of environmental media monitoring programs.

6.4 Reporting

Reporting would comply with the requirements of 10 CFR 70.59 and the guidance specified in *NRC Regulatory Guide 4.16* (NRC, 1985) It is expected that a single semiannual report for the

Wilmington Site (that would include the proposed GLE Facility) would be submitted to the NRC. The semiannual report would include the quantities of the radionuclides released in the unrestricted area and other information necessary to evaluate the radiation dose from effluent releases to the public (GLE, 2008). The NRC would place this report (and all other relevant information pertaining to environmental sampling) on the NRC's web site to make it available to the public.

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7 COST-BENEFIT ANALYSIS

The costs and benefits of the proposed action and no-action alternative are considered in this chapter as an aid in evaluating environmental consequences. Costs and benefits are presented, to the extent possible, in monetary terms. Important costs and benefits that cannot be quantified in monetary terms, such as environmental impacts, are presented qualitatively.

Cost-benefit analysis can provide a rationale for deciding whether a project is likely to have a net positive impact by aggregating each of the costs and benefits resulting from the project. Cost-benefit analysis involves valuing the benefits and costs associated with a project in monetary terms, to the extent possible. Depending on the extent of the data available, cost-benefit analyses may rely partially on qualitative data to assess the various costs and benefits; the methodology employed for a cost-benefit analysis is usually dependent on the specific issues involved in a project. Costs and benefits are often separated into two categories – private and societal. Private costs and benefits are those that impact the owner of a project or facility, in this case General Electric (GE)-Hitachi Global Laser Enrichment LLC (GLE), while societal costs and benefits are those that impact society as a whole. Much of the data associated with the construction and operation of the proposed GLE Facility that would be used to assess private costs (i.e., the costs of constructing and operating the proposed facility) are proprietary commercial information, withheld in accordance with 10 CFR 2.390. Although these costs are presented in Appendix H, they cannot be discussed in this section of this draft Environmental Impact Statement (EIS).

The analysis focuses on the various private and societal costs and benefits associated with the proposed action and the no-action alternative using data provided by GLE (GLE, 2008; GLE, 2009a). These data include the economic and fiscal benefits of facility construction and operation to the region in which the plant is located, and to the North Carolina state economy. As described in Section 3.13, the area in which workers are expected to live and spend most of their salary is referred to as the region of influence (ROI) for the analysis of socioeconomic impacts. The ROI corresponds to the Wilmington Metropolitan Statistical Area (MSA), a three-county area comprising Brunswick, New Hanover, and Pender Counties. Although the majority of the costs and most of the socioeconomic impacts of the various phases of the proposed GLE Facility development would occur in the ROI, there would be economic, fiscal, and, in particular, energy security benefits that would occur at both the local and national level. Therefore, the cost-benefit analysis addresses a larger area than the ROI that was considered in the analysis of socioeconomic impacts. Also discussed are the benefits of the proposed GLE Facility at the national level in fulfilling the need for enriched uranium to fulfill domestic electricity requirements, for domestic supplies of enriched uranium for national energy security, and for upgraded uranium enrichment technology in the United States. Societal costs considered include those related to impacts on land use, historical and cultural resources, visual resources, air quality, geology and soils, water resources, ecological resources, environmental justice, noise, transportation, public and occupational health, and waste management.

This chapter analyzes the costs and benefits both quantitatively, in monetary terms where possible, and qualitatively. Section 7.1 addresses the no-action alternative. Section 7.2 weighs the costs and benefits associated with the proposed action. Section 7.3 compares the costs and benefits for the proposed action to those of the no-action alternative. Section 7.4 combines these sections into overall conclusions. Alternatives that have previously been ruled out for failing to meet the project's technical and policy objectives are described in Section 2.3 of this draft EIS and are not revisited in this chapter.

7.1 The No-Action Alternative

Although the proposed GLE Facility would not be constructed or operated under the no-action alternative, preconstruction activities that are not covered under the scope of the NRC review could still take place (see Section 1.4.1 of this draft EIS). These activities would involve the disturbance of land associated with site clearing and the construction of ancillary facilities, in addition to other preconstruction activities, meaning that some ecological, natural, and socioeconomic impacts would therefore occur. All potential local environmental impacts related to water use, land use, groundwater contamination, ecology, air emissions, human health and occupational safety, waste storage and disposal, disposition of depleted uranium, and decommissioning projected to occur during construction, operations, and decommissioning phases would be avoided. Similarly, all socioeconomic impacts related to employment, economic activity, population, housing, and community resources during construction, operations, and decommissioning phases would not occur.

7.2 Costs and Benefits of the Proposed Action

Under the proposed action, GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina. In support of this proposed action, the U.S. Nuclear Regulatory Commission (NRC) would grant a license to GLE to possess and use source material, byproduct, and special nuclear material in accordance with the requirements of Title 10, "Energy," Parts 40, 30, and 70 of the U.S. *Code of Federal Regulations* (10 CFR), respectively. The proposed GLE Facility would be constructed from 2012–2017, with preconstruction activities beginning in 2011. The start-up activities would begin in 2013 and continue until 2017. Full production would be achieved in 2017, and continue through 2051, followed by license termination in 2052 and decommissioning.[1]

The principal socioeconomic impact or benefit from the proposed GLE Facility would be an increase in employment and income in the ROI. Although the majority of the costs and most of

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[1] As discussed in Section 4.1, the cost-benefit analysis was based on the assumption that a licensing decision would be made in late 2011, construction (if authorized) would start shortly after the licensing decision was made, and license termination would occur in 2051. The analysis was also based on the assumption that initial operations would begin in 2013, final construction activities would continue from 2013 to 2017, and that full operations would be achieved in 2017. Subsequently, the Commission's *Notice of Hearing and Commission Order* (75 FR 1819) specified that a licensing decision be made within 30 months of the Order (i.e., June 2012). Thus, the NRC staff currently expects that a licensing decision will be made in 2012, construction will begin in 2012, and that termination of the 40-year license, if granted, will occur in 2052. The NRC staff expects that the dates for start-up and final construction (2013-2017) and full facility operations (2017) will remain unchanged. The NRC staff expects that any resulting changes in the licensing and construction schedule would cause slight changes to cost–benefit analysis but would not affect the conclusions regarding impacts presented in this chapter. Any necessary changes to the analysis will be reflected in the final EIS.

the socioeconomic impacts of the various phases of GLE facility development would occur in the ROI, there would be economic, fiscal, and, in particular, energy security benefits, which would occur at both the local and national level. Therefore, the cost-benefit analysis addresses a larger area than the ROI, which was considered in the analysis of socioeconomic impacts.

This section describes the costs and benefits of each life-cycle stage of preconstruction and the proposed action. Quantitative estimates (in terms of dollars) are provided where possible. Other costs and benefits are described in qualitative terms.

7.2.1 Costs of the Proposed Action

The direct costs associated with the proposed action may be categorized by the following life-cycle stages:

- construction
- start-up activities
- facility operation
- depleted uranium disposal
- decommissioning

In addition to the costs of the proposed action, costs would be incurred for preconstruction activities that occur under both the proposed action and no-action alternatives. Because the monetary costs associated with preconstruction, construction, operations, and decommissioning phases of the proposed GLE Facility are withheld under the provisions of 10 CFR 2.390, the costs associated with each of these life-cycle stages are discussed in the proprietary appendix (Appendix H of this draft EIS) and summarized in Table H-1.

An additional element of the development of the proposed GLE Facility in the Wilmington area would be the tax incentives provided to GLE by the State of North Carolina and New Hanover County. It is anticipated that these incentives would amount to up to \$26.6 million from the State, most of which would be payable over a 12-year period; and up to \$10 million from the county, payable over a 10-year period. Both incentives are contingent upon GLE reaching specified investment and employment levels at the proposed GLE Facility (GLE, 2009b). In the cost-benefit calculation, the analysis reduced the total cost of construction of the proposed facility by the amount of these tax incentives, and reduced the county and State tax benefits from the proposed GLE Facility.

In addition to monetary costs, the proposed action would result in impacts on various resource areas, which can also be considered "costs" for the purpose of this analysis. The resource areas and corresponding impacts are summarized below and described in more detail in Chapter 4 of this draft EIS. The impact of the proposed action is estimated to be SMALL or SMALL to MODERATE for all resource areas.

- Land Use. As described in Section 4.2.1, preconstruction and construction activities associated with the proposed GLE Facility would include construction of the proposed facility and associated buildings, storage areas, and parking areas. Impacts during preconstruction and construction, and operations and decommissioning phases are expected to be SMALL.

- Historical and Cultural Resources. As described in Section 4.2.2, no direct impacts on historic and cultural resources are currently expected. However, operations at the proposed GLE Facility could affect a historic site that was identified on the Wilmington Site if expansion of the proposed facility was deemed necessary in the future. Because of this potential impact on one historic site, the overall impacts on the historic and cultural resources have been categorized as SMALL to MODERATE. However, consultation between the NRC, the North Carolina State Historic Preservation Office (SHPO), and GLE is ongoing, and impact levels could be reduced if a plan to mitigate impacts on the identified historic site is developed and implemented.

- Visual and Scenic Resources. As described in Section 4.2.3, temporary visual impacts may result from the use of construction cranes during preconstruction and construction activities, with impacts expected to be SMALL.

- Air Quality. As described in Section 4.2.4, road construction, land-clearing, and building construction activities are projected to cause a temporary increase in the concentrations of particulate matter having a mean diameter of 10 micrometers or less (PM_{10}) in the ambient air that slightly exceed the air quality standard, primarily to the north of the proposed GLE Facility site. These impacts are expected to be SMALL to MODERATE.

- Geology and Soils. As described in Section 4.2.5, preconstruction activities would require clearing and grading of approximately 58 hectares (143 acres). Although terrain changes would be minimal, a short-term increase in soil erosion would occur. Impacts on soils and geology are expected to be SMALL.

- Surface Water Resources. As described in Section 4.2.6, indirect surface water quality impacts caused by stormwater runoff from the proposed GLE Facility site would occur, together with treated wastewater effluent discharges to the effluent channel. These impacts are expected to be SMALL.

- Groundwater Resources. As described in Section 4.2.7, groundwater used for operations of the proposed GLE Facility would come from existing groundwater supplies at the site and would be offset by the industrial reuse of treated sanitary wastewater effluent as process water. Groundwater flow patterns would remain unchanged, with only a small change in groundwater elevations. These impacts are expected to be SMALL.

- Ecological Resources. As described in Section 4.2.8, although construction and operation of the proposed facility would alter the composition of habitat on the site, it would not destabilize the existence of forested habitats or wildlife communities. Impacts would be SMALL to MODERATE.

- Noise. As described in Section 4.2.9, MODERATE impacts of increased noise are associated with the operation of preconstruction and construction machinery, and SMALL impacts are expected from the operation of the proposed GLE Facility itself.

- Traffic. As described in Section 4.2.10, increased truck and car traffic associated with preconstruction and construction activities, and with transportation of materials, product, and employees, to and from the proposed GLE Facility could produce SMALL to MODERATE increases in traffic congestion in the local road network.

- Transportation Accidents. As described in Section 4.2.10, the probability of a severe transportation accident that releases sufficient quantities of uranium hexafluoride (UF_6) that could pose a health risk is low. The consequences of such an accident, should it occur, are high. Based on this analysis, the public health impacts associated with such an accident as part of the proposed action are expected to be SMALL.

- Waste Management. As described in Section 4.2.12, there may be trace radiological releases from waste streams, primarily during operation of the proposed GLE Facility. In addition, UF_6 tails may remain onsite for an extended period due to inadequate conversion capacity. These impacts are expected to be SMALL.

- Socioeconomics. As described in Section 4.2.13, employment and income would be created in the ROI around the proposed GLE Facility site. In-migration into the ROI would result in socioeconomic impacts, including impacts to housing resources, community, and social services. These impacts are estimated to be SMALL.

- Environmental Justice. As described in Section 4.2.14, the area surrounding the proposed GLE Facility site includes a mixture of low-income and minority residents. In these areas, any adverse environmental impacts from the proposed GLE Facility are not expected to disproportionately impact low-income or minority populations. Impacts are expected to be SMALL.

- Facility Accidents. As described in Section 4.2.15, accidents associated with operation of the proposed GLE Facility could result in SMALL impacts on the workers and the surrounding public.

7.2.2 Benefits of the Proposed Action

The proposed action would result in an annual peak capacity of 6 million separative work units (SWU), producing approximately 2.5 million pounds of enriched uranium per year from 2017 through 2051. The benefits to the company will depend on the market price of natural uranium, the cost to enrich the uranium, and the market price of enriched uranium.

As discussed in Section 1.3, the level of production expected by the proposed GLE facility would augment the domestic supply of enriched uranium and would assist in meeting the need for increased domestic supplies of enriched uranium for national energy security. Under the proposed action, enriched uranium production would be undertaken with the latest enrichment technology.

The proposed action would also result in small positive socioeconomic impacts in the ROI, as described in Section 4.2.13. Table 7-1 presents the estimated employment and tax revenue benefits associated with the proposed action. Between 2012 and 2017, average annual direct employment at the site as a result of construction activities would be 1552 jobs; State direct income tax revenues would be $0.7 million per year, and State sales tax receipts would be $0.5 million per year during construction on average.[2,3] Start-up activities from 2013 to 2017 are expected to create 200 annual direct jobs in the ROI, provide $1.3 million to the State in income tax revenues, and provide $0.9 million in sales tax revenues. During the GLE operations phase between 2017 and 2051, 350 direct jobs would be created annually. The State would benefit from $2.3 million in additional income tax, and $1.7 million in sales tax receipts. The decommissioning phase of the proposed action is expected to create a total of 50 annual direct jobs, with annual State income and sales tax revenues of $0.3 million and $0.2 million, respectively.

During the preconstruction phase, 119 jobs would be created; State direct income tax revenues would be $0.3 million and State sales tax receipts would be $0.2 million.

Between approximately 20 percent and 30 percent of direct State income taxes from the construction and operation of the proposed GLE Facility would be generated as a result of wages and salaries paid to GLE employees moving into the ROI from elsewhere. Procurement of equipment, materials, and services, and the spending of wages and salaries associated with

Table 7-1 Socioeconomic Benefits Associated with the Proposed GLE Facility

Project Phase	Direct and Indirect Jobs Created (Annual, Full-Time Jobs)	Direct Annual State Income Tax Revenues ($ 2008 m)[a]	Direct Annual State Sales Tax Revenues ($ 2008 m)
Proposed Action			
Construction	1550[b]	1.4	1.0
Start-up	418	1.3	0.9
Facility operation	732	2.3	1.7
Decommissioning	83	0.3	0.2
Preconstruction	119	0.3	0.2

[a] Includes individual and corporate income taxes.
[b] Chapter 4 lists 3811 preconstruction and construction jobs, which is the peak number of workers; 1552 represents the average number of construction jobs.
Sources: GLE, 2008; 2009b.

2 All direct income and direct sales tax impact estimates are provided in 2008 dollars.

3 The socioeconomic impacts analysis is based on the assumption that the peak construction year will be 2012, if a license is granted. The NRC staff expects this assumption would remain accurate despite the six-month schedule adjustment discussed in Section 7.2.

the construction and operation of the proposed GLE Facility would generate less than one percent of annual State sales taxes. Corporate income taxes would also be collected by the State during the facility operational period, and would total an estimated $52.7 million annually.

Although it can be assumed that some portion of State sales and income taxes paid would be returned to the ROI under revenue-sharing arrangements between each county and the State government, the exact amount that would be received by each county cannot be determined.

In addition to sales and income taxes, the proposed GLE Facility would also be subject to property taxes levied by New Hanover County, which were $0.45 per $100 of assessed valuation in 2009, and by the City of Wilmington, which would levy $0.33 per $100 in addition to the County tax (see Section 3.13.4). Assuming that assessed valuation equals total capital investment cost of the proposed GLE Facility, then GLE would pay total property taxes of $8.7 million annually during the period 2017 to 2051.

Beyond the economic and fiscal benefits of the proposed GLE Facility in the ROI, the proposed facility would also create fiscal benefits in the nation as a whole, primarily in the form of Federal income taxes on employee wages and salaries. Based on the distribution of employees in each salary category at the proposed facility, it is estimated that annual direct individual Federal income taxes during facility construction would be $1.4 million, with $6.4 million generated annually during facility operations. Although, as was the case with State taxes, some portion of Federal income taxes paid by GLE workers would become part of expenditures by various Federal government programs occurring in the ROI, the exact amount that would be received by each county cannot be determined.

7.2.3 Summary

This analysis shows that although there are economic and fiscal benefits associated with the proposed action, these impacts are expected to be SMALL. There would also be costs resulting from impacts associated with the proposed action on various resource areas that cannot be expressed in dollar terms. For the majority of these resource areas, impacts are estimated to be SMALL, or SMALL to MODERATE in magnitude.

7.3 Comparative Cost-Benefit Analysis of Proposed Action Relative to No-Action Alternative

This section compares the costs and benefits of the proposed action to those of the no-action alternative. This comparison focuses on the tradeoffs between the proposed GLE Facility compared to not building the facility.

7.3.1 Methodology

The proposed action and the no-action alternative are first assessed in Section 7.3.2 for compliance with various policy and technical objectives. The proposed action and the no-action alternative are then analyzed in Section 7.3.3 for impacts and values across the following impact areas or attributes:

- construction costs
- operating costs
- depleted uranium disposal costs
- decommissioning costs

Costs associated with preconstruction activities were not included in the analysis, as they are likely to be similar for both the proposed action and the no-action alternative.

The other non-monetary cost areas described in Section 7.2.1 are not included in this comparison because the effect of these impacts is assumed to be either: (1) approximately equal for the proposed action and the no-action alternative as defined above or (2) too small of a differential impact to materially affect the comparative cost-benefit analysis. The NRC staff assessed impacts and values for these criteria using either: (1) estimated dollars or (2) ordinal ratings based on expert judgment where quantification is regarded as inappropriate or unnecessary. This approach is consistent with NRC guidance and is well suited to the current analysis.

This analysis does not attempt to estimate the economic effects of a cheaper source of enriched uranium for nuclear power plants, or to estimate the impact of lower enriched uranium prices on the ratio of nuclear and non-nuclear power in the domestic economy, on overall power demand and price, and on the potential economic benefits to consumers and suppliers.

7.3.2 Compliance with Policy and Technical Objectives

The following policy and technical objectives are relevant to the choice of an enrichment technology:

- the need for enriched uranium to fulfill domestic electricity requirements
- the need for domestic supplies of enriched uranium for national energy security
- the need for upgraded uranium enrichment technology in the United States

The following sections compare the proposed action and the no-action alternative in terms of how well they meet each of these objectives.

7.3.2.1 Meeting Future Demand

As indicated in Section 1.3.1, the demand for enriched uranium in the United States is currently being met from two categories of sources:

- domestic production of enriched uranium
- foreign sources

The current U.S. demand for enriched uranium is 13–14 million SWU per year (EIA, 2008; EIA, 2009). This demand could reach 15 million to 16 million SWUs by 2025, depending on the rate of nuclear generation growth in the United States (EIA, 2008). Currently, as much as 85–90 percent of the U.S. demand is supplied by foreign sources. The construction and operation of the proposed GLE Facility would contribute to reliable domestic supply of enriched uranium to meet the increased demand for nuclear fuel from the nuclear power industry. This benefit could potentially be SMALL to MODERATE.

7.3.2.2 National Energy Security

Foreign sources currently supply as much as 85–90 percent of the U.S. demand for enriched uranium, and all of the domestic production of enriched uranium currently takes place at a single facility – the Paducah Gaseous Diffusion Plant. It is anticipated that all gaseous diffusion enrichment operations in the United States will cease in the near future due to the higher cost of aging facilities (DOE, 2007). Furthermore, the Megatons-to-Megawatts Program is scheduled to expire in 2013 (DOE, 2010). As noted in Section 1.3.1, these two sources meet approximately half of the current U.S. demand for low-enriched uranium (LEU). As a result, new domestic sources of enriched uranium are needed to reliably provide fuel to both existing and future nuclear power plants in the United States. Therefore, the projected 6 million SWU production capacity resulting from the proposed action could be important for increasing the nation's energy security. This benefit could potentially be SMALL to MODERATE.

7.3.2.3 Technology Upgrade

The proposed action represents the implementation of a new uranium enrichment technology, with gaseous diffusion technology currently the only technology in commercial use in the United States. Gas centrifuge technology, which will be used at the National Enrichment Facility (NEF), American Centrifuge Plant (ACP), and proposed Eagle Rock Enrichment Facility (EREF), is known to be more efficient and substantially less energy-intensive than gaseous diffusion technology. The GLE laser-based technology that would be deployed at the proposed GLE Facility is newer than gas centrifuge technology, and GE-Hitachi expects it to offer certain advantages over both the gaseous diffusion and gas centrifuge processes (GLE, 2008). This could potentially result in a SMALL to MODERATE impact.

7.3.3 Impacts and Value Analysis

A comparison of the impacts and values of the proposed action and the no-action alternative would include the following cost and categories:

- construction costs

- operating costs

- depleted uranium disposal costs

- decommissioning costs

As the monetary costs associated with preconstruction, construction, operations, and decommissioning phases of the proposed GLE Facility are proprietary and withheld under the provisions of 10 CFR 2.390, the costs associated with each of these life-cycle stages are discussed in a proprietary appendix (Appendix H) and summarized in Table H-1.

7.3.4 Summary Regarding the Proposed Action versus the No-Action Alternative

Based on consideration of local and national socioeconomic benefits, the costs of construction and operation of the proposed GLE Facility on a range of environmental resources, and on public and occupational health, the proposed action is preferable relative to the no-action alternative in the following respects:

- The proposed action would contribute to meeting future demand from domestic sources and increase national energy security. It would also introduce a newer technology with potential to have smaller resource requirements and environmental impacts in the United States to fulfill these needs.

- The proposed action would have positive impacts in the ROI on employment, income, and tax revenues during the construction, operations, and decommissioning phases (as discussed in Sections 4.2.13 and 4.2.17.12), and on State and Federal income tax revenues.

7.4 Overall Cost-Benefit Conclusions

While there are national energy security and fiscal benefits associated with the proposed action, and local socioeconomic benefits in the ROI, there are also direct costs associated with the construction and operation phases of the proposed action, as well as impacts associated with the proposed action on various resource areas. However, these impacts are estimated to be SMALL to MODERATE in magnitude and small in comparison to the local and national benefits of the proposed action. In addition, many of the impacts on environmental resources associated with the proposed action relate to preconstruction activities at the proposed facility site, and would also occur under the no-action alternative.

Although the no-action alternative would include the continuation of uranium enrichment using gaseous diffusion, the development of new facilities based on gas centrifuge technology, and imported enriched uranium supplies, the proposed action would better satisfy the objectives to meet future demand for enriched uranium and improve national energy security. It is therefore apparent that in comparison to the no-action alternative, the proposed action would be associated with net positive benefits.

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8 SUMMARY OF ENVIRONMENTAL CONSEQUENCES

On January 30, 2009, General Electric (GE)-Hitachi Global Laser Enrichment LLC (GLE) submitted an environmental report (GLE, 2008) to the U.S. Nuclear Regulatory Commission (NRC) in anticipation of its application for a license to construct, operate, and decommission the GLE Commercial Facility near Wilmington, North Carolina. If licensed, the proposed GLE Facility would enrich uranium for use in commercial nuclear fuel for power reactors. Feed material would be comprised of non-enriched uranium hexafluoride (UF_6). GLE would employ a laser-based enrichment process to enrich uranium to up to 8 percent uranium-235 by weight with an initial planned maximum target production of 6 million separative work units (SWUs) per year. The proposed GLE Facility would be licensed in accordance with the provisions of the *Atomic Energy Act*. Specifically, an NRC license under Title 10, "Energy," of the *U.S. Code of Federal Regulations* (10 CFR) Parts 30, 40, and 70 would be required to authorize GLE to possess and use byproduct material, source material, and special nuclear material at the proposed GLE Facility.

GLE expects to begin preconstruction activities in 2011. If the license application is approved, facility construction would begin in 2012 and continue for six years. GLE anticipates commencing initial production in 2013 and reaching full production in 2017. Prior to license expiration in 2052, GLE would decide to seek to renew its license to continue operating the facility, or plan for the decontamination and decommissioning of the facility per the applicable licensing conditions and NRC regulations.

Section 102 of the *National Environmental Policy Act* (NEPA) of 1969, as amended (42 USC 4321 et seq.), directs that an environmental impact statement (EIS) is required for major Federal actions that significantly affect the quality of the human environment. Section 102(2)(C) of NEPA requires that an EIS include information about the following:

- the environmental impacts of the proposed action;
- any adverse environmental effects that cannot be avoided should the proposal be implemented;
- alternatives to the proposed action;
- the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity; and
- any irreversible and irretrievable commitments of resources that would be involved if the proposed action is implemented.

NRC's regulations under 10 CFR Part 51 implement the requirements of the NEPA, as amended (Public Law 91-190). In particular, 10 CFR 51.20 (b)(10) states that issuance of a license for a uranium enrichment facility requires the NRC to prepare an EIS.

GLE submitted a license application for the proposed GLE Facility on June 26, 2009. GLE proposes to co-locate the facility on the existing General Electric Company (GE)/Global Nuclear Fuel-Americas (GNF-A) site near Wilmington, North Carolina. On May 8, 2009, the NRC granted an exemption authorizing GLE to conduct preconstruction activities on the Wilmington Site. Subsequently, GLE submitted Supplement 1 to its environmental report on July 13, 2009 (GLE, 2009a), which distinguishes between the environmental impacts of preconstruction activities and those of NRC-licensed construction activities, which cannot be undertaken unless a license is granted. On November 13, 2009, GLE submitted Supplement 2 to its environmental report (GLE, 2009b), which provides information describing the environmental impacts associated with revising the location of the Wilmington Site entrance and roadway to the proposed GLE site.

Upon acceptance of the environmental report, the NRC began the environmental review process described in 10 CFR Part 51 by publishing, on April 9, 2009, a Notice of Intent to prepare an EIS and conduct scoping (Volume 74, page 45075, of the *Federal Register* [74 FR 16237]). The NRC staff held two public scoping meetings on May 19, 2009. The NRC also met with local officials and conducted a site visit and technical meetings with GLE on May 18–20, 2009. Due to a delay in submission of the license application, the NRC extended the conclusion of the public scoping comment period from June 8, 2009, to August 31, 2009 (74 FR 36781).

The NRC staff reviewed GLE's environmental report and supplemental documentation, and consulted with other Federal, State, and local agencies, and Tribal organizations. The NRC staff also considered the public comments received during the scoping process for preparation of this draft EIS; these comments are provided in Appendix A. The NRC staff issued a Scoping Summary Report in November 2009.

Included in this draft EIS are (1) the results of the NRC staff's preliminary analyses, which consider and weigh the environmental effects of the proposed action; (2) mitigation measures for reducing or avoiding adverse effects; (3) the environmental impacts of alternatives to the proposed action; and (4) the NRC staff's preliminary recommendation regarding the proposed action based on its environmental review.

The NRC defines three significance levels for rating impacts on a resource (10 CFR Part 51, Subpart A, Appendix B):

- SMALL – Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

- MODERATE – Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.

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

Mitigation measures were considered for each environmental issue and are discussed in Chapters 4 and 5 of this draft EIS. During its environmental review, the NRC considered planned activities and actions that GLE indicates it and others would likely take should GLE receive a license. In addition, GLE provided estimates of the environmental impacts resulting from construction and operation of the proposed GLE Facility at the Wilmington Site.

In a final rule dated October 9, 2007 (72 FR 57416), the Commission limited the definition of "construction" to those activities that fall within its regulatory authority (10 CFR 51.4). Many of the activities required to build a proposed nuclear facility are not part of the NRC action to license the facility. Activities associated with construction of a facility that are not within the purview of the NRC action are grouped under the term "preconstruction." Preconstruction activities include clearing and grading, excavating, erection of support buildings and transmission lines, and other associated activities. Although preconstruction activities are not part of the NRC action, they support or are requisite to the NRC action. In addition, certain preconstruction activities require permits from other Federal, State, and local agencies.

8.1 Unavoidable Adverse Environmental Impacts

Section 102(2)(C)(ii) of NEPA requires that an EIS include information about any adverse environmental effects that cannot be avoided should the proposal be implemented. Unavoidable adverse environmental impacts are those potential impacts of the NRC action that cannot be avoided and for which no practical means of mitigation are available.

The environmental impacts associated with the proposed action and the no-action alternative are described in detail for each resource area in Chapter 4. The impacts of the two alternatives are summarized and compared in Section 2.4. Brief summaries of the impacts are also provided in Chapter 7 under the Cost-Benefit Analysis and in the Executive Summary. Chapter 4 discusses the mitigation measures that GLE proposed in its environmental report to mitigate the potential impacts from the proposed action and the measures that NRC recommends to further reduce the potential impacts on the affected environment. These two sets of mitigation measures are summarized in Tables 5-1 and 5-2, respectively. The cumulative impacts on the environment that would result from the proposed action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such action, are described in Section 4.3. As discussed in Chapter 4, the environmental impacts that would result if the proposed action were to be implemented as proposed by GLE would generally be SMALL, and would, in most cases, be mitigated by the methods proposed by GLE. The only impacts that could potentially be classified as MODERATE would be in the following resource areas: historic and cultural resources, ecological resources, and transportation. In addition, air quality and noise impacts could be MODERATE on a temporary basis during preconstruction and construction activities.

The impact level on historic and cultural resources has been classified as SMALL to MODERATE because operations at the proposed GLE facility could affect the historic site 31NH801 on the Wilmington Site if expansion of the plant was deemed necessary in the future. The North Carolina State Historic Preservation Office (SHPO) asked to review the measures that will be taken by GLE to ensure protection and preservation of site 31NH801 from future ground-disturbing activities (NCDCR, 2009). Consultation between the NRC, North Carolina SHPO, and GLE is ongoing. Impact levels could be reduced if a plan for site 31NH801 is developed and implemented.

The impact level on ecological resources has been classified as SMALL to MODERATE, mainly due to clearing of land that would occur during preconstruction activities.

The transportation impacts on local roads in the immediate vicinity of the Wilmington Site could be SMALL to MODERATE due to increases in traffic density during certain phases of the proposed action (e.g., during construction and when the construction and operations overlap during late 2013 to 2017) and due to other reasonably foreseeable actions (e.g., the development of a retirement community to the south of the Wilmington Site). The regional transportation impacts would be classified as SMALL.

The ground-disturbing activities during preconstruction and construction activities could result in increased fugitive dust emissions and cause MODERATE air quality impacts. Similarly, noise generated by ground-clearing and construction equipment could raise the noise levels to a range considered to be MODERATE impact. However, both the air quality and noise impacts would be at the MODERATE level only temporarily. The majority of the time, these impacts would be considered to be SMALL.

8.2 Relationship between Local Short-Term Uses of the Environment and the Maintenance and Enhancement of Long-Term Productivity

Consistent with the Council on Environmental Quality (CEQ) definition and the definition provided in Section 5.8 of NUREG-1748 (NRC, 2003), this draft EIS defines short-term uses and long-term productivity as follows:

- Short-term uses generally affect the present quality of life for the public (i.e., the 40-year license period for the proposed GLE Facility).

- Long-term productivity affects the quality of life for future generations on the basis of environmental sustainability (i.e., the period after license termination for the proposed GLE Facility).

The construction and operation of the proposed GLE Facility would necessitate short-term commitments of resources and would permanently commit certain other resources (such as energy and water). The short-term use of resources would result in potential long-term socioeconomic benefits to the local area and the region. The short-term commitments of resources would include the use of materials required to construct new buildings, the new operations support facilities, transportation, and other disposal resources and materials for proposed GLE Facility operations.

Workers, the public, and the environment would be exposed to increased amounts of hazardous and radioactive materials over the short term from operations of the proposed GLE Facility and the associated materials, including process emissions and the handling of waste and depleted uranium hexafluoride (UF_6) cylinders. Construction and operation of the proposed GLE Facility would require a long-term commitment of terrestrial resources, such as land, water, and energy. Short-term impacts would be minimized by the application of proper mitigation measures and resource management. Upon the closure of the proposed GLE Facility, GLE would decontaminate and decommission the buildings and equipment and restore them for unrestricted use. This work would make the site available for other uses. The use of the site and the buildings for other industrial purposes would constitute a long-term benefit to the community and would increase long-term productivity. Continued employment, expenditures, and tax revenues generated during the implementation of the proposed action would directly benefit the local, regional, and state economies and would be considered a long-term benefit.

8.3 Irreversible and Irretrievable Commitment of Resources

Irreversible commitment of resources refers to resources that are destroyed and cannot be restored, whereas an irretrievable commitment of resources refers to material resources that once used cannot be recycled or restored for other uses by practical means (NRC, 2003). The implementation of the proposed action as described in Section 2.1 would include the commitment of land, water, energy, raw materials, and other natural and manmade resources. About 40 hectares (100 acres) on the 656-hectare (1621-acre) site would be used for the construction and operation of the proposed GLE Facility. The applicant stated in its ER that it plans to decontaminate and decommission the proposed facility for unrestricted use (GLE, 2008). Given the Wilmington Site's current land use zoning, the 40-hectare (100-acre) parcel of land would likely remain industrial beyond license termination. Water required during the entire proposed action, including preconstruction and construction, operation, and decontamination and decommissioning, would be obtained from the existing wells at the Wilmington Site and would be replenished through natural mechanisms. The wastewaters that are generated would be treated to meet applicable standards and would be released to local receiving surface waters. The energy used in the form of electricity, natural gas, and diesel fuel would be supplied through existing systems in the Wilmington area. The specific types of construction materials and the quantities of energy and materials used cannot be determined with certainty until the final facility design is completed. However, it is not expected that the quantities required would put any strains on the availability of these resources.

Even though the land on the Wilmington Site used to construct the proposed GLE Facility would be returned to other productive uses after the facility is decommissioned, there would be some irreversible commitment of land at some offsite locations used to dispose of solid wastes generated at the proposed GLE Facility. In addition, wastes generated during the conversion of depleted UF_6 produced at the proposed GLE Facility and the depleted uranium oxide conversion product from the depleted UF_6 conversion would be disposed of at an offsite location (see Section 2.1.3). The land used for the disposal of these materials would also represent an irreversible commitment of land. No solid wastes or depleted uranium oxide conversion product originating from the proposed GLE Facility would be disposed of at the Wilmington Site.

When the facility is decommissioned, some of the materials used in its construction, such as concrete, steel, other metals, plastics, and other materials, would be recycled and reused. Other materials would be disposed of in a licensed and approved offsite location. The amount of land used to dispose of these materials would also be an irretrievable land resource.

During the operation of the proposed GLE Facility, natural UF_6 would be used as the feed material. This would require the mining of uranium and several other operational steps in the uranium fuel cycle that result in the production of UF_6. The use of uranium minerals would be an irretrievable resource commitment. There would also be other irreversible and irretrievable commitments of resources during uranium fuel cycle operations that result in the production of natural UF_6 feed. As shown in Figure 1-3, there are several fuel cycle operations leading up to the production of the natural UF_6 that feeds enrichment operations. These steps include the mining and processing of uranium ore, which results in the production of natural triuranium octaoxide (U_3O_8), and conversion of natural U_3O_8 to UF_6. All the materials and energy used in the construction and operation of the facilities used to mine and process the uranium ore, and convert natural U_3O_8 to natural $UF_{6,}$ would constitute irreversible and irretrievable commitment of resources.

8.4 References

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9 AGENCIES AND PERSONS CONSULTED

The following sections list the agencies and persons consulted for information and data for use in the preparation of this draft Environmental Impact Statement (draft EIS):

9.1 Federal Agencies

U.S. Army Corps of Engineers, Wilmington Regulatory Office, Wilmington, North Carolina
Keith Harris, Chief
Jennifer Frye, Project Manager

U.S. Fish and Wildlife Service, Raleigh Field Office, Raleigh, North Carolina
Howard Hall, Fish and Wildlife Biologist
John Hannon, Fish and Wildlife Biologist

9.2 Indian Tribes and Organizations

Coharie Indian Tribe, Clinton, North Carolina
Gene Faircloth, Chief
Elizabeth Maynor, Executive Director

Cumberland County Association for Indian People, Fayetteville, North Carolina
Roy Maynor, Chairman
Gladys Hunt, Executive Director

Eastern Band of Cherokee, Cherokee, North Carolina
Leon Jones, Principal Chief

Guilford Native American Association, Greensboro, North Carolina
Rick Oxendine, Executive Director

Haliwa-Saponi Indian Tribe, Hollister, North Carolina
Ruth Ealing, Chairperson
Archie Lynch, Tribal Administrator

Sappony, Roxboro, North Carolina
Dante Desiderio, Executive Director

Lumbee Indian Tribe, Pembroke, North Carolina
Milton Hunt, Chairman
Darlene Jacobs, Tribal Administrator

Meherrin Indian Tribe, Winton, North Carolina
Denyce Hall, Executive Director

Metrolina Native American Association, Charlotte, North Carolina
Letha Strickland, Executive Director

Triangle Native American Society, Raleigh, North Carolina
Brett Locklear, President

Waccamaw Siouan Indian Tribe, Bolton, North Carolina
Sabrina Jacobs, Executive Director

Eastern Band of Cherokee Indian, Cherokee, North Carolina
Russ Townsend, Tribal Historic Preservation Officer

Catawba Indian Tribe, Catawba, South Carolina
Wenonah Haire, Tribal Historic Preservation Officer

United Keetoowah Band of Cherokee, Tahlequah, Oklahoma
Lisa C. Stopp, Tribal NAGPRA Point of Contact

Cherokee Nation of Oklahoma, Tahlequah, Oklahoma

Tuscarora Nation, Lewiston, New York
Leo Henry, Chief

9.3 State Agencies

North Carolina Department of Administration, State Environmental Review Clearinghouse, Raleigh, North Carolina
Valeria McMillan, Director

North Carolina Department of Environment and Natural Resources, Raleigh, North Carolina
Melba McGee, Environmental Review Coordinator

North Carolina Department of Environment and Natural Resources, Division of Air Quality
Dean Carroll, Permit Coordinator

North Carolina Department of Environment and Natural Resources, Division of Coastal Management, Morehead City, North Carolina
Steven Everhart, District Manager
Stephen Rynas, Federal Consistency Coordinator

North Carolina Department of Environment and Natural Resources, Division of Environmental Health, Radiation Protection Section, Emergency Response and Environmental Branch, Raleigh, North Carolina
Dale Dusenberry, Manager

North Carolina Department of Environment and Natural Resources, Division of Inactive Hazardous Sites
Ginny Henderson, Hydrogeological Technician

North Carolina Department of Environment and Natural Resources, Division of Water Quality, Basinwide Planning Unit and SEPA Program, Raleigh, North Carolina
Hannah Stallings, SEPA Coordinator

North Carolina Department of Environment and Natural Resources, Division of Surface Water Protection
Rhonda Hall, Environmental Engineer
Linda Willis, Environmental Engineer

North Carolina Department of Environment and Natural Resources, Division of Waste Management, Eastern Region Compliance Branch
Ted Cashion, Supervisor

North Carolina Department of Environment and Natural Resources, Division of Waste Management, Solid Waste Section
Dennis Shackelford, Central District Supervisor

North Carolina Department of Environment and Natural Resources, Division of Waste Management, Superfund Section
S. Franch, Environmental Chemist

North Carolina Department of Environment and Natural Resources, One-Stop/Express Permitting
Cameron Weaver, Coordinator

North Carolina Department of Labor
Kevin O'Barr, Standards Supervisor
Jennifer Chrisohon, Deputy General Counsel
Ric Schumann, Industrial Hygienist
Wanda Lagoe, Bureau Chief, Education, Training, and Technical Assistance
Lafayette Atkinson, District 10 Supervisor, Compliance Bureau

North Carolina Division of Historical Resources, Raleigh, North Carolina

North Carolina Department of Cultural Resources, State Historic Presentation Office, Raleigh, North Carolina
Renee Gledhill-Early, Environmental Review Coordinator
Dolores Hall, Deputy State Archaeologist

North Carolina Wildlife Resources Commission, Raleigh, North Carolina
Molly Ellwood, Southeastern Permit Coordinator

9.4 Local Agencies

Cape Fear River Watch, Wilmington, North Carolina
Doug Springer, Executive Director/Riverkeeper

New Hanover County, Wilmington, North Carolina

David F. Weaver, Assistant County Manager

New Hanover County Soil and Water Conservation District, Wilmington, North Carolina

Jennifer Braswell, Director, Community Conservation

New Hanover County Planning Department, Wilmington, North Carolina

Sam Burges, Principal Development Planner
Wanda B. Coston, Community Development Planner
Jane Daughtridge, Senior Planner
Chris B. O'Keefe, Planning Director
Shawn Ralston, Senior Environmental Planner

New Hanover County Engineering Department, Wilmington, North Carolina

James P. Iannucci, Chief Project Engineer
Dennis Ihnat, Director
Beth E. Wetherill, Erosion Control Engineer

10 LIST OF PREPARERS

10.1 U.S. Nuclear Regulatory Commission (NRC) Contributors

Jennifer A. Davis
B.A., Historic Preservation and Classical Civilization (Archaeology), Mary Washington College, 1996
Years of Relevant Experience: 8

A. Christianne Ridge
B.A., Physics, Drew University, 1996
M.S., Environmental Engineering, Cornell University, 1999
Ph.D., Environmental Engineering, University of California-Berkeley, 2004
Years of Relevant Experience: 6

Behram Shroff
M.C.P., City/Regional Planning, Georgia Tech, 1973
M.S., Electrical Engineering, University of California-Berkeley, 1966
Years of Relevant Experience: 2

Haimanot Yilma
B.S., Chemical Engineering, University of Maryland-College Park, 1998
M.B.A., University of Maryland at College Park, 2010
Years of Relevant Experience: 1

10.2 Argonne National Laboratory (Argonne) Contributors

Tim Allison: Socioeconomics, environmental justice, cost-benefit analysis
B.A., Economics and Geography, Portsmouth Polytechnic, (U.K.), 1982
M.A., Geography, West Virginia University, 1987
M.S., Mineral and Energy Resource Economics, West Virginia University, 1990
Years of Relevant Experience: 25

Halil Avci: Argonne Project Team Lead
B.S., Nuclear Engineering, University of Wisconsin-Madison, 1973
M.S., Nuclear Engineering, University of Wisconsin-Madison, 1975
Ph.D., Nuclear Engineering, University of Wisconsin-Madison, 1978
Years of Relevant Experience: 24

Bruce Biwer: Transportation, waste management, accidents
B.A., Chemistry, St. Anselm College, 1980
M.S., Chemistry, Princeton University, 1983
Ph.D., Chemistry, Princeton University, 1985
Years of Relevant Experience: 19

Young-Soo Chang: Air quality, noise
B.S., Chemical Engineering, Seoul National University, Korea, 1977
M.S., Chemical & Materials Engineering, University of Iowa, 1984
Ph.D., Chemical & Materials Engineering, University of Iowa, 1987
Years of Relevant Experience: 21

Victor Comello, Technical editing
B.S., Physics, DePaul University, 1962
M.S., Physics, University of Notre Dame, 1970
Years of Relevant Experience: 33

Karl Fischer: Argonne Deputy Team Lead, Document Manager
B.S.E., Nuclear Engineering, University of Michigan, 1995
M.Eng., Radiological Health Engineering, University of Michigan, 1996
Years of Relevant Experience: 12

Elizabeth Hocking: Environmental regulations/permits
B.A., Psychology and English, University of Wisconsin-Eau Claire, 1971
M.A., Guidance and Counseling, University of Wisconsin-Oshkosh, 1973
J.D., Washington College of Law, American University, 1991
Years of Relevant Experience: 19

Pat Hollopeter: Technical editing
B.A., Religion, West Virginia Wesleyan College, 1970
M.A., Philosophy, University of Chicago, 1979
Years of Relevant Experience: 25

Sunita Kamboj: Health physics, decommissioning, accidents
B.Sc., Science, Rajasthan University, 1972
M.Sc., Physics, Rajasthan University, 1974
M.S., Health Physics, Georgia Institute of Technology, 1990
Ph.D., Health Physics, Georgia Institute of Technology, 1994
Years of Relevant Experience: 15

Dan O'Rourke: Cultural resources, land use
B.A., History, Michigan State University, 1991
M.S., Industrial Archaeology, Michigan Technological University, 1997
Years of Relevant Experience: 17

Kurt Picel: Chemical risks and accidents, and cumulative impacts
B.S., Chemistry, Western Michigan University, 1976
M.S., Environmental Health Sciences, University of Michigan, 1979
Ph.D., Environmental Health Sciences, University of Michigan, 1985
Years of Relevant Experience: 24

John Quinn: Hydrology, geology and soils

B.S., Geosciences, Purdue University, 1987

B.S.E., Geo-Engineering, Purdue University, 1988

M.S., Hydrogeology, University of Minnesota, 1992

Ph.D., Hydrogeology, University of Minnesota, 2009

Years of Relevant Experience: 19

William Vinikour: Ecology

B.S., Biology, Northern Illinois University-DeKalb, 1971

M.S., Biology with Environmental Emphasis, Northern Illinois University-DeKalb, 1977

Years of Relevant Experience: 34

Suzanne Williams: Technical editing (Lead Editor)

B.S., Communication Studies w/concentration in English, Northwestern University, 1980

Years of Relevant Experience: 25

APPENDIX A
SCOPING FOR THIS ENVIRONMENTAL IMPACT STATEMENT

Docket No. **70-7016**

ENVIRONMENTAL IMPACT STATEMENT SCOPING PROCESS

SCOPING SUMMARY REPORT

Proposed GE-Hitachi Global Laser Enrichment LLC Global Laser Enrichment Facility

Wilmington, North Carolina

November 2009

U.S. Nuclear Regulatory Commission
Rockville, Maryland

1 INTRODUCTION

On January 30, 2009, GE-Hitachi Global Laser Enrichment LLC (GLE) submitted an Environmental Report (ER) to the U.S. Nuclear Regulatory Commission (NRC) for its proposed Global Laser Enrichment commercial facility (GLE Facility). The proposed GLE Facility is a laser-based uranium enrichment facility that GLE has proposed to locate on GE's existing industrial site in Wilmington, North Carolina. On June 26, 2009, GLE submitted an application to the NRC for a license to construct and operate the GLE Facility. If licensed, the proposed GLE Facility would enrich uranium for use in commercial nuclear fuel for power reactors. The facility would use non-enriched uranium hexafluoride (UF_6) as feed material. GLE proposes to use laser-based technology to enrich the isotope uranium-235 in the UF_6 up to 8.0 percent at a nominal facility capacity of 6.0 million separative work units (SWU).[1]

In accordance with NRC regulations in 10 CFR Part 51, the NRC regulation that implements the *National Environmental Policy Act of 1969*, as amended (NEPA), the NRC is preparing an Environmental Impact Statement (EIS) for the proposed GLE Facility as part of its decision-making process. The proposed action is for GLE to construct, operate, and decommission the GLE Facility. To allow the proposed action, NRC would issue a license for GLE to possess and use special nuclear material, source material, and byproduct material at the proposed GLE Facility. The EIS will examine the potential environmental impacts associated with the proposed GLE Facility in parallel with the review of the license application. The EIS will be prepared by NRC staff with technical assistance from Argonne National Laboratory. The NRC has not identified any cooperating agencies for the preparation of this EIS. In addition to the EIS, the NRC will prepare a Safety Evaluation Report (SER) which will document the staff's review of safety and security issues.

As part of the NRC's environmental review, and to comply with 10 CFR 51.26 and 51.27, scoping was initiated on April 9, 2009, with the publication in the *Federal Register* of a Notice of Intent to prepare an EIS and to conduct a scoping process (74 *Fed. Reg.* 16237). Scoping is an early and open part of the NEPA process designed to help determine the range of actions, alternatives, and potential impacts to be considered in the EIS, and to identify significant issues related to the proposed action. In addition to the public scoping process, the NRC solicits input from State, local and other Federal agencies as well as potentially affected Native American Tribes in order to focus on issues of genuine concern.

On May 19, 2009, the NRC staff held two public scoping meetings in Wilmington, North Carolina, to receive oral and written comments from interested parties. The public scoping meetings began with NRC staff providing a description of the NRC's role, responsibilities, and mission. A brief overview of the safety review process was followed by a description of the environmental review process and a discussion of how the public can effectively participate. The majority of each meeting was reserved for attendees to ask questions and make comments on the scope of the environmental review. Due to a delay in submission of the license application, the NRC extended the conclusion of the public scoping comment period from June 8, 2009, to August 31, 2009.

As part of the environmental review, NRC has requested scoping information from several sources. NRC has begun a consultation process with the North Carolina State Historic

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[1] SWU relates to a measure of the work used to enrich uranium.

Preservation Officer (SHPO) as required by Section 106 of the *National Historic Preservation Act*. In accordance with 36 CFR 800.3(f), NRC has requested information from Native American Tribal members identified by the SHPO and NRC staff. NRC staff also has consulted with representatives of the New Hanover County Planning Department, the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service, and the U.S. Fish and Wildlife Service as required by Section 7 of the *Endangered Species Act*.

This scoping summary report only addresses public comments and is included as Appendix A of the EIS. Input from consulting agencies and potentially affected Native American Tribes was used as a basis for the impact assessments performed for each resource area.

This report has been prepared to summarize the determinations and conclusions reached in the scoping process as required in 10 CFR 51.29(b). After publication of the draft EIS, the public will be invited to submit additional comments. Availability of the draft EIS, the dates of the public comment period, and information about a public meeting to be held to discuss the draft EIS will be announced in the *Federal Register*, on NRC's website (http://www.nrc.gov/public-involve.html), and in the local news media when the draft EIS is distributed. After evaluating comments on the draft EIS, the NRC staff will issue a final EIS that will serve as the basis for the NRC's consideration of environmental impacts in its decision on the proposed GLE Facility.

This report is organized into four main sections. Section 1 provides an introduction and background information on the environmental review process. Section 2 summarizes the comments and concerns expressed by government officials, agencies, and the public. Section 3 identifies the issues that the draft EIS will address and Section 4 describes those issues that are not within the scope of the draft EIS. Where appropriate, Section 4 also identifies other places in the decision-making process where issues that are outside the scope of the draft EIS may be considered.

2 ISSUES RAISED DURING THE SCOPING PROCESS

2.1 Overview

Approximately 55 individuals not affiliated with the NRC attended the May 19, 2009, afternoon and evening public scoping meetings, respectively, concerning the environmental impact statement for the GLE Facility. The scoping meeting attendance list is available on NRC's Electronic Reading Room website, hppt://www.nrc.gov/reading-rm/adams/web-based.html, as ML0914706500; six individuals attended both meetings. During the meeting, one individual asked specific questions about the scoping process. Six individuals offered specific oral comments related to the proposed GLE Facility. In addition, six written comments, including one duplicate, were received from various individuals during the public scoping period, which ended on August 31, 2009. Some of the individuals who submitted written comments also provided oral comments at the scoping meetings. The scoping meeting transcripts (ML0915202420 and ML0915202440) and the five written comments received by the NRC are available on the NRC website, electronic reading room, at http://www.nrc.gov/reading-rm/adams/web-based.html.

The active participation of the public in the scoping process is an important component in determining the major issues that the NRC should address in the draft EIS. Individuals providing oral and written comments addressed several subject areas related to the proposed GLE Facility and the draft EIS development. In addition to private citizens, the various commenters included:

- A New Hanover County Commissioner, and
- A representative of the Wilmington County Council.

The following general topics categorize the comments received during the public scoping period:

- General support or opposition;
- NEPA and public participation;
- Alternatives;
- Need for the proposed facility;
- Land use;
- Water resources;
- Climate, noise, visual resources;
- Socioeconomics and environmental justice;
- Transportation;
- Waste management;
- Historic and cultural resources;
- Safety and risk;
- Terrorism; and
- Nonproliferation concerns.

In addition to raising important issues about the potential environmental impacts of the proposed facility, some commenters offered opinions and concerns that typically would not be included in the subject matter of an EIS; these include general opinions about the use of nuclear energy. Comments of this type do not fall within the scope of environmental issues to be analyzed.

Other statements may be relevant to the proposed action, but they have no direct bearing on the evaluation of alternatives or on the decision-making process involved in the proposed action. For instance, general statements of support for or opposition to the proposed action fall into this category. Again, comments of this type have been noted but are not used in defining the scope and content of the draft EIS.

Section 2.2 summarizes the comments received during the public scoping period. Most of the issues raised have a direct bearing on the NRC's analysis of potential environmental impacts.

2.2 Summary of Issues Raised

As noted above, a number of commenters expressed support for the facility. Several individuals, on the other hand, raised concerns regarding the construction and operation of the proposed GLE Facility. The following summary groups the comments received during the scoping period by technical area and issue.

2.2.1 General Support or Opposition

Several commenters expressed general support for the GE and the GLE Facility.

One commenter expressed general support for licensing of the proposed GLE Facility and expressed the view that it would provide benefits to the region and the nuclear power industry. He also expressed confidence in GE and its safety record, noting that GE has been operating in Wilmington since the late 1960s (and before that, California) without impacting the environment. Another commenter expressed confidence in GE and acknowledged that the past safety record of the existing GE facility has been well demonstrated.

One commenter expressed general support for the proposed GLE Facility and expressed the opinion that it would be an asset to the local community and nation. Another commenter expressed general support for the proposed GLE Facility, as well as GE's history of safe operation and benefit to the Wilmington area. He noted that the area needs jobs, that GE has proven that they can deliver products safely, and that GE is a good steward of their property.

One commenter noted the positive public image that GE has in the surrounding community and expressed hope that the proposed GLE Facility would be successful. Another commenter expressed general support for GE-Hitachi and its commitment to the community and environment.

2.2.2 NEPA and Public Participation

Several commenters asked for information about the proposed project. One commenter asked for information regarding the duration of the licensing action (finite or indefinite), whether GLE pays a fee with the license application, and the fee amount. He also asked whether the EIS process relates to the test loop or the proposed GLE Facility, whether the license is dependent on evaluation of the test loop, and which entity will perform the test loop evaluation. Another commenter inquired about the duration of construction. Other questions about the project are noted in sections about specific topic areas below.

Three commenters expressed views about the environmental review process. One noted that reassuring local citizens that environmental issues (air, water, wildlife, and public safety) are studied and no negative impacts will result is most important. He requested that the EIS contain as much information as possible, as presenting the facts will help dispel misunderstandings and uncertainty about the proposed GLE Facility. Another commenter expressed the view that the NRC process has been open and informative, while a third commenter noted that the public scoping meeting that he attended was well-managed and informative.

One commenter noted that the report (assumed to refer to the GLE Environmental Report) is well done, but questioned the methods of communicating it to the public and surrounding communities. The commenter stated that few people seemed to know about the proposed project. He expressed the view that a forum should be conducted closer to the affected area(s).

One commenter expressed disagreement with GE's decision to pursue boiling water reactor technology and noted his inability to get in contact with the appropriate contacts at GE.

2.2.3 Alternatives

One commenter noted the sensibility of co-locating the proposed GLE Facility near GE's existing fuel fabrication facility, reducing the need for shipping between the two facilities.

2.2.4 Need for the Proposed Facility

Two commenters noted the need for the proposed GLE Facility. One commenter expressed general support for the proposed facility, noting that it would be an important element of the nation's drive for energy independence and national security. The second commenter expressed the view that the United States must become less dependent on foreign oil, and that the proposed facility will be instrumental in making nuclear energy more economical.

2.2.4 Land Use

One commenter suggested that a graphic of the construction plan and timeframe would be helpful. Another commenter noted the beautiful and unusual environment (ocean, tidal zones, and river) that surrounds the proposed GLE Facility.

2.2.5 Water Resources

Three commenters expressed concern with water resources, two of whom requested upgrade of water and sewer service for surrounding communities.

One commenter noted that sewer and water in an adjacent residential development are local for each home. He suggested that GLE or the City of Wilmington should consider funding or installing sewer and water infrastructure in the development (replacing the existing well and septic systems) to prevent the possibility (or perception) that drinking water could be contaminated by the proposed GLE Facility or existing septic systems. He believes that municipal or GLE waste and drinking water treatment would eliminate the potential hazard posed by a potential increase in groundwater contaminants. He also requested a graphic of the intakes and outputs of the existing GE facilities and the proposed GLE Facility to help nearby residents assess the potential increase in discharge of contaminants to their communities.

Finally, he suggested real-time or periodic monitoring in the absence of local sewer and water treatment.

Another commenter noted the absence of a public sewer system in the area. He is planning an 800-unit residential subdivision to the south of the GE site, which will discharge treated effluent via a drip system. He expressed opposition to any potential increase of sewer discharge to the Northeast Cape Fear River as a result of the proposed GLE Facility, noting that the river is already compromised. This commenter also noted the absence of a municipal water system capable of supplying water for industrial growth in the area, and that a large tract of land to the east of the GE site is currently zoned industrial. He suggested that, if GE satellite support businesses will be located outside of but near the GE site, GE should be expected or required to partner with area developers and contribute to building new municipal water supply and sewer infrastructure in the area.

The third commenter requested that the EIS consider the effects of the proposed GLE Facility on groundwater supply and quantity, and surface water quantity.

2.2.6 Climate, Noise, and Visual Resources

Climate: One commenter noted the region's susceptibility to hurricanes and recommended that the EIS consider the potential for hurricanes, their effects, and site preparation for hurricanes.

Noise: Two commenters expressed concern with noise from construction and operation of the proposed GLE Facility. One commenter inquired about the noise level in the nearby residential development during construction. He recommended that onsite traffic routes to the proposed GLE Facility could be routed with a 200- to 300-foot buffer or sound barrier (depending on the anticipated noise level) to assure nearby residents that their quality of life will be maintained. The second commenter requested that audible alarm testing (current and future) be conducted later in the day.

Visual Resources: One commenter expressed concern over potential plans to clear trees or other vegetative buffer along the GE site boundary and construct a fence, and the resulting cosmetic and financial impacts to a proposed residential development to the south of the GE site. Another commenter noted that it would be difficult to know that the proposed GLE Facility exists, because it will fit so well on the existing GE site.

2.2.7 Socioeconomics and Environmental Justice

Property Value: One commenter expressed concern about the value of property in the vicinity of the proposed facility (asserting that this could be the first time that an enrichment facility has been located in such close proximity to an exiting residential development) and requested that present and future property values be considered in the EIS. He recommended that the EIS consider economic impacts, environmental impacts (current and future), and their effect on property resale values. He expressed concern that potential buyers may not be informed of GE's safety record and may choose not to settle in the neighborhood due to the location of the proposed GLE Facility. He recommended that GLE consider guaranteeing property values as a means of preventing potential devaluation.

Environmental Justice: One commenter requested that the EIS consider the conclusion of small negative effect stated in the Environmental Justice section (assumed to refer to Section 4.11 of the GLE Environmental Report).

2.2.8 Transportation

Three commenters expressed concerns regarding transportation. One commenter expressed concern that, although the GE site is probably well-protected, the flow of materials to and from large projects represents a vulnerability and potential security issue. He recommended that all potential transportation modes (including rail, water, and air) be considered in the EIS, along with potential transportation security issues.

Another commenter suggested that GLE conduct a Traffic Impact Analysis and be responsible for any recommended road improvements. The third commenter recommended that Sledge Road on the northern boundary of the GE site should be off-limits to construction and delivery vehicles and left unimproved, with all traffic routed to the proposed GLE Facility through the North or South Gate. He also inquired if it is possible to build direct ramps to I-140.

2.2.9 Waste Management

One commenter suggested that a schematic comparison of the present and future site be available to help members of the public assess the plan for waste discharges from the proposed GLE Facility.

2.2.10 Historic and Cultural Resources

One commenter noted GE's recent efforts to help locate and preserve a historic plantation and cemetery on the GE site.

2.2.11 Safety and Risk

One commenter suggested that a graphic or website showing the current and planned onsite radiation monitoring systems would be helpful. He also asked if real-time radiation assessments will be possible (collected) and if nearby residents would be informed and protected in case of accidents. Another commenter asked if the proposed GLE Facility will cause any safety risks to a proposed residential development to the south of the GE site.

2.2.12 Terrorism

One commenter expressed concern about the attractiveness of the proposed GLE Facility and its incoming and outgoing shipments as targets of terrorism and recommended that this be considered in the EIS.

2.2.13 Nonproliferation Concerns

One group of commenters expressed concerns that licensing the proposed GLE Facility would raise significant proliferation issues.

3 SCOPE OF THE ENVIRONMENTAL IMPACT STATEMENT

The NEPA (Public Law 91-190, as amended), and the NRC's Implementing Regulations for NEPA (10 CFR Part 51), specify in general terms what should be included in an EIS prepared by the NRC staff. Regulations established by the Council on Environmental Quality (40 CFR Parts 1500-1508), while not binding on NRC staff, provide useful guidance. Additional guidance for meeting NEPA requirements associated with licensing actions can be found in NUREG-1748, "Environmental Review Guidance for Licensing Actions Associated with Office of Nuclear Material Safety and Safeguards (NMSS) Programs."

Pursuant to 10 CFR 51.71(a), in addition to public comments received during the scoping process, the contents of the draft EIS will also address the matters discussed in the GLE Environmental Report. In accordance with 10 CFR 51.71(b), the draft EIS will consider major points of view and objections concerning the environmental impacts of the proposed action raised by other Federal, State, and local agencies, by any affected Indian Tribes, and by other interested persons. Pursuant to 10 CFR 51.71(c), the draft EIS will list all Federal permits, licenses, approvals, and other entitlements that must be obtained in implementing the proposed action, and will describe the status of compliance with these requirements. Any uncertainty as to the applicability of these requirements will be addressed in the draft EIS.

Pursuant to 10 CFR 51.71(d), the draft EIS will include a preliminary analysis that considers and weighs the environmental effects of the proposed action; the environmental impacts of alternatives to the proposed action; and alternatives available for reducing or avoiding adverse environmental effects. In the draft analysis, due consideration will be given to compliance with environmental quality standards and regulations that have been imposed by Federal, State, regional, and local agencies having responsibilities for environmental protection. The environmental impact of the proposed action will be evaluated in the draft EIS with respect to matters covered by such standards and requirements, regardless of whether a certification or license from the appropriate authority has been obtained. Compliance with applicable environmental quality standards and requirements does not negate the requirement for NRC to weigh all environmental effects of the proposed action, including the degradation, if any, of water quality, and to consider alternatives to the proposed action that are available for reducing adverse effects. While satisfaction of NRC standards and criteria pertaining to radiological effects will be necessary to meet the licensing requirements of the *Atomic Energy Act*, the draft EIS will also, for the purposes of NEPA, consider the radiological and nonradiological effects of the proposed action and alternatives.

The following documents are environmental assessments and other EISs which have been prepared that are related to the action under consideration. The following list is not intended to be comprehensive:

- Programmatic EIS for Alternative Strategies for the Long-Term Management and Use of Depleted Uranium Hexafluoride (DOE/EIS-0269, March 1999)

- Environmental Impact Statement for Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the Paducah, Kentucky, Site (DOE/EIS-0359, December 2003)

- Environmental Impact Statement for Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at Portsmouth, Ohio Site (DOE/EIS-0360, December 2003)

- Environmental Impact Statements for the American Centrifuge Plant (ACP) and National Enrichment Facility (NEF).

Pursuant to 10 CFR 51.71(e), the draft EIS will include a preliminary recommendation by NRC staff with respect to the proposed action. Any such recommendation would be reached after considering the environmental effects of the proposed action and reasonable alternatives, and after weighing the costs and benefits of the proposed action.

The scoping process summarized in this report will help determine the scope of the draft EIS for the proposed facility. The draft EIS will contain a discussion of the cumulative impacts of the proposed action as referenced in NUREG-1748. The development of the draft EIS will be closely coordinated with the SER prepared by the NRC staff to evaluate the health and safety impacts of the proposed action.

One goal in writing the draft EIS is to present the impact analyses in a manner that makes it easy for the public to understand. This draft EIS will provide the basis for the NRC decision with regard to potential environmental impacts. Significant impacts will be discussed in greater detail in the draft EIS. This should allow readers of the draft EIS to focus on issues that were determined to be important in reaching the conclusions supported by the draft EIS. The following topical areas and issues will be addressed in the draft EIS.

- *Alternatives.* The draft EIS will describe and assess the no-action alternative and other reasonable alternatives to the proposed action. Other alternatives may include alternative sites, enrichment sources, or technological alternatives to the proposed laser technology.

- *Need for the Facility.* The draft EIS will provide a discussion of the need for the proposed GLE Facility.

- *Compliance with Applicable Regulations .* The draft EIS will present a listing of the relevant permits and regulations that are believed to apply to the proposed GLE Facility. These would include air, water, and solid waste regulations and disposal permits.

- *Land Use.* The draft EIS will discuss the potential land use impacts associated with the proposed site preparation, construction, and operating activities.

- *Transportation.* The draft EIS will discuss the impacts associated with the transportation of construction materials, feed material, product, and waste tails during both normal transportation and under credible accident scenarios. The impacts on local transportation routes due to workers, delivery vehicles, and waste removal vehicles will be evaluated.

- *Geology and Soils.* The draft EIS will assess the potential impacts to the geology and soils of the proposed GLE Facility site due to soil compaction, erosion, contamination, landslides, and disruption of natural drainage patterns. Evaluation of the potential for earthquakes or any other major ground motion considerations will be addressed mainly in the SER and only in terms of possible environmental impacts in the draft EIS.

- *Water Resources.* The draft EIS will assess the potential impacts on surface water and groundwater quality and water use due to the proposed action and alternatives.

- *Ecological Resources.* The draft EIS will assess the potential environmental impacts on ecological resources including plant and animal species. Threatened and endangered species and critical habitats that may occur in the area will also be discussed, along with the appropriate consultation as required by Section 7 of the *Endangered Species Act of 1973* (16 USC Section 1536(a)(2)). As appropriate, the assessment will include an analysis of mitigation measures to address potential adverse impacts.

- *Air Quality.* The draft EIS will make determinations concerning the meteorological conditions of the site location, the ambient air quality, the contribution of other sources, and the impacts of site preparation, construction, and operation of the proposed GLE Facility on local air quality. In addition, the draft EIS will consider the impact of the proposed facility on climate change, as well as the impact of climate change on the proposed facility.

- *Noise.* The draft EIS will discuss potential impacts associated with noise levels generated from site preparation, construction, operation, and decommissioning of the proposed GLE Facility.

- *Historic and Cultural Resources.* The draft EIS will address the potential impacts of the proposed GLE Facility on the historic and archaeological resources of the area.

- *Visual and Scenic Resources.* Potential impacts to the overall visual and scenic character of the area will be addressed.

- *Socioeconomics.* The draft EIS will address the demography, economic base, labor pool, housing, utilities, public services, education, and recreation as impacted by the proposed action and alternatives. The hiring of new workers from the outside area could lead to impacts on the regional housing, public infrastructure, and economic resources. Population changes leading to changes to the housing market and demands on the public infrastructure will be assessed.

- *Costs and Benefits.* The draft EIS will address the potential costs and benefits of constructing and operating the proposed GLE Facility, and will discuss the costs and benefits of tails disposition options.

- *Resource Commitments.* The draft EIS will identify the unavoidable adverse impacts and irreversible and irretrievable commitments of resources. It will also address the relationship between local, short-term uses of the environment and the maintenance and enhancement of long-term productivity. Associated mitigative measures and environmental monitoring will be presented, if applicable.

- *Public and Occupational Health.* The draft EIS will include a determination of potentially adverse effects on human health that result from chronic and acute exposures to ionizing radiation and hazardous chemicals as well as from physical safety hazards. These potentially adverse effects on human health might occur during site preparation, construction, or operation. Impacts associated with the implementation of the proposed action will be assessed under normal operation and credible accident scenarios.

- *Waste Management.* The draft EIS will discuss the management of wastes, including by-product materials, generated from the site preparation, construction, and operation of the proposed GLE Facility to assess the impacts of generation, storage, and disposal.

- *Depleted Uranium (DU) Disposal.* The draft EIS will discuss the depleted uranium hexafluoride (DUF_6) material, or tails, that results from the enrichment operation over the operating lifetime of the proposed GLE Facility. Topics addressed will include the safe and secure storage and ultimate removal of the material from the site, and the potential conversion of the DUF_6 to DU oxide and ultimate disposition.

- *Decommissioning.* The draft EIS will include a discussion of facility decommissioning and associated impacts.

- *Cumulative Impacts.* The draft EIS will address the potential cumulative impacts from past, present, and reasonably foreseeable activities at and near the site, including site preparation.

- *Environmental Justice.* The draft EIS will address environmental impacts of the proposed GLE Facility on low-income or minority populations. The EIS will assess whether disproportionately high and adverse impacts on low-income or minority populations are identified.

4 ISSUES CONSIDERED TO BE OUTSIDE THE SCOPE OF THE ENVIRONMENTAL IMPACT STATEMENT

The purpose of an EIS is to assess the potential environmental impacts of a proposed action in order to assist in an agency's decision-making process – in this case, NRC's licensing decision. As noted in Section 2.2, some issues and concerns raised during the scoping process are not relevant to the draft EIS because they are not directly related to the assessment of potential impacts or to the decision-making process. The lack of in-depth discussion in the draft EIS, however, does not mean that an issue or concern lacks value. Issues beyond the scope of the draft EIS either may not yet be at the point where they can be resolved, or are more appropriately discussed and decided in other venues.

Some of the issues raised during the public scoping process (e.g., GE's pursuit of boiling water reactor technology) will not be addressed in the draft EIS. Other issue areas including nonproliferation concerns, and security and safety issues are also beyond the scope of the EIS. The mission of the NRC is to license and regulate the Nation's civilian use of byproduct, source, and special nuclear materials in order to protect public health and safety, promote the common defense and security, and protect the environment. The NRC's regulations are designed to protect both the public and workers against radiation hazards from industries that use radioactive materials. The NRC's scope of responsibility includes regulation of commercial nuclear power plants; research, test, and training reactors; nuclear fuel cycle facilities; medical, academic, and industrial uses of radioactive materials; and the transport, storage, and disposal of radioactive materials and wastes.

Regarding the nonproliferation issue, these activities are not within NRC jurisdiction and as such are beyond what the NRC can regulate.

Some of the issues raised during the public scoping process for the proposed facility are outside the scope of the draft EIS, but they will be analyzed in the SER. For example, health and safety issues will be considered in detail in the SER prepared by NRC staff for the proposed action and will be summarized in the EIS. The draft EIS and the SER are related in that they may cover the same topics and may contain similar information, but the analysis in the draft EIS is focused on an assessment of potential environmental impacts. In contrast, the SER deals primarily with safety evaluations and procedural requirements or license conditions to ensure the health and safety of workers and the general public. The SER also covers other aspects of the proposed action such as demonstrating that the applicant will provide adequate funding for the proposed facility in compliance with NRC's financial assurance regulations.

APPENDIX B
CONSULTATION LETTERS

B.1 *Endangered Species Act* Consultation Letters

The U.S. Nuclear Regulatory Commission (NRC) sent coordination letters to the U.S. Fish and Wildlife Service (Raleigh Field Office) and the National Marine Fisheries Service (Southeast Regional Office) related to threatened and endangered species and critical habitats. All of the NRC letters and agency responses can be accessed via NRC's online document retrieval system (ADAMS) using the accession numbers in Table B-1.

Table B-1 Consultations with Government Agencies Related to Threatened and Endangered Species and Critical Habitats

Agency (Date)	ADAMS Accession Number(s)
U.S. Fish and Wildlife Service, Raleigh Field Office (May 1, 2009)	ML091100107
Response from U.S. Fish and Wildlife Service, Raleigh Field Office (June 8, 2009)	ML091700024
U.S. Fish and Wildlife Service, Raleigh Field Office (August 10, 2009)	ML092030404
National Oceanic and Atmospheric Administration (NOAA) Fisheries, Southeast Regional Office (June 18, 2009)	ML091660499
Response from NOAA Fisheries, Southeast Regional Office (August 3, 2009)	ML092170775

May 1, 2009

Mr. Pete Benjamin
Field Supervisor
U.S. Fish and Wildlife Service
Raleigh Field Office
Post Office Box 33726
Raleigh, North Carolina 27636-3726

SUBJECT: REQUEST FOR INFORMATION REGARDING ENDANGERED SPECIES AND CRITICAL HABITATS FOR GENERAL ELECTRIC-HITACHI GLOBAL LASER ENRICHMENT PROPOSED URANIUM ENRICHMENT FACILITY IN NEW HANOVER COUNTY, NORTH CAROLINA

Dear Mr. Benjamin:

On January 30, 2009, General Electric-Hitachi Global Laser Enrichment (GLE) submitted an environmental report (ER) to the U.S. Nuclear Regulatory Commission (NRC). The ER is one part of an application for a license to authorize construction, operation, and decommissioning of a proposed uranium enrichment facility. The NRC staff is in the initial stages of developing an Environmental Impact Statement (EIS) for the proposed facility to be located on the existing General Electric/Global Nuclear Fuels-Americas site near Wilmington, North Carolina, in New Hanover County (Wilmington site). The facility, if licensed, would use a laser-based technology to enrich the isotope uranium-235 in uranium hexafluoride (UF_6) up to 8 percent by weight. The EIS will document the impacts associated with the construction, operation, and decommissioning of the proposed facility.

We are requesting a list of threatened or endangered species or critical habitats within the action area for the proposed facility. GLE's ER identifies 107 hectares (265 acres) of the 656 hectare (1621 acre) Wilmington site as the action area for the construction, operation, and decommissioning of the proposed facility. The Wilmington site is located approximately 9.6 kilometers (6 miles) north of the city of Wilmington in New Hanover County, North Carolina, on Parcel number R01700-001-000. The coordinates for the center of the action area are 34.333923 ºN and -77.945009 ºW. We have enclosed additional background information relating to ecological resources on the Wilmington site, including a map showing the action area, as it appears in the GLE ER.

As part of the EIS preparation, the NRC will be hosting two public scoping meetings on Tuesday, May 19, 2009, in Ballroom 1 of the Warwick Center at the University of North Carolina at Wilmington, North Carolina, 28403. The first meeting will be held from 1:00 p.m. to approximately 4:00 p.m. and the second meeting will be held from 7:00 p.m. to approximately 10:00 p.m. The meetings will include NRC staff presentations on the safety and environmental review process, after which members of the public will be given the opportunity to present their comments on issues NRC should consider during its environmental review. The scoping information gathered at this meeting and in written public comments will be used with any information you provide to document environmental impacts of the proposed action.

We intend to use the EIS process to comply with Section 7 of the Endangered Species Act of 1973, as amended. After assessing information you provide, we will determine what additional actions are necessary to comply with the Section 7 consultation process. If you have any questions or comments, or need any additional information, please contact Christianne Ridge of my staff at 301-415-5673.

Sincerely,

/RA/

Andrea Kock, Chief
Environmental Review Branch
Division of Waste Management and
Environmental Protection,
Office of Federal and State Materials and
Environmental Management Programs

Docket No.: 70-7016

Enclosure: as stated

cc without enclosure:

William Szymanski/DOE
Patricia Campbell/GEH
Robert Brown/GEH
Tammy Orr/GEH
AKennedy/GEH
JOlivier/GEH
Tom Clements/FOTE
Doug Springer/CFRW
Stephen Rynas/NCDENR
Jennifer Frye/USACE
David Weaver/New Hanover County
Jennifer Braswell/New Hanover County
Bruce Shell/New Hanover County
Marty Lawing/Brunswick County
George Brown/Pender County
Bill Saffo/Wilmington
Mike Giles/CFC
Malissa Talbert/Wilmington
Wanda Lagoe/NCOSH
Cameron Weaver/NCDENR
Lee Cox/SLO
Kimberly Garvey/USACE
Christopher O'Keefe/New Hanover County

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USNRC

United States Department of the Interior

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FISH AND WILDLIFE SERVICE
Raleigh Field Office
Post Office Box 33726
Raleigh, North Carolina 27636-3726

RECEIVED

June 8, 2009

Ms. Andrea Kock
Chief, Environmental Review Branch
Division of Waste management and Environmental Protection
Office of Federal and State Materials and Environmental Management Programs
United States Nuclear Regulatory Commission
Washington, D.C. 20555-0001

4/09/09
74 FR 16237

Chief, Rules and Directives Branch
Mail Stop TWB 5B01M
United States Nuclear Regulatory Commission
Washington, D.C. 20555-0001

(1)

Subject: Docket No. 70-7016; General Electric-Hitachi Global Laser Enrichment Facility, New Hanover County, North Carolina

Greetings:

This letter responds to Ms. Kock's request of May 1, 2009, for information from the U. S. Fish and Wildlife Service (Service) regarding federally threatened or endangered species within the action area of the Global Laser Enrichment (GLE) facility proposed by General Electric-Hitachi in New Hanover County, North Carolina. The Service is also providing comments to the Chief, Rules and Directives Branch, on the Notice of Intent (NOI), published in the Federal Register on April 9, 2009, to prepare an Environmental Impact Statement (EIS) for this facility. These comments are submitted in accordance with the Fish and Wildlife Coordination Act (FWCA) (48 Stat. 401, as amended; 16 U.S.C. 661-667d) and section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531-1543).

The GLE facility, if licensed by the Nuclear Regulatory Commission (NRC), would enrich uranium for use in manufacturing commercial nuclear fuel for use in power reactors. The action area of the proposed GLE facility would be 265 acres of a 1,621-acre area known as the Wilmington Site (WS) that contains an existing nuclear fuels facility. The existing facility occupies 303 acres within the WS and the proposed GLE facility may occupy an additional 100 acres. Managed pines on the site occupy 312 acres.

Existing conditions on the WS are described in the Ecological Resources section (Section 3.5) of GLE Environmental Report (ER) that accompanied Ms. Kock's letter. The WS contain 13 major biotic communities in varying stages of succession, including alluvial

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E-RIDS = ADM-03
Add = C. Bridge (ACR1)

forest, swamp forest, ephemeral ponds, and pocosin/bay forest. These communities provide habitat for resident and migratory birds. The site contains two unnamed tributaries to the Northeast Cape Fear River. The North Carolina Natural Heritage Program (NCNHP) has identified the swamp forest on the WS as part of a natural area of national significance that includes one of the best examples of the tidal cypress-gum communities in North Carolina.

Federally Protected Species

The action area of the GLE facility appears to be in the northeastern portion of the WS (Figure 3.5-2). A list of all federally-protected endangered and threatened species with known occurrences in North Carolina is now available on the U.S. Fish and Wildlife Service's (Service) web page at < http://www.fws.gov/raleigh/es_tes.html > along with a link to the "County List." Additional information on special status species is available from the NCNHP on special status species at the county level and individual topographic quads. The project is within the Castle Hayne quad. The NCNHP database can be accessed at < http://www.ncnhp.org/Pages/heritagedata.html >.

More site specific information on special status species, both State and federal, can be obtained through the Virtual Workroom of the NCNHP at the same intranet address given above. The Virtual Workroom is a web-based GIS application that allows users to obtain information on rare species, natural communities, and natural areas. This site allows the public to generate a list of all NCNHP records (designated as element occurrences) within two miles of the location specified by the user, and reflects the data as it currently exists in the program's database. Before using the Virtual Workroom, users should review the User's Manual (available through the "Help" link at the upper right of the Web page).

The Service's review of the ER indicates that the nine species listed in Table 3.5-7 as the federally threatened or endangered species known to occur in New Hanover County is accurate at this time. This table presents an assessment of whether habitat is present for each species within the WS. The Service concurs that the three coastal species would not be present in the action area. These are the two sea turtles and the piping plover (*Charadrius melodus*). There is no formally designated critical habitat in the project area.

The Service does not concur that the federally endangered West Indian manatee (*Trichechus manatus*) could not use the tidal creeks on the site. The Northeast Cape Fear River and some of its tributaries may provide suitable habitat for manatees that move along the Atlantic Coast and into inland waters during summer months and are seasonal transients in North Carolina, primarily from June through October. While the ER states (p. 3.5-15) that manatees use waters at least five feet deep, the species may occur in water as shallow as one to two meters (3.3 -6.6 feet) deep. The species moves extensively when in North Carolina waters and past occurrence records cannot be used to precisely determine the likelihood that it will be presence at a particular construction site. Therefore, potential impacts to this species should be assessed if construction and operation of the facility would produce any direct or indirectly impacts on waters of sufficient depth and with a direct, unobstructed connection to the river.

The American alligator (*Alligator mississippiensis*) in North Carolina does not require ESA consideration. The species is only listed as threatened due to similarity of appearance (TS/A) with the American crocodile (*Crocodylus acutus*) which only occurs in southern Florida. From the federal perspective, the alligator is not biologically threatened and does not have protection under the ESA. However, the alligator has a State status of threatened.

The federally endangered shortnose sturgeon (*Acipenser brevirostrum*) is under the jurisdiction of the National Marine Fisheries Service (NMFS). That agency should be contacted for potential impacts to this species which may occur in the lower Cape Fear River watershed.

While the biotic communities that would be impacted by the proposed GLE facility are not identified, Table 3.5-7 indicates that there is habitat for two federally endangered species under the jurisdiction of the Service in the action area. The endangered rough-leaved loosestrife (RLL) (*Lysimachia asperulaefolia*) is considered in the ER (pp. 3.5-15 to 16). This perennial herb generally occurs in the ecotones, or edges, between longleaf pine uplands and pond pine pocosins (areas of dense shrub and vine growth usually on a wet, peaty, poorly drained soil), on moist to seasonally saturated sands, and on shallow organic soils overlaying sand. It has also been found on deep peat soils in the low shrub community of Carolina bays. The grass-shrub ecotone, where RLL is found, is fire-maintained, as are the adjacent plant communities (longleaf pine-scrub oak, savanna, flatwoods, and pocosin). Suppression of naturally-occurring fire in these ecotones allows shrubs to increase in density and height. Shrubs may eliminate the open edges required by this plant.

The portion of the ER available to the Service is unclear on the current status of RLL habitat in the WS. While Table 3.5-7 states that habitat is present, Section 3.5.8.1.2 states that naturally occurring habitat for the RLL "may have occurred naturally on the Wilmington Site in the past, but the pocosin habitat that could have supported this plant has been drained." Furthermore, the fire regime necessary for the species is not currently present on the site. If suitable burning and hydrology were reestablished, the ER concludes that habitat is potentially available on the site.

The evaluation of impacts to this species in the EIS should state whether RLL habitat currently exists on the site. Surveys for the presence of suitable RLL habitat (as opposed to the actual plants) can generally be performed year round.

If these surveys reveal that suitable habitat exists within the project area, then actual RLL surveys should be done. This work should be performed during the period when RLL is detectable. The optimal period is mid-May through June (refer to < http://www.nc-es.fws.gov/plant/optimal_survey_window_for_plants.htm >), but can extent to October. Most RLL populations are small, both in area covered and in number of stems. If RLL plants are discovered within areas that would be impacted, the Service should be contacted in order to develop a conservation plan.

The ER states (p. 3.5-15) that one active colony of the endangered red-cockaded woodpecker (RCW) (*Picoides borealis*) is located within a five-mile radius of the WS. While no cavity (nesting) trees have been observed on the site, some birds "may occasionally forage in the Site." As noted, Table 3.5-7 states that RCW habitat is present on the site.

Prior to licensing, the NRC must require the company to determine the impact of the proposed facility on the RCW. The second revision of the Service's Recovery Plan for the RCW (U. S. Fish and Wildlife Service [hereafter USFWS] 2003) provides survey protocols (Appendix 4) for nesting and foraging habitat. The first step in the survey procedure is to determine if suitable nesting or foraging habitat exists within the area to be impacted. If no suitable nesting or foraging habitat is present within the project impact area, further assessment is unnecessary and a "no effect" determination is appropriate.

The EIS should provide information to support the finding that no RCW cavity trees occur on the site. The recovery plan discusses the identification of suitable nesting habitat and survey methods for RCW cavity trees (USFWS 2003, p. 289-290). For the purpose of surveying, suitable nesting habitat consists of pine, pine/hardwood, and hardwood/pine stands that contain pines 60 years in age or older. Additionally, pines 60 years in age or older may be scattered or clumped within younger stands. Older pine trees within younger stands must be considered as potential RCW nesting sites. These characteristics do not necessarily describe good quality nesting habitat; rather, this is a conservative description of potential nesting habitat. Determination of suitable nesting habitat may be based on existing stand data, aerial photo interpretation, and/or field reconnaissance. All stands meeting the above description, regardless of ownership, should be considered as suitable nesting habitat.

If suitable nesting habitat is identified on the site, this habitat must be surveyed for cavity trees (nest sites) of the RCW by personnel experienced in management and/or monitoring of the species (USFWS 2003, pp. 289-290). Potential nesting habitat is surveyed by running line transects through stands and visually inspecting all medium-sized and large pines for evidence of cavity excavation by the RCW. Transects must be spaced so that all trees are inspected. Necessary spacing will vary with habitat structure and season from a maximum of 91 m (100 yards) between transects in very open pine stands to 46 m (50 yards) or less in areas with a dense mid-story. Transects should run north-south, because many cavity entrances are oriented in a westerly direction, and can be set using a hand compass. If RCW cavity trees are found, these trees must not be cut and this office should be contacted before work commences to develop plans for avoiding take of the species.

Even if no cavity trees are present in the project area, surveys should establish whether RCW foraging habitat is present for those birds that "may occasionally forage in the site." Suitable foraging habitat consists of a pine or pine/hardwood stand of forest, woodland, or savannah in which 50 percent or more of the dominant trees are pines and the dominant pine trees are generally 30 years in age or older (USFWS 2003, pp. 288-289). These characteristics do not necessarily describe good quality foraging habitat; rather, this is a conservative description of potentially suitable habitat. Identification of pine and pine/hardwood stands can be made using cover maps that identify pine and pine/hardwood stands, aerial photographs interpreted by standard techniques, or a field survey conducted by an experienced forester or biologist. Age of stands can be determined by aging representative dominant pines in the stands using an increment-borer and counting annual growth rings. Stand data describing size classes may be substituted for age if the average size of 30 year-old pines is known, i.e., at least 20.3 cm (8 in) diameter breast height (dbh) or larger, for the local area and habitat type.

Stands cannot be considered suitable as RCW foraging habitat unless they have an "open" character. A pine stand that is 30 years in age and has an average tree dbh of 20.3 cm (8 in) or more does not necessarily qualify as suitable foraging habitat (USFWS 2003, p. 294). If such a stand has not been prescribed burned (or otherwise treated to control hardwood mid-story) and has not been thinned to a basal area of 16.1 m^2/ha (70 ft^2/ac) or less, it will not satisfy the "open" condition criterion. Dense stands of young pine and pine/hardwood are typical of unmanaged plantations and natural regeneration areas (particularly loblolly seed tree harvests) that have not been thinned or frequently burned. Such stands cannot be considered suitable foraging habitat simply because they have the required total and stand basal area and average stem diameter. Stand quality, as measured by an open structure, is a critical factor determining suitability and use of foraging habitat and must be considered when acceptable foraging habitat is identified.

If suitable foraging habitat is present and would be impacted, potential use of this foraging habitat by RCW clusters outside the actual construction corridor must be determined. This is accomplished by identifying any potential nesting habitat within 0.8 km (0.5 mile) of the suitable foraging habitat that would be impacted. Surveys of potential nesting habitat for RCW cavity trees should be made in the area one-half mile from the foraging habitat. If active clusters are located in this area, surveys must be made to determine if clearing foraging habitat within the project area would adversely affect these birds.

If no active clusters are found that could potentially use the forage habitat in the project corridor, then a "no effect" determination is appropriate. If one or more active clusters are found within 0.5 mile of foraging habitat in the project area, a foraging habitat analysis must be conducted (see Section 8I of the recovery plan) to determine whether sufficient amounts of foraging habitat will remain for each group after construction.

As stated in the ER (p. 3.5-20), if the proposed action may affect a listed species, then formal consultation with the Service would be required. A biological assessment or evaluation may be prepared to fulfill that requirement and in determining whether additional consultation with the Service is necessary. Information on completing a biological assessment or evaluation and can be found on our web page at <

http://www.fws.gov/raleigh/es_consultation.html >. Please check the web site often for updated information or changes.

Other Special Status Species

The site contains potential habitat for several Federal Species of Concern (FSC), a term referring to those species which the Service believes might be in need of concentrated conservation actions. These species receive no legal protection and their designation does not necessarily imply that the species will eventually be proposed for listing as a federally endangered or threatened species. As noted in the ER (p. 3.5-16) the federal status of these species may change at any time. For this reason, the Service supports their consideration in project planning and recommends that all practicable measures be taken to avoid or minimize adverse impacts to any FSC.

Table 3.5-8 lists the 31 FSCs that are known to occur in New Hanover County. The ER discusses (pp. 3.5-16 to 20) the FSCs that have been observed on the WS or in the immediate vicinity. These species include the southern hognose snake (*Heterodon simus*), the southeastern myotis (*Myotis austroiparius*), Venus flytrap (*Dionaea muscipula*), spring-flowering goldenrod (*Solidago verna*), and coastal goldenrod (*S. villosicarpa*). The two goldenrods have a state status of endangered. Pondspice (*Litsea aestivalis*) is known to occur in the North-Central Sector, but altered hydrologic conditions do not favor recruitment of new plants. The Service recommends that planning consider that the coastal plain subspecies of Rafinesque's big-eared bat (*Corynorhinus rafinesquii macrotis*) may occur within the WS. The virtual workroom of the NCNHP shows that this FSC has been reported within two miles of the site. This species roosts in hollow trees, old buildings, and beneath bridges, usually near water.

Service Recommendations for the Environmental Impact Statement

The NOI provides the environmental aspects to be considered in the EIS. The list is comprehensive and a thorough evaluation of each should form a sound basis for choosing a course of action. We encourage a careful consideration of the cumulative impacts of any development along the Northeast Cape Fear River.

The Service seeks to foster the recovery and delisting of federally listed species and conserve FSCs in order to prevent their formal listing as threatened or endangered. As a means of achieving these goals, the Service sees an opportunity to conserve and restore areas within the WS that are not now being used by the company or would not be developed for the proposed GLE facility. As part of the consideration of indirect, or secondary, impacts of the GLE facility, the Service recommends that the EIS consider the likelihood that those areas of the site that are now undeveloped would retain their natural ecological functions. We encourage the company to develop a long-term conservation plan for the undeveloped areas, especially wetland forests along the river, tidal creeks, and ponds. There may be opportunities for restoration of degraded habitats such as the altered conditions that prevent the recruitment of pondspice. The naturally occurring habitat for the RLL that once occurred on the WS could be restored by eliminating artificial drainage and implementing a natural fire regime through carefully controlled burns. Local, conservation groups could be contacted to assist in the development and management of conservation areas. This office can provide general advice on developing a conservation plan for the site.

The Service appreciates the opportunity to provide these scoping comments and technical assistance on the proposed work. If you have questions regarding these comments, please contact Howard Hall at 919-856-4520, ext. 27 or by e-mail at < howard_hall@fws.gov >.

Sincerely,

Pete Benjamin
Field Supervisor

U.S. Fish and Wildlife Service. 2003. Recovery plan for the red-cockaded woodpecker (*Picoides borealis*): second revision. U.S. Fish and Wildlife Service, Atlanta, GA. 296 pp. available at < http://ecos.fws.gov/docs/recovery_plan/030320_2.pdf >.

cc:

Jennifer Frye, U. S. Army Corps of Engineers, Wilmington, NC
Stephen Rynas, NC Division of Coastal Management, Morehead City, NC
Molly Ellwood, NC Wildlife Resources Commission, Wilmington, NC

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

June 18, 2009

David Bernhart, Director
Protected Resources Division
National Oceanic and Atmospheric
Administration (NOAA) Fisheries
Southeastern Regional Office
263 13th Avenue South
St. Petersburg, FL 33701-5505

SUBJECT: REQUEST FOR INFORMATION REGARDING ENDANGERED OR THREATENED SPECIES AND CRITICAL HABITAT RELEVANT TO THE PROPOSED GENERAL ELECTRIC-HITACHI GLOBAL LASER ENRICHMENT (GLE) COMMERCIAL FACILITY

Dear Mr. Bernhart:

On January 30, 2009, General Electric-Hitachi (GEH) Global Laser Enrichment LLC submitted an Environmental Report (ER) to the U.S. Nuclear Regulatory Commission (NRC). The ER is one part of an application for a license to authorize construction, operation, and decommissioning of a proposed uranium enrichment facility. GEH proposes to build the facility on the existing General Electric/Global Nuclear Fuels-Americas site near Wilmington, North Carolina, in New Hanover County (Wilmington site). The facility, if licensed, would use a laser-based technology to enrich the isotope uranium-235 in uranium hexafluoride (UF_6) up to 8 percent by weight.

As established in Title 10 of the Code of Federal Regulations, Part 51 (10 CFR 51), the NRC regulation that implements the National Environmental Policy Act of 1969, as amended, NRC is preparing an Environmental Impact Statement (EIS) to address the environmental impacts associated with the construction, operation, and decommissioning of the proposed facility. In accordance with Section 7 of the Endangered Species Act of 1973, as amended, the EIS will include an analysis of potential impacts to endangered or threatened species or critical habitat in the action area. To support the environmental review, the NRC is requesting information from NOAA Fisheries to facilitate the identification of endangered or threatened species or critical habitat that may be affected by construction, operation, or decommissioning of the proposed facility. Any information you provide will be used to enhance the scope and quality of our review in accordance with 10 CFR 51 and 50 CFR 402.

The applicant's ER identifies 107 hectares (265 acres) of the 656 hectare (1621 acre) Wilmington site as the action area for the construction, operation, and decommissioning of the proposed facility. The coordinates for the center of the action area are 34.333923 °N and -77.945009 °W. The applicant has proposed to discharge stormwater, treated process wastewater, and, potentially, treated sanitary wastewater under existing National Pollutant Discharge Elimination System (NPDES) permits into an unnamed tributary to the Northeast Cape Fear River. Stormwater runoff also may be received by an unnamed tributary to Prince George Creek. We have enclosed additional background information regarding ecological resources on the Wilmington site, including a map showing the action area, as it appears in the applicant's ER. The applicant's ER is publicly available in the NRC Agencywide Documents

Access and Management System (ADAMS) at http://www.nrc.gov/reading-rm/adams.html using accession number ML090910573.

We intend to use the EIS process to comply with Section 7 of the Endangered Species Act of 1973, as amended. After assessing information you provide, we will determine what additional actions are necessary to comply with the Section 7 consultation process. If you have any questions or comments, or need any additional information, please contact Christianne Ridge of my staff at 301-415-5673.

Sincerely,

Andrea Kock, Chief
Environmental Review Branch
Environmental Protection and
 Performance Assessment Directorate
Division of Waste Management
 and Environmental Protection
Office of Federal and State Materials
 and Environmental Management Programs

Docket No.: 70-7016

Enclosure:
Background Information

cc w/o enclosure:
See next page

From: Andrew.Herndon [mailto:Andrew.Herndon@noaa.gov]
Sent: Monday, August 03, 2009 8:33 AM
To: GLE_EIS Resource
Subject: NOAA Fisheries Protected Species Information

To Whom it May Concern,

Per your request, attached and included here is information on the protected species under NOAA Fisheries' purview that may by affected by the proposed project.

Attachment 1: List of all Endangered Species Act (ESA)-listed species known to occur off North Carolina.
Attachment 2-4: Information on Shortnose Sturgeon. Additional information on shortnose sturgeon can be found in its recovery plan at:
http://www.nmfs.noaa.gov/pr/pdfs/recovery/sturgeon_shortnose.pdf
Attachment 5: A guide to how best analyze potential impacts to ESA-listed species.

Below are links to information on the species of sea turtles that may be affected by the project. The first link to the NOAA Fisheries-Protected Resources webpage for each species, the second link is to the most recent version of the recovery plan for each species. Please note links to other useful documents may be available on each species' webpage.

Loggerhead:
http://www.nmfs.noaa.gov/pr/species/turtles/loggerhead.htm;
http://www.nmfs.noaa.gov/pr/pdfs/recovery/turtle_loggerhead_atlantic.pdf
Leatherback:
http://www.nmfs.noaa.gov/pr/species/turtles/leatherback.htm;
http://www.nmfs.noaa.gov/pr/pdfs/recovery/turtle_leatherback_atlantic.pdf
Hawksbill: http://www.nmfs.noaa.gov/pr/species/turtles/hawksbill.htm;
http://www.nmfs.noaa.gov/pr/pdfs/recovery/turtle_hawksbill_atlantic.pdf
Green: http://www.nmfs.noaa.gov/pr/species/turtles/green.htm;
http://www.nmfs.noaa.gov/pr/pdfs/recovery/turtle_green_atlantic.pdf
Kemp's ridley:
http://www.nmfs.noaa.gov/pr/species/turtles/kempsridley.htm;
http://www.nmfs.noaa.gov/pr/species/turtles/kempsridley.htm

Please remember that providing your determination of why an ESA-listed species may or may not be affected by the proposed action with your request for consultation will increase the speed with which it can be processed.

Feel free to contact this office at any time if you have additional questions.

Andy

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

August 10, 2009

Mr. Pete Benjamin
Field Supervisor
U.S. Fish and Wildlife Service
Raleigh Field Office
Post Office Box 33726
Raleigh, North Carolina 27636-3726

SUBJECT: CONSULTATION REGARDING NUCLEAR REGULATORY COMMISSION EXEMPTION TO ALLOW GENERAL ELECTRIC-HITACHI TO BEGIN PRECONSTRUCTION ACTIVITIES ASSOCIATED WITH THE PROPOSED GLOBAL LASER ENRICHMENT FACILITY IN NEW HANOVER COUNTY, NORTH CAROLINA

Dear Mr. Benjamin:

On June 26, 2009, General Electric-Hitachi (GEH) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) for a license to authorize construction and operation of a uranium enrichment facility. The facility, if licensed, would use a laser-based technology to enrich the isotope uranium-235 in uranium hexafluoride (UF_6) up to 8 percent by weight. GEH proposes to locate the facility on the existing General Electric/Global Nuclear Fuel-Americas site near Wilmington, North Carolina (Wilmington site).

On May 1, 2009, the NRC staff initiated consultation about this project with your office as required by Section 7 of the Endangered Species Act of 1973, as amended (ESA). On June 8, 2009, your office replied to NRC's request for information regarding endangered or threatened species in the vicinity of the Wilmington site and indicated specific actions to be taken before land is disturbed.

On May 8, 2009, NRC granted GEH an exemption from certain NRC regulations related to the commencement of construction (Enclosure 1). The exemption, which was granted in response to a December 8, 2008, request from GEH (Enclosure 2), allows GEH to begin certain activities that are not related to nuclear safety or security. These activities include clearing 40 hectares (100 acres) of land, grading the site and implementing erosion control, building storm water retention ponds, building roadways and guardhouses, installing utilities, constructing parking lots, and building administrative buildings. GEH has indicated that it plans to begin these activities in early 2011.

Because the exemption request was granted after NRC initiated consultation with your office, the NRC staff is requesting a teleconference with your office to discuss the exemption, NRC's licensing role for the proposed uranium enrichment facility, and NRC responsibilities under the ESA. On July 21, 2009, Ms. Christianne Ridge of my staff discussed this issue briefly with Mr. Howard Hall of the U.S. Department of the Interior, Fish and Wildlife Service, Raleigh Field Office. Ms. Ridge will contact Mr. Hall to arrange a teleconference to discuss the issue further.

If you need any additional information related to this request, please contact me at 301-415-7183 or contact Ms. Ridge at 301-415-5673.

Sincerely,

James R. Park for

Andrea Kock, Chief
Environmental Review Branch
Environmental Protection and
Performance Assessment Directorate
Division of Waste Management
and Environmental Protection,
Office of Federal and State Materials
and Environmental Management Programs

Docket No.: 70-7016

Enclosures:
1. NRC Letter Granting Exemption Request
2. General Electric-Hitachi Exemption request

cc w/o enclosures: See next page

[Attachment 1 of e-mail from Andrew Herndon]

Endangered and Threatened Species and Critical Habitats
under the Jurisdiction of the NOAA Fisheries Service

North Carolina

Listed Species	Scientific Name	Status	Date Listed
Marine Mammals			
blue whale	*Balaenoptera musculus*	Endangered	12/02/70
finback whale	*Balaenoptera physalus*	Endangered	12/02/70
humpback whale	*Megaptera novaeangliae*	Endangered	12/02/70
North Atlantic right whale	*Eubalaena glacialis*	Endangered	12/02/70
sei whale	*Balaenoptera borealis*	Endangered	12/02/70
sperm whale	*Physeter macrocephalus*	Endangered	12/02/70
Turtles			
green sea turtle	*Chelonia mydas*	Threatened[1]	07/28/78
hawksbill sea turtle	*Eretmochelys imbricata*	Endangered	06/02/70
Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered	12/02/70
leatherback sea turtle	*Dermochelys coriacea*	Endangered	06/02/70
loggerhead sea turtle	*Caretta caretta*	Threatened	07/28/78
Fish			
shortnose sturgeon	*Acipenser brevirostrum*	Endangered	03/11/67

Designated Critical Habitat
None

Species Proposed for Listing
None

Proposed Critical Habitat
None

[1] Green turtles are listed as threatened, except for breeding populations of green turtles in Florida and on the Pacific Coast of Mexico, which are listed as endangered

[Attachment 2 of e-mail from Andrew Herndon]

Moser, M.L., and S.W. Ross. "Habitat Use and Movements of Shortnose and Atlantic Sturgeons in the Lower Cape Fear River, North Carolina." *T AM Fish Soc* 124:225–234, 1995. ADAMS Accession No. ML092170775

[Attachment 3 of e-mail from Andrew Herndon]

99-EP-06

99-EP-06

J. Robin Hall

Effects of recreational electrofishing on sturgeon habitat in the Cape Fear River drainage.

Mary.L.Moser, Jean Conway, and Teresa Thorpe
Center for Marine Science Research.
7205 Wrightsville Avenue
Wilmington, NC 28403

and

J. Robin Hall
68 Flowers Settlemeyer Road
Riegelwood, NC 28456

Final Report to:
North Carolina Sea Grant
Fishery Resource Grant Program

January 2000

INTRODUCTION

The shortnose sturgeon (*Acipenser brevirostrum*) is a federally-listed endangered species. This fish was reportedly abundant in North Carolina waters in the early 1900s, but due to overfishing and habitat degradation it now occurs only rarely in the Cape Fear River and Albemarle Sound drainages and has apparently been extirpated from other state waters (Ross et al. 1984, NMFS 1998). In spite of Endangered Species Act (1973) protections and a moratorium on Atlantic sturgeon (*A. oxyrinchus*) harvest in North Carolina (1991), shortnose sturgeon are still very rare in state waters. Consequently, concerns about habitat quality and the possible need for enhancement with cultured fish are current shortnose sturgeon management issues in North Carolina.

The Shortnose Sturgeon Recovery Plan (NMFS 1998) outlines priority tasks for recovery of each shortnose sturgeon population segment. In addition, it provides general guidelines for conditions that must be met for stock enhancement or restoration using cultured shortnose sturgeon. Among these recommendations for the Cape Fear River population is the need to assess sturgeon bycatch in other fisheries and the impacts of non-indigenous species. Enhancement or restoration of shortnose sturgeon populations cannot be considered until it has been established that essential habitats are available to sustain the species, and that mortalities from bycatch or from predation by non-indigenous fishes are not a significant threat to these efforts (NMFS 1998).

The 1966 introduction of flathead catfish (*Pylodictis olivaris*) and blue catfish (*Ictalurus furcatus*) into the Cape Fear River (Moser and Roberts in press) had several potentially significant repercussions for already rare sturgeon populations. Both catfish species attain very large sizes and occur in shortnose sturgeon spawning and nursery habitats. The flathead catfish is piscivorous and is known to feed on other demersal species (particularly other catfishes). The blue catfish is omnivorous and could act as both a potential predator on and/or a competitor for food of the shortnose sturgeon juveniles. The rapid expansion of these non-indigenous catfishes heralded the demise of native icatlurids in the upper Cape Fear River and the 1981 establishment of a novel recreational electrofishing fishery to target non-native catfish (Moser and Roberts 1999).

Sturgeon, like catfish, possess exceptional electro-sensory capabilities. Consequently, they are likely to be significantly impacted by electrofishing developed to target catfish (Morris and Novak 1968). Avoidance of electroshocking and the results of being shocked could reduce feeding or alter spawning behavior and subsequently reduce sturgeon fitness. In this study, we examined both the effects of catfish predation on shortnose sturgeon and the potential impact of recreational electrofishing, which is prosecuted intensively in the Cape Fear River main stem from the mouth of the Black River to Lock and Dam #3 (Figure 1).

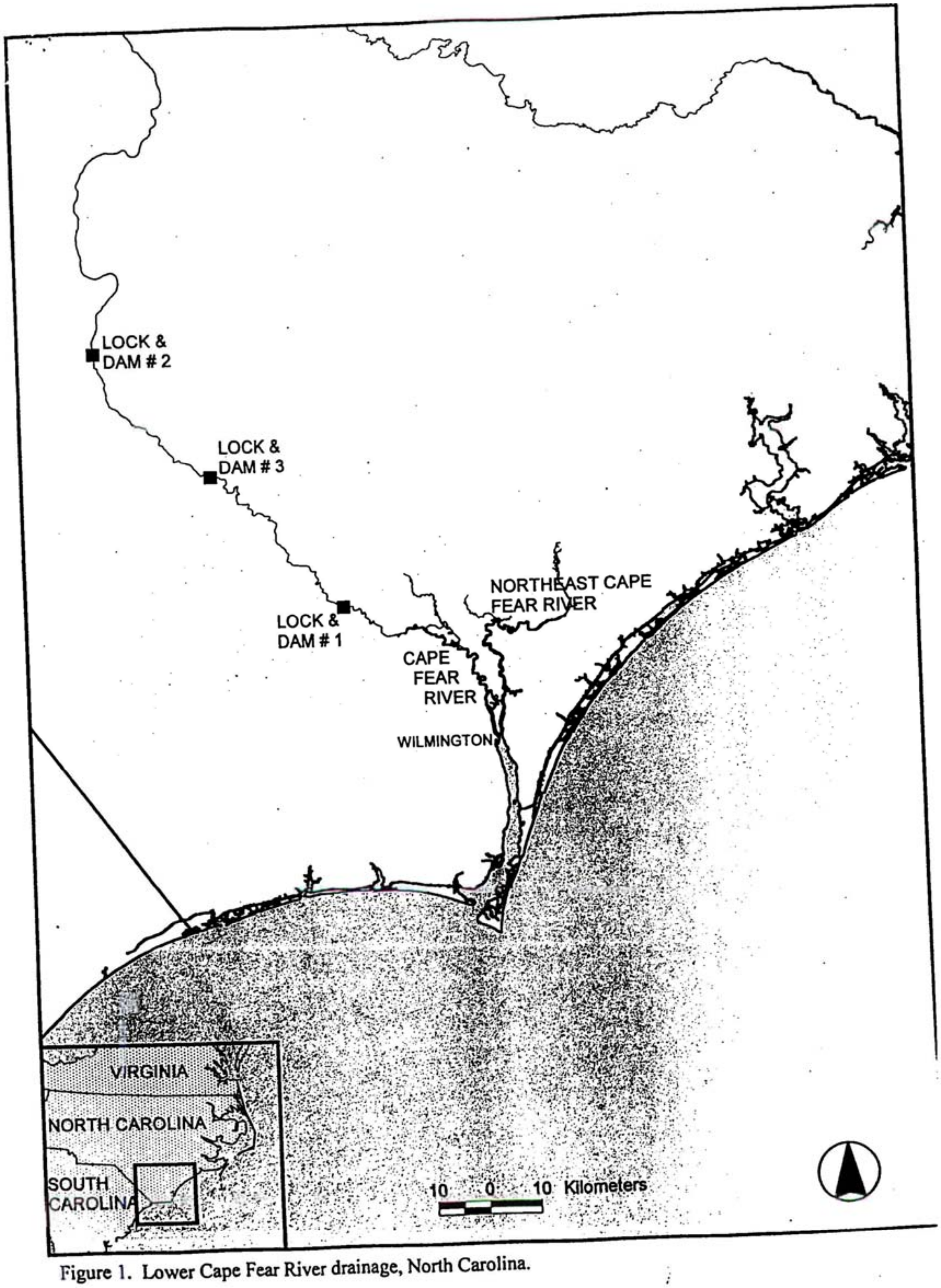


Figure 1. Lower Cape Fear River drainage, North Carolina.

Electrofishing

Juvenile hatchery-reared shortnose sturgeon and channel catfish were exposed to simulated electrofishing conditions while being held in ambient Cape Fear River water. The electrofishing device was a hand-cranked "telephone" generator supplied by a local recreational fisherman. It consisted of a 5-bar telephone generator wired to a capacitor. A pulley connected the generator to a bicycle wheel that permitted hand-cranking at approximately 80 revolutions per minute during a one minute treatment. This use of the gear was consistent with that of local electrofishers. Two insulated wires were connected to the capacitor and acted as electrodes, which were positioned along the bottom of the treatment area in each experiment. We also observed behavioral responses of fish when they were subjected to a variety of DC frequencies and pulse widths by using a commercially available back-pack electroshocker (Smith Root Model 12A). This enabled us to empirically determine the frequency and pulse width that elicited the same response as that produced by the hand-cranked generator.

Shortnose sturgeon juveniles were obtained from the U.S. Fish and Wildlife Service fish hatcheries at Warm Springs, Georgia and Bear's Bluff, South Carolina. Blue catfish juveniles were obtained from Southeastern Pond Stocking and Aquatic Maintenance. Fish were maintained in aerated 8, 800 gallon tanks with water circulated from the Cape Fear River for over eight months prior to testing, to allow adequate acclimation to their new setting and for water quality to approximate conditions when electrofishing is prosecuted most intensely. Unfortunately, during this period an electrical storm caused a power outage and the backup generation system for tanks housing the sturgeon failed, resulting in mass mortality. Consequently, scaled down experiments were conducted with a small number of fish held in a backup facility (Cape Fear Community College). The experiments were conducted in two, 800 gal tanks: one treatment and one control tank. Fish were fed ad libitum (approximately 72 g) on Hi-Pro #3 every evening. Salinity, conductivity, dissolved oxygen and water temperature were recorded prior to each electroshocking test and these parameters were also recorded continuously in the control tank using a data logger (Yellow Springs Instruments 6600).

On the first day of electroshock experiments, all fish were weighed and measured. The tank containing the experimental fish was lined with a seine net, which, when raised, allowed us to observe fish behaviors. These fish were then exposed to the output from the "telephone" generator four to five times a day for two weeks. During the one minute exposure, the following behaviors were recorded, the second at which it occurred, how long it lasted and the recovery time:

- Twitching – rapid twitching/swimming usually accompanied by heightened operculation.
- Lateral roll – fish rolls over to one side. This behavior was often preceded by a period of rigor when the fish would form a rigid "S" shaped curve and remains motionless.
- Belly up – fish completely rolls upside-down.
- Avoidance.

Fish in the control tank were not exposed to the output from the "telephone" generator, but were regularly disturbed to replicate activities associated with the electroshocking treatment. After two weeks, all fish were again weighed and measured. The electroshock experiment was conducted a second time; however, the seine net was removed and no observations were made during shocking. This test was conducted to insure that disturbance associated with making the observations was not confounding the results. After two weeks, the fish were again weighed and measured. All electroshock experiments were conducted in October and November 1999. Weights and total-lengths of experimental and control fish were compared before and after the electroshock experiments to determine any deleterious effects of electroshocking on shortnose sturgeon. The instantaneous growth rate (G) was computed as: $G = (\ln W_t - \ln W_0)t^{-1}$ where W_t was the mean weight at the end of the experiment, W_0 was the mean weight at the start of the experiment, and t was the length of the experiment in days.

Catfish predation

Large adult flathead catfish (> 3000 g) were collected from the Cape Fear River using gillnets (Mallin et al. 1999). They were held in the River in floating net pens and were not fed for one week prior to experimentation. Hatchery-reared shortnose sturgeon, channel catfish (*Ictalurus punctatus*) and striped bass (*Morone saxatilis*) juveniles were held in aerated 800 gal tanks with flow-through Cape Fear River water for over three months prior to experimentation and were fed ad libitum during this period. Temperature, salinity and dissolved oxygen were recorded daily.

To initiate experiments, one flathead catfish was moved to an empty aerated 800 gallon tank with water circulated from the Cape Fear River and allowed to acclimate to the tank for 24 h. Then, ten each of shortnose sturgeon, channel catfish and striped bass were placed in fish cages and lowered into the tank containing the flathead catfish. They remained in the cage for 24 hours to acclimate and were then released. Every day for a period of two weeks, the fish were counted in order to determine consumption rates and preferential prey species of the flathead catfish. After two weeks, the flathead catfish was returned to the Cape Fear River and replaced with a new one. This experiment was repeated four times; however, in the last three replicates striped bass were not available. The first three replicates were conducted between February 17th and April 19th 1999, the fourth from November 30th to December 14th 1999.

Moses
206-860-3351
who was technician?

RESULTS

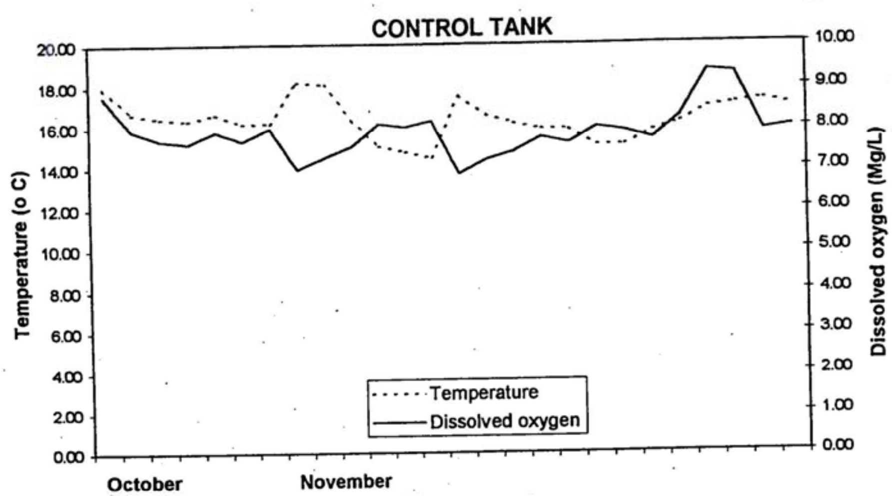
Electrofishing

Water quality in the control and experimental tanks was very similar (Figure 2 and 3). The temperature ranged from 14.5 – 18.1 ^{0}C. Dissolved oxygen was also within a narrow range. At the end of November, the salinity began to rise from 0.00 ‰ to a maximum of 4.1 ‰ in the control tank and 3.4 ‰ in the experimental tank. Thus conductivity increased from an average of 101.8 µmols/cm in the control tank and 95.4 µmols/cm in the experimental tank when salinity was 0.00, to a maximum of 5057 and 5042.5 µmols/cm respectively.

Average lengths and weights of fish used were similar in the control and experimental tanks, although shortnose sturgeon were larger and heavier than channel catfish (Figure 4 and 5). Both species increased in length and weight over the four week experimental period. Instantaneous daily growth rates for shortnose sturgeon in the first replicate were lower (0.013 d^{-1}) for fish exposed to electroshocking and .0214 d^{-1} for controls. In contrast, electroshocked sturgeon in the second replicate grew faster (0.024 d^{-1} than controls (0.022 d^{-1}). As for sturgeon, electroshocked catfish in the first replicate grew more slowly (0.003 d^{-1}) than controls (0.016 d^{-1}), but in the second replicate, the shocked catfish grew faster (0.034 d^{-1}) than controls (0.007 d^{-1}). Consequently, there were similar growth rates observed between treatments when the growth rate was calculated over the entire four week time period for each species (Figure 4 and 5).

Using the back-pack electroshocker, we were able to elicit the same type of sturgeon and catfish responses as obtained with the hand cranked generator when 100 volt output was produced at 10 Hz and 10 pulses/second (as in Quinn 1986). Sturgeon were initially more responsive to the electroshocking treatment than catfish; however, they recovered quickly and moved to avoid the stimulus (Figure 6). More sturgeon than catfish rolled onto their side or completely rolled upside-down within the first 15 seconds. They also exhibited more twitching, rigor and avoidance behaviors than did catfish (Table 1). But, sturgeon generally recovered immediately after the experiment. Over 75% of the sturgeon recovered immediately, with maximum recovery times of 5 minutes. In contrast, catfish tended to display electronarcosis and as the shocking continued, more catfish lost equilibrium. Catfish also took longer to recover than sturgeon, sometimes up to 8 minutes after the experiment had ended (Figure 6). The average recovery time for catfish was 3.5 min and only 7 fish recovered immediately.

Figure 2. Water quality in control tanks during electroshocking experiments.



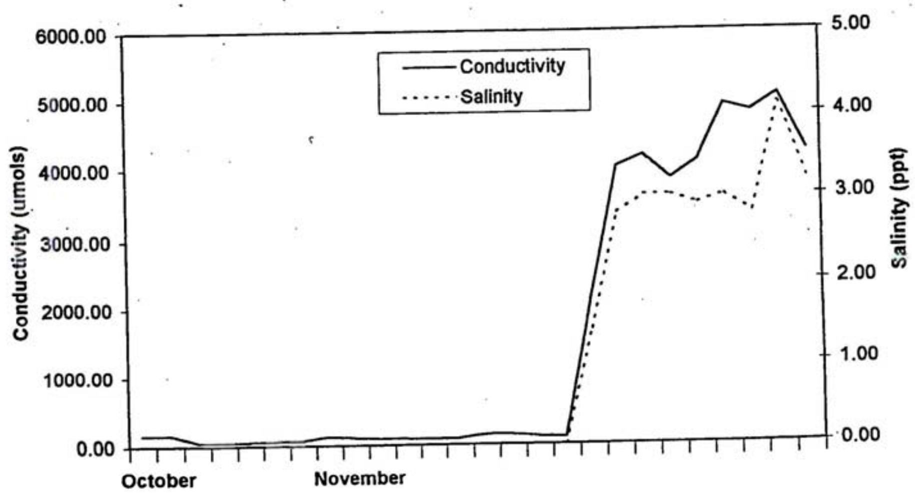
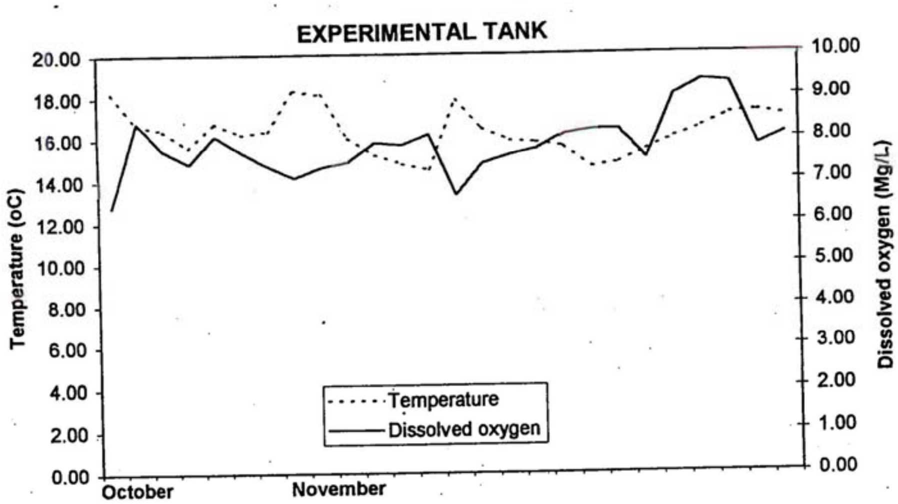


Figure 3. Water quality in experimental tanks during electroshocking experiments.



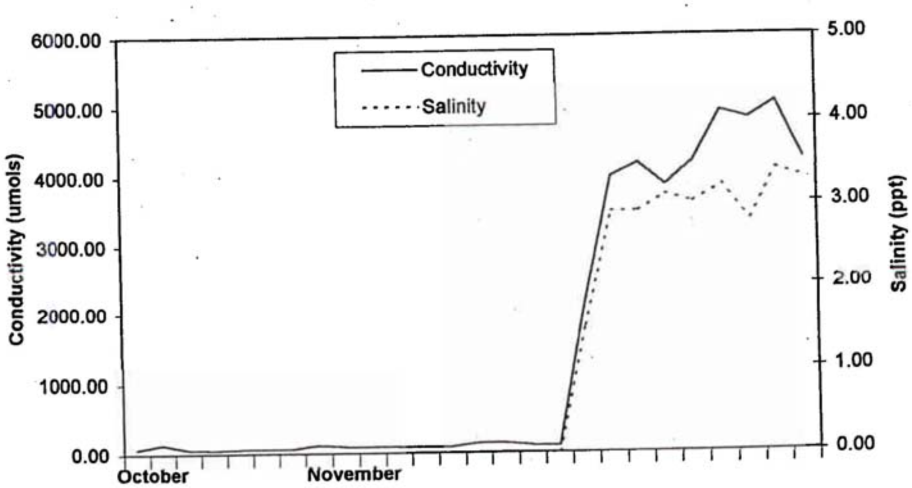


Figure 4. Mean total length (mm) and weight (g) of shortnose sturgeon in control (upper panel) and electroshocking treatments (bottom panel) conducted over the 32 day period from 10/22/99 – 11/23/99.

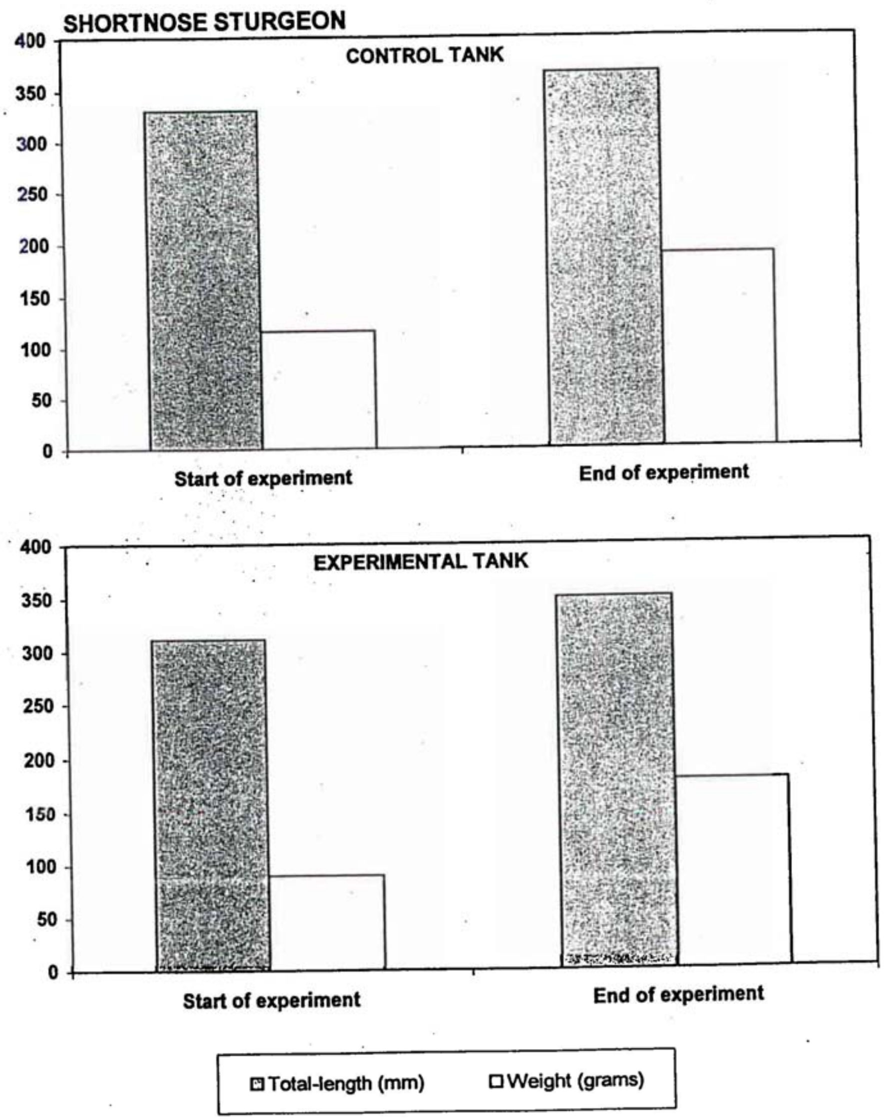


Figure 5. Mean total length (mm) and weight (g) of channel catfish sturgeon in control (upper panel) and electroshocking treatments (bottom panel) conducted over the 32 day period from 10/22/99 – 11/23/99.

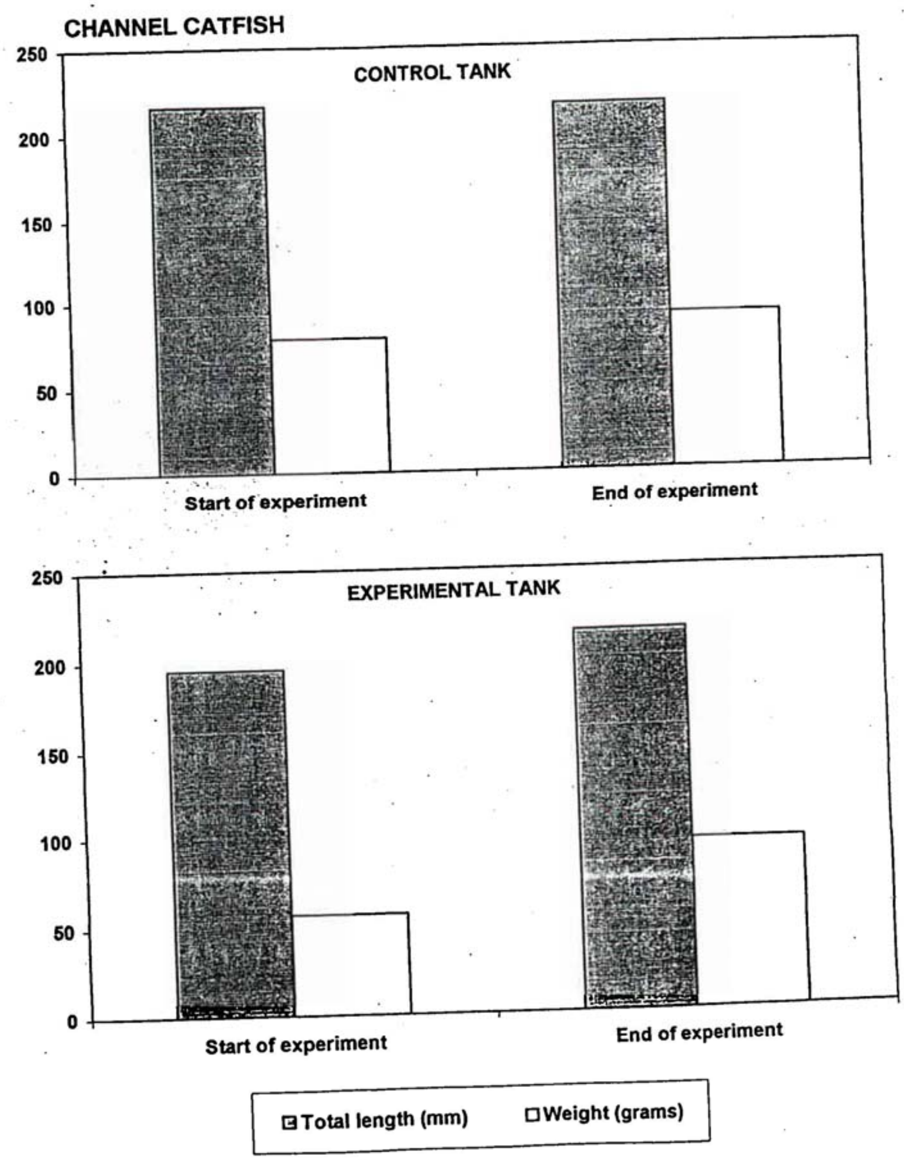


Figure 6. Total number of shortnose sturgeon (top panel) and channel catfish (bottom panel) that exhibited either a lateral roll (dark bars) or complete loss of equilibrium (open bars) during 28 observation periods of 60 seconds each.

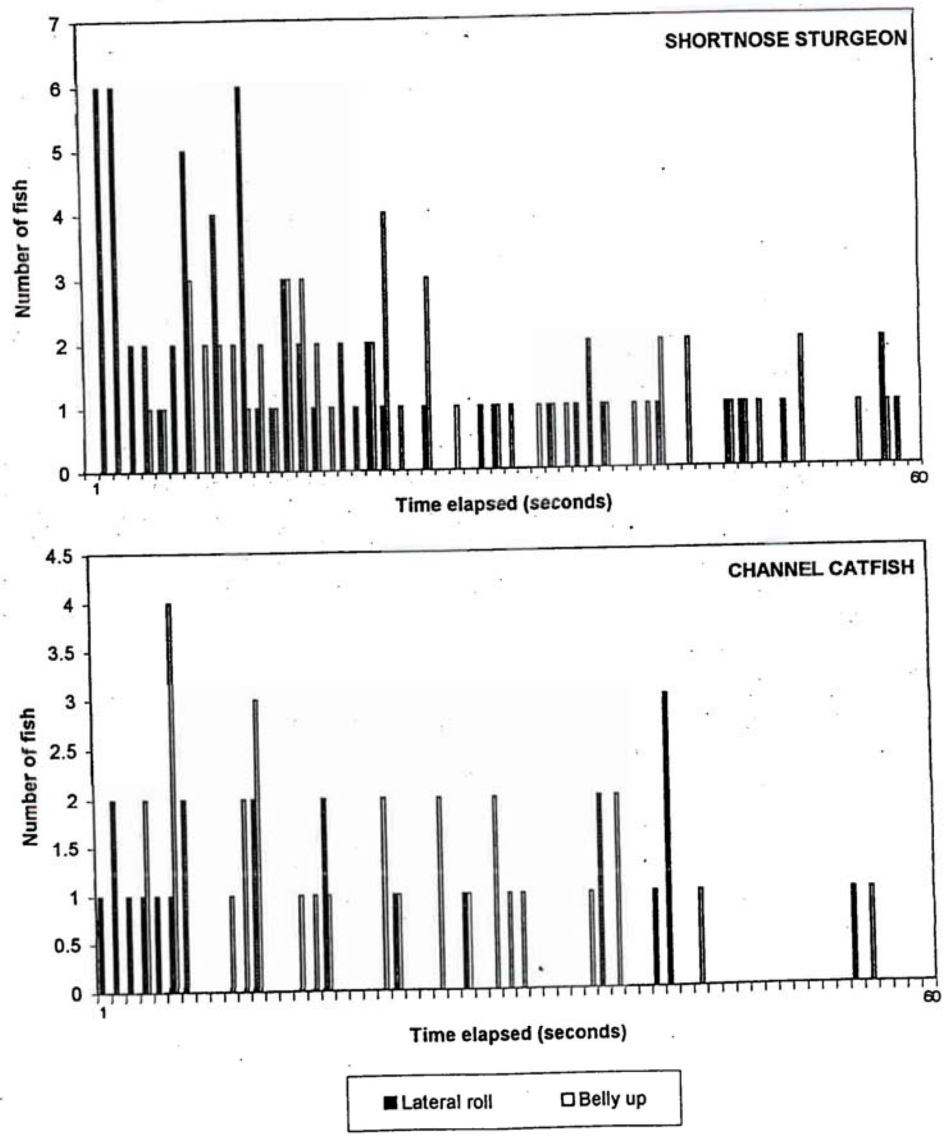


Table 1. Percent of all shortnose sturgeon and channel catfish that exhibited twitching, partial (roll) or complete (belly up) loss of equilibrium or avoidance in response to electroshocking during the first two week experiment (n=8 fish of each species observed during 48 electroshocking bouts).

	Twitch	Roll	Belly up	Avoidance
Sturgeon	12.5	16.1	17.1	10.0
Channel catfish	8.3	6.0	8.8	5.5

Catfish predation.

Salinity and temperature were the most variable water quality parameters during the catfish predation study (Figure 7). The temperature during experiment three was higher than in experiments one and two, although the temperature dropped below 10 ^{0}C only during experiment one. Salinity was generally lower during experiment three, and was elevated at the start of experiment two, peaking at 9.9 ‰ (Figure 7).

Size ranges of prey used in catfish predation studies differed among experiments due to availability of each size class (Table 2). Although sturgeon were longer than catfish in experiments 2-4, they were similar in weight and girth due to their long heterocercal tails. When striped bass were available, these were eaten first (Table 3). In experiment two, when striped bass were removed, channel catfish were missing from the tank. Flathead catfish did not eat any of the shortnose sturgeon in our experiments.

Figure 7. Water quality conditions during the four flathead catfish predation experiments: temperature °C (light line), salinity ppt (heavy line), and dissolved oxygen mg/L (dotted line).

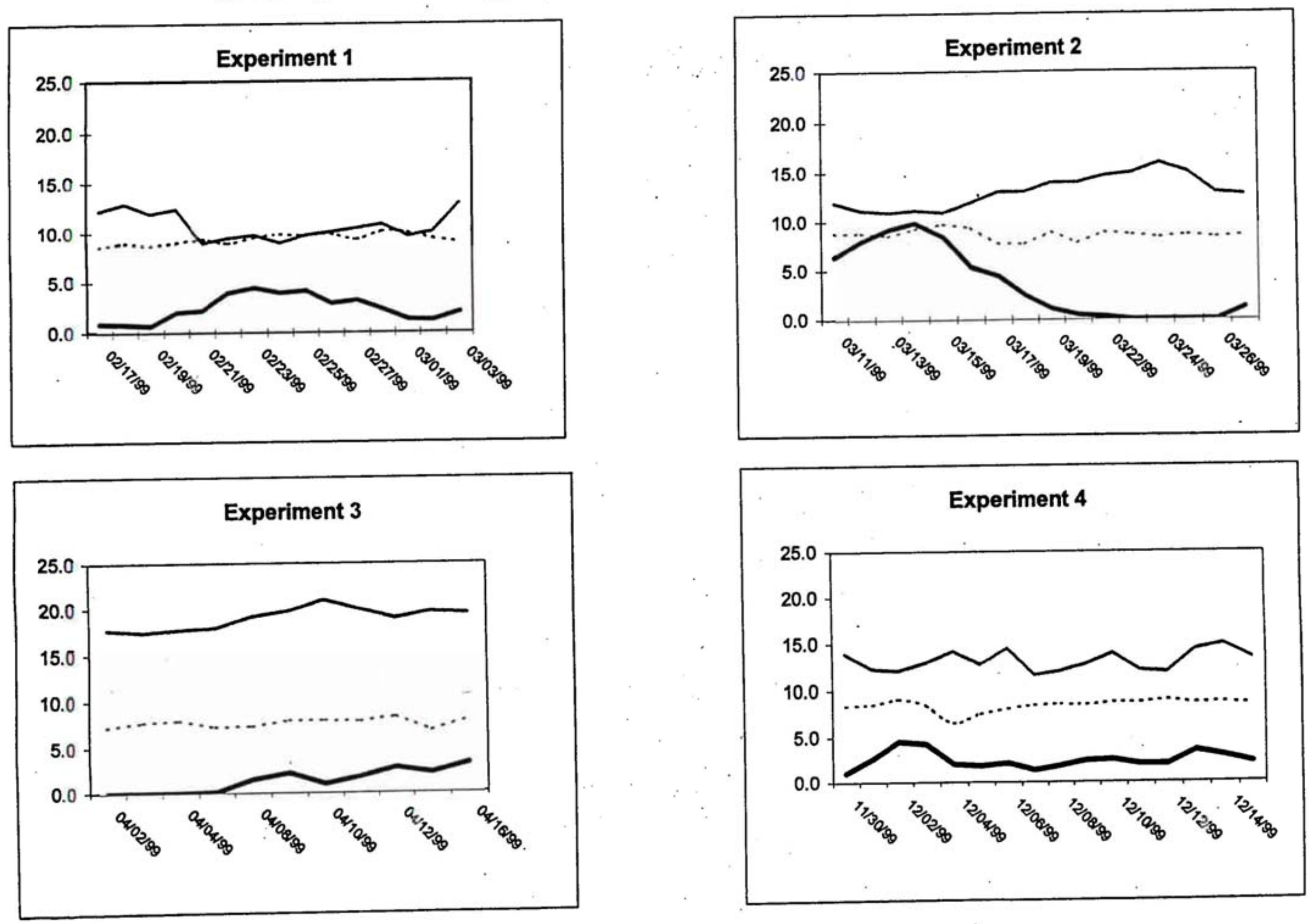


Table 2. Size ranges of fish used in flathead catfish predation study (total-length, mm).

	Striped bass	Channel catfish	Shortnose sturgeon	Flathead Catfish
Experiment 1	136-154	140-160	168-199	698
Experiment 2	-	98-124	172-199	640
Experiment 3	-	80-120	141-213	697
Experiment 4	-	181-258	298-355	695

\- striped bass not used

Table 3. Number of each prey species consumed by flathead catfish in each experiment.

	Striped bass	Channel catfish	Shortnose sturgeon
Experiment 1	2	0	0
Experiment 2	-	3	0
Experiment 3	-	0	0
Experiment 4	-	0	0

DISCUSSION

Shortnose sturgeon are very sensitive to electrical currents produced by hand-held generators used for recreational electrofishing. We documented a variety of behaviors that sturgeon exhibited more frequently than did catfish (the species targeted by this gear) including: avoidance, twitching, rigor, and loss of equilibrium. However, the sturgeon recovered very rapidly during the one minute treatments they were exposed to in our experiments. The one minute treatments are conservative in that it is unlikely that the fish would be exposed to shocking of this duration during normal electrofishing. Moreover, it is unlikely that sturgeon would ever be subjected to four-five electroshocking events on a single day, even during periods of intensive fishing pressure. The fact that both experimental and control sturgeon exhibited similar positive growth rates indicates that sturgeon are able to recover from even excessive amounts of electroshocking of this type and are able to feed normally. However, subtle changes in feeding behavior would not have been detected in our tank experiments. Sturgeon were fed ad libitum and had to expend very little effort to feed; whereas in natural conditions a relatively short period of inactivity due to shocking could result in missed feeding opportunities. Moreover, behavior associated with courtship and spawning could easily be disrupted by electroshocking, as evidenced by the sensitivity of sturgeon to very low level electrical output.

We found no evidence that flathead catfish fed preferentially on shortnose sturgeon juveniles. The flathead catfish in our experiments seemed to feed most readily on striped bass, with channel catfish preferred over sturgeon when the bass were not available. A number of studies have documented predation of flathead catfish on other ictalurids, which has led to extirpation of native catfishes in rivers where flathead catfish have been introduced (reviewed in Moser and Roberts in press). While we found no evidence that flathead catfish fed as readily on sturgeon as on other catfish, we were also disappointed that so few prey were taken by the flathead catfish in our experiments. The flathead catfish were starved prior to experimentation and were allowed extended periods to recover from gillnetting and to acclimate to experimental tanks. One possible reason for the low feeding rates of our predators may have been the relatively low water temperatures during experimental periods. Yet, feeding was observed during the periods of lowest temperature, and no feeding occurred during experiment 3, which had the highest temperature (Figure 7). Future experiments could limit food choices to only sturgeon to determine whether flathead catfish will take them if nothing else is available. Moreover, the ability of flathead catfish to feed on sturgeon of a variety of sizes should be examined to insure that they are not able to target a size range of sturgeon juveniles that was not available in our experiments.

In summary, we found that the direct effects of electroshocking are more likely to negatively impact shortnose sturgeon than the indirect effect of removing potential flathead catfish predators. Unfortunately, due to unavoidable reductions in the number of fish available for the experiments and the time periods when they could be conducted (due to hurricanes), these experiments represent a pilot effort. Nevertheless, they clearly indicated that extensive periods of electroshocking could negatively effect shortnose sturgeon, particularly during critical, easily disrupted behaviors, such as courtship and spawning. Moreover, the energy expended to avoid shocking in summer could depress fitness of sturgeon already stressed by low oxygen and high temperature conditions. Further research to assess these issues should be conducted before restoration of shortnose sturgeon in the Cape Fear River drainage is considered.

ACKNOWLEDGEMENTS

We thank the U.S. Army Corps of Engineers for supplying the sturgeon and striped bass used in our experiments. The personnel of Warm Springs, Bears Bluff and Edenton fish hatcheries accommodated our needs for fish and Southeastern Pond Stocking and Aquatic Maintenance delivered them in fine condition. Special thanks to Cape Fear Community College for making space, and their expertise, available throughout the study. Without their help, this work would have ended with the deaths of fish at our primary fish holding facility. Michael Williams was instrumental in providing catfish for the predation study and the North Carolina National Estuarine Research Reserve kindly provided office support. This project was funded by a North Carolina Sea Grant, Fishery Resource Grant.

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I have permission from Mr. Ashley to give you a copy of his report and would appreciate it if you would put it in with my final report. I think the information Mr. Ashley has obtained is also beneficial.

Thank you,

Robin

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NORTH CAROLINA WILDLIFE RESOURCES COMMISSION

Division of Boating and Inland Fisheries

Final Report

Determination of Current Food Habits of Flathead Catfish in the Cape Fear River

Project Type: Survey

Period Covered: April 1986 - December 1986

Keith V. Ashley

Bobby Buff

Raleigh, North Carolina

December 1986

19 pf

Abstract: Current food habits of flathead catfish in the Cape Fear River were determined through analysis of 184 stomachs collected during the spring and summer of 1986. Fish were collected with a 5-bar, hand-cranked telephone generator (magneto). The objective was to determine if frequency of occurrence and percent by numbers of individual food items in the diet of flathead catfish changed significantly between 1979 and 1986. Current data indicates ictalurids, clupeids and centrarchids remain the primary food items in the diet of Cape Fear River flatheads; however, a shift from ictalurids to clupeids as the primary food item occurred between 1979 and 1986. Centrarchids occurred with equal frequency in flathead stomachs during 1979 and 1986 but were less numerous in the 1986 samples. There is no evidence to support anglers claims that flatheads may be responsible for the reputed decline in sunfish populations within the river. Decapods were more abundant in flathead stomachs in 1986 while frequency of occurrence remained unchanged. Pelecypods were less abundant in the 1986 samples but occurred with significantly higher frequency.

Flathead catfish (*Pylodictis olivaris*) are native to the New and French Broad Rivers of western North Carolina and were once common to the Nolichucky River. It is a solitary species preferring medium to large rivers with deep holes and abundant drift piles, sunken logs, log jams and standing timber (Minckley and Deacon 1959, Cross 1967, Morris et al. 1968, Pflieger 1975 and Glodek 1979). The Cape Fear River was stocked with flathead catfish in 1966 when 11 adults weighing 107.0 kg were released near Fayetteville, North Carolina by North Carolina Wildlife Resources

Commission personnel. This is the only known introduction of flathead catfish into the Cape Fear system. Guier and Nichols (1977) documented the establishment of a reproducing flathead population in 1976 with the collection of 5 specimens representing several age groups. Fourteen additional specimens, ranging in size from 10.0 g to 22.7 kg, were collected during 1977 providing further evidence of flathead reproduction within the Cape Fear River (Guier et al. 1980). Since its initial introduction the flathead population has expanded to inhabit 201 km of the mainstream Cape Fear and is considered the top level predator within the system (Guier et al. 1980).

The highly predatory feeding habits of flathead catfish were suspected of having adverse effects on the native fish species of the Cape Fear River. As early as 1970 NCWRC fisheries biologists received reports from local fishermen that native bullhead populations were declining. The fishermen attributed this decline to flathead predation. Apparently, rapid expansion of the flathead population during the mid 1970s resulted in a tremendous reduction in the bullhead population. This study was initiated in response to complaints from local fishermen concerning a perceived decline in sunfish populations within the river. The objective of this study was to determine if frequency of occurrence and percent by numbers of individual food items of flathead catfish in the Cape Fear River have changed significantly since 1979.

We wish to thank Mr. and Mrs. Earl Russell and Mr. James D. Davis for their assistance with data collection. This study was funded in part

through Dingell-Johnson Federal Aid in Fish Restoration, Project F-22, North Carolina.

METHODS

The Cape Fear River forms at the confluence of the Deep and Haw Rivers in piedmont North Carolina and flows southeasterly for approximately 274 km where it discharges into the Atlantic Ocean at Cape Fear near Southport (Louder 1963). Ninety percent of the drainage basin lies within the Coastal Plain and encompasses an area of approximately 1,916,600 ha (7,400 mi^2). Below river km 219 the river is regulated during low and moderate stages by 3 federal navigation locks and dams. The lunar tidal influence extends from the mouth of the river upstream to Lock and Dam #1, a distance of approximately 113 km.

Flathead catfish were collected from 1 April 1986 through 30 September 1986 from the mainstream Cape Fear River at Fayetteville, Tarheel/Elizabethtown, Elwell's Ferry and Riegelwood. All flathead catfish collected during this study were taken with a 5-bar, hand-cranked telephone generator as described by Morris and Novak (1968). Morris and Novak reported flathead catfish are particularly susceptible to capture using this device. The collecting operation was conducted using a shocking boat and a pickup or chase boat. Areas shocked included drift piles, log jams, sunken logs and standing timber located in the deeper pool areas along both banks.

Stomach contents were collected from all flathead catfish exceeding 1.0 kg in weight using the pulsed gastric lavage technique described by Foster (1977). Approximately 25.0 % of all fish were sacrificed to verify the effectiveness of the pulsed gastric lavage technique. All flatheads were weighed (kg) and measured (cm) prior to removal of the stomach contents. Individual food items were identified (if possible), sorted, counted and weighed.

Food habit data (frequency of occurrence, percent by numbers) collected during this study were statistically compared ($\alpha = 0.05$) with food habit data collected by Guier et al. (1980) using the following statistical test for comparing the equality of 2 percentages (Sokal and Rohlf 1969):

$$t_s = \frac{\arcsin\sqrt{p_1} - \arcsin\sqrt{p_2}}{\sqrt{820.8\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

where: p_1 = the proportion of food item 1 in the 1979 samples

p_2 = the proportion of food item 1 in the 1986 samples

n_1 = sample size for 1979

n_2 = sample size for 1986

820.8 = a constant representing the parametric variance of a distribution of arcsine transformations of proportions or percentages.

RESULTS

Examination of stomachs from sacrificed fish indicated pulsed gastric lavage removed approximately 100.0 % of all material present. Occasionally, a large particle would become lodged in the esophagus and require removal with forceps. It is an excellent technique for collecting stomach contents without injury to the fish.

Contents from 184 flathead catfish stomachs were examined and analyzed (Table 1). Fifty-five percent (102) of the stomachs were empty. Fish were the dominant food item in the diet of Cape Fear River flathead catfish during 1986 by frequency of occurrence, percent by numbers and percent by weight (Table 1). Fish accounted for 65.5 % by number and 97.0 % by weight of all food items consumed by flatheads during 1986. Unidentified fish remains occurred in 28.0 % of the stomachs.

Clupeids (12.1 % by number; 57.1 % by weight) were the most dominant food item group comprising the diet of Cape Fear River flathead catfish (Table 1). They occurred in approximately 18.0 % of the stomachs containing food (Table 2). White shad (*Alosa sapidissima*) accounted for approximately 51.0 % by weight of the diet during 1986; however, they occurred in stomachs collected during April and May suggesting their consumption may be related to seasonal influences (distribution and abundance). It is interesting to note the occurrence of white shad weighing 1.1 kg and 1.5 kg in the stomachs of flathead catfish weighing 6.5 kg and 17.2 kg, respectively. Gizzard shad (*Dorosoma cepedianum*) represented an additional 7.5 % by number and 6.4 % by weight of the diet.

Ictalurids, most notably white catfish (*Ictalurus catus*), blue catfish (*Ictalurus furcatus*), channel catfish (*Ictalurus punctatus*) and flathead catfish (*Pylodictis olivaris*), were the second most preferred forage items consumed by flatheads. They occurred in approximately 20.0 % of the stomachs containing food (Table 2). Two specimens of snail bullhead (*Ictalurus brunneus*), representing 1.2 % by number and 1.3 % by weight of the diet, accounted for the only other ictalurid comprising the food habits of Cape Fear River flatheads.

Centrarchids occurred in only 8.5 % of the stomachs containing food (Table 2) and accounted for only 4.6 % by number and 3.5 % by weight of the diet. Largemouth bass (*Micropterus salmoides*) were not found in any of the 82 stomachs containing food.

Cyprinids represented 16.1 % by number but less than 1.0 % by weight of the flathead diet during 1986. Longnose gar (*Lepisosteus osseus*) and yellow perch (*Perca flavescens*) accounted for an additional 4.6 % by number and 1.1 % by weight of all food items consumed (Table 1). The occurrence of 1 southern flounder (*Paralicthys lethostigma*), 2 spot (*Leiostomus xanthurus*) and 3 crabs (Brachyura) in stomachs of fish collected at the Riegelwood station is a reflection of saltwater intrusion resulting from the extensive and prolonged drought which occurred during the summer of 1986.

Decapods (crayfish) accounted for 11.5 % by number but only 1.2 % by weight of the flathead diet and occurred in 12.0 % of the stomachs containing food (Tables 1 and 2). Pelecypods (freshwater clams) represented an even higher percentage of the diet by percent number (18.4 %) but less than 1.0 % by weight and occurred relatively infrequently in the diet (8.5 % of the stomachs).

DISCUSSION

Food habit data collected by Guier et al. (1980) included data collected from flathead catfish taken near Lillington, NC; however, since there was no comparable station during this study the Lillington data was not included in the data analysis. In addition, individual weights for the food items examined and analyzed by Guier et al. (1980) could not be located making it impossible to compare the data from both studies on a percent by weight basis. Figures 1 and 2 compare the frequency of occurrence and percent total numbers, respectively, of individual food items comprising the diet of flathead catfish, collected from the Cape Fear River during 1979 and 1986.

Flathead catfish exceeding 300 mm feed primarily on fish (Minckley and Deacon 1959, Turner and Summerfelt 1970, Pflieger 1975 and Borawa 1982). In an earlier study, in which they examined and analyzed the stomach contents of 105 Cape Fear River flathead catfish, Guier et al. (1980) reported they fed predominantly on ictalurids (39.0 %), clupeids (12.0 %) and centrarchids (10.0 %) during 1979 (Figure 1). Data collected during the present study indicates flatheads are still utilizing these forage items heavily; however, there was a significantly higher proportion, both in frequency of occurrence and percent by numbers, of clupeid food items in the 1986 samples. This coincides with a significant reduction, again, both in frequency of occurrence and percent by numbers, of ictalurid food items indicating a shift in food habits from ictalurids to clupeids between 1979 and 1986.

Shad availability is dependent upon the annual shad run up the river which normally occurs between March 15 and May 1 in any given year. Guier et al. (1980) conducted their sampling in May and June and August and September of 1979 while sampling was conducted from April through September during the present study. The shift in food habits from ictalurids to clupeids could be the result of the temporal difference in sampling schedules between the 2 studies. By beginning their sampling in May Guier et al. (1980) may have missed the majority of the shad run up the river in 1979 and therefore their food habit data would not adequately reflect the true percentage of shad (especially white shad) in the flathead diet for 1979. In addition, the shad forage base (especially white shad) available to flathead catfish in 1986 could have been much larger than that available in 1979 and could be another explanation for the shift in food habits. According to Mr. Earl Russell (personal communication), more white shad were observed coming back down the river in 1986 than in the past 5 to 6 years. Furthermore, the majority of adult white shad returning down river die and sink to the bottom becoming easy prey for flathead catfish.

Edmundson (1974) reported sunfish were the dominant forage consumed by flathead catfish in Bluestone Reservoir, West Virginia and they occurred in approximately 23.0 % of the flathead stomachs examined by Guier et al. (1980). However, there was no significant difference in the frequency of occurrence of centrarchid food items in the flathead diet between 1979 and 1986 (Figure 1). There was a significantly lower number of sunfish food items in the 1986 diet indicating sunfish were not as heavily foraged upon in 1986 (Figure 2). A decline in the available sunfish forage base between 1979 and 1986 could explain the lower number of sunfish in the 1986 diet; however, there is no data to support anglers' claims that flatheads are responsible for the reputed decline in sunfish populations within the Cape Fear River.

Ictalurids and cyprinids were the principal food items consumed by flathead catfish in a riverine system (Morris et al. 1968). There was a significantly higher proportion (both in frequency of occurrence and percent total numbers) of cyprinid food items in the 1986 diet; however, since they accounted for less than 1.0 % by weight of the food items consumed (Table 1), their occurrence would be considered insignificant.

According to Hackney (1965), flathead catfish selected centrarchids and ictalurids over cyprinids in experiments conducted in plastic-lined pools and earthen ponds. There was no significant difference in the proportion of unidentified fish remains comprising the diet between 1979 and 1986.

Previous studies (Morris et al. 1968, Edmundson 1974 and Pflieger 1975) have indicated crayfish can serve as a major food item in the diet of flathead catfish. The number of decapods consumed in 1986 was significantly higher than the number consumed during 1979 (Figure 2) but frequency of occurrence remained the same indicating more crayfish may have been available for consumption during 1986. Frequency of occurrence of pelecypods was significantly higher in the 1986 samples while the percent total numbers was significantly lower. This may indicate either preference for clams by flathead catfish increased during 1986 or that there may have been fewer clams available for consumption.

In summary, the diet of flathead catfish in the Cape Fear River between 1979 and 1986 remained fairly constant regarding the consumption of primary food items (ictaluirds, clupeids and centrarchids). A shift in food habits from catfish to shad as the primary food item occurred between 1979 and 1986 and was probably the result of temporal differences between sampling schedules between 1979 and 1986 or the result of a larger shad forage base in 1986 or both. Sunfish were consumed with equal frequency in 1979 and 1986 but occurred in fewer numbers in the 1986 samples indicating a possible decline in the sunfish forage base since 1979. There is no data to support anglers claims that flatheads are responsible for the reputed decline in sunfish populations within the Cape Fear River. Crayfish were more abundant in flathead stomachs during 1986 while frequency of occurrence remained unchanged. Finally, freshwater clams were less abundant in flathead stomachs in 1986 but occurred with significantly higher frequency.

RECOMMENDATIONS

1. Flathead catfish should not be stocked in any system dominated by ictalurids and clupeids unless it is to be used as a predator to control these species.
2. Food habits of flathead catfish in the Cape Fear River should be examined in the near future (within the next 5 - 10 years) to determine if dietary preference has changed or has stablilized.

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Table 1. Numbers, weights and percent composition of food items in stomachs of flathead catfish collected from the Cape Fear River, North Carolina during 1986. (n = 82)

Food Item	Number	Weight (g)	% No.	% Wt.
Crustecea				
Decapoda				
Astacidae	15.0	65.1	8.62	1.19
Palaemonidae	5.0	1.5	2.87	0.03
Pelecypoda	32.0	22.5	18.39	0.41
Gastropoda	1.0	4.0	0.57	0.07
Brachyura	3.0	66.0	1.72	1.21
Insecta				
Terrestrial insects	3.0	1.5	1.72	0.03
Tricoptera	1.0	1.0	0.57	0.02
Osteichthyes				
Seminonotiformes				
Lepisosteidae				
Lepisosteus osseus	7.0	38.0	4.02	0.70
Clupeiformes				
Clupeidae				
Alosa sapidissima	8.0	2,763.0	4.60	50.70
Dorosoma cepedianum	13.0	348.0	7.47	6.39
Cypriniformes				
Cyprinidae				
Notropis spp.	28.0	30.5	16.09	0.56
Siluriformes				
Ictaluridae				
Ictalurus brunneus	2.0	72.0	1.15	1.32
Ictalurus catus	5.0	13.0	2.87	0.24
Ictalurus furcatus	5.0	1,096.0	2.87	20.11
Ictalurus punctatus	5.0	368.0	2.87	6.75
Pylodictis olivaris	1.0	10.0	0.57	0.18
Perciformes				
Centrarchidae				

Table 1. Cont.

Food Item	Number	Weight (g)	% No.	% Wt.
Lepomis macrochirus	6.0	172.0	3.45	3.16
Lepomis microlophus	2.0	16.0	1.15	0.29
Percidae				
Perca flavescens	1.0	23.0	0.57	0.42
Sciaenidae				
Leiostomus xanthurus	2.0	93.0	1.15	1.71
Pleuronectiformes				
Bothidae				
Paralicthyes lethostigma	1.0	12.0	0.57	0.22
Unidentified fish remains	28.0	234.0	16.09	4.29
Totals	174.0	5,450.1	99.95	100.00

Table 2. Frequency of occurrence of food items in flathead catfish stomachs collected from the Cape Fear River, North Carolina during 1979 and 1986.

	Year			
	1979		1986	
Food Item	Number	Percent	Number	Percent
Clupeidae	11.0	16.7	15.0	18.0
Ictaluridae	22.0	33.4	16.0	20.0
Centrarchidae	15.0	22.7	7.0	8.5
Percidae	0.0	0.0	1.0	1.0
Cyprinidae	1.0	1.5	10.0	12.0
Lepisosteidae	1.0	1.5	4.0	5.0
Sciaenidae	0.0	0.0	2.0	2.0
Bothidae	0.0	0.0	1.0	1.0
Fish Remains	26.0	39.4	23.0	28.0
Decapoda	7.0	10.6	10.0	12.0
Pelecypoda	2.0	3.0	7.0	8.5
Gastropoda	2.0	3.0	1.0	1.0
Brachyura	0.0	0.0	3.0	4.0
Insecta	19.0	28.8	4.0	5.0
Totals	106.0		174.0	

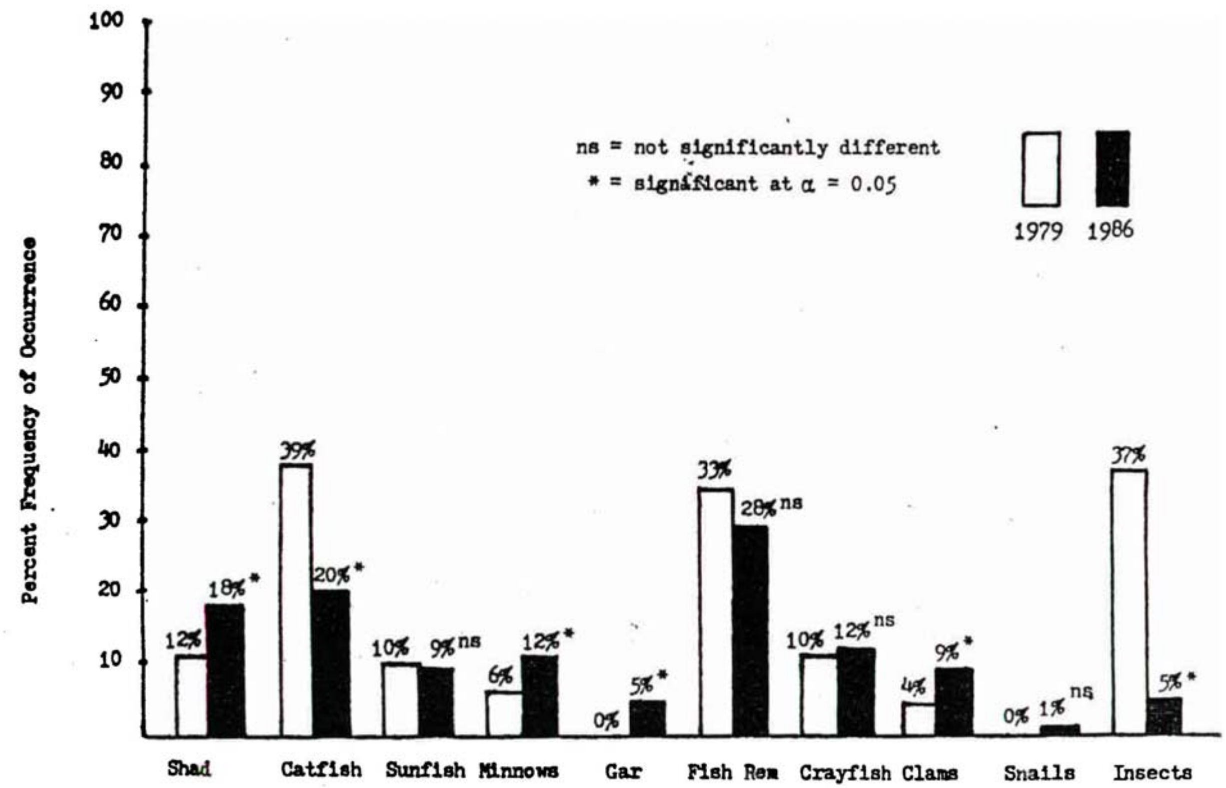


Figure 1. Percent frequency of occurrence of food items occurring in flathead catfish stomachs collected from the Cape Fear River, North Carolina during 1979 and 1986.

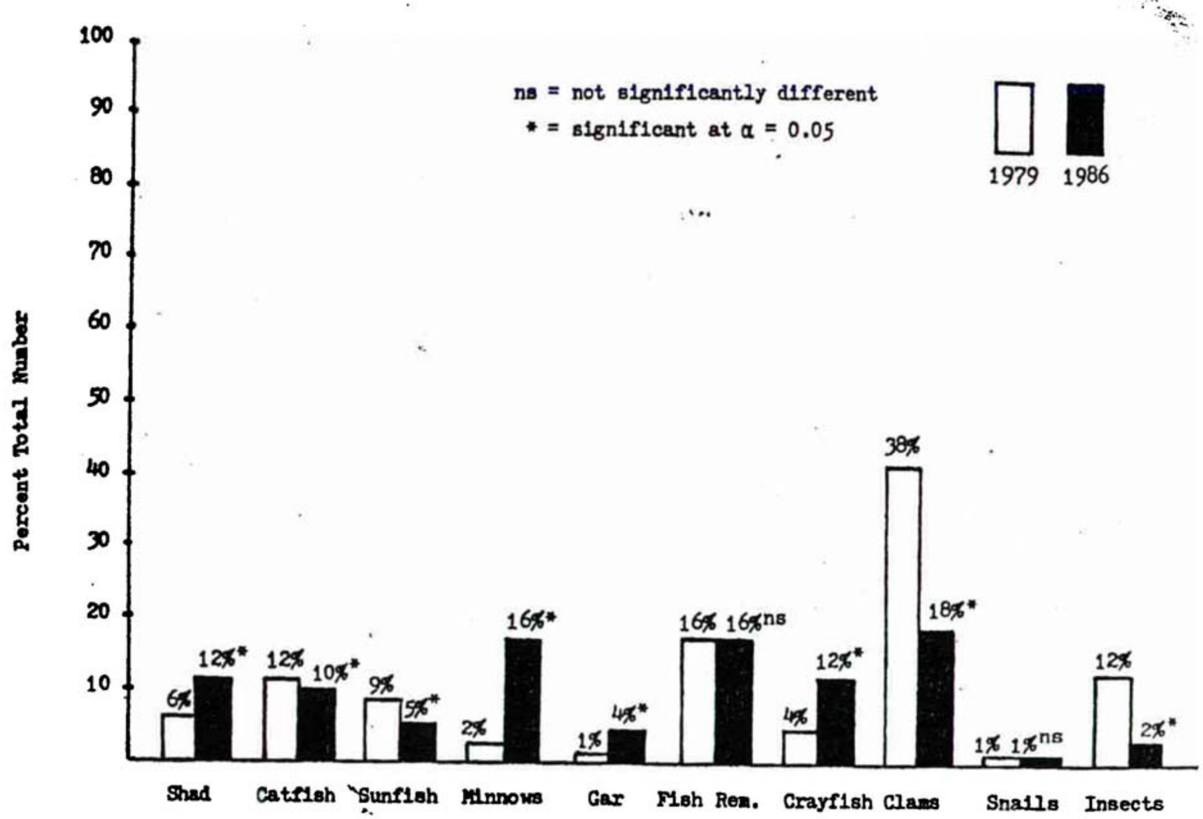
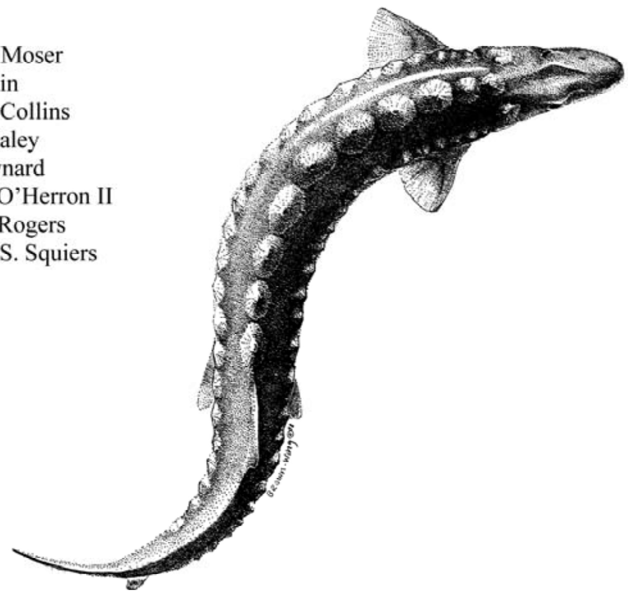


Figure 2. Percent total numbers of food items occurring in flathead catfish stomachs collected from the Cape Fear River, North Carolina during 1979 and 1986.

[Attachment 4 of e-mail from Andrew Herndon]

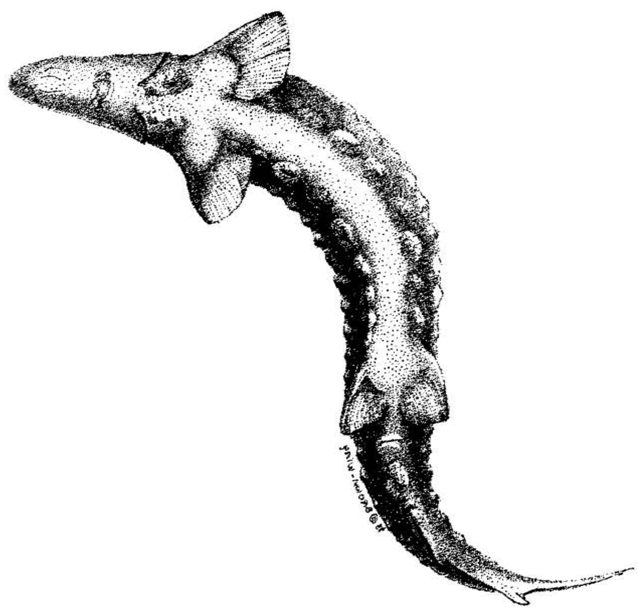
A Protocol for Use of Shortnose and Atlantic Sturgeons

Mary L. Moser
Mark Bain
Mark R. Collins
Nancy Haley
Boyd Kynard
John C. O'Herron II
Gordon Rogers
Thomas S. Squiers



U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

NOAA Technical Memorandum NMFS-OPR-18
May 2000



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A Protocol for Use of Shortnose and Atlantic Sturgeons

Mary L. Moser
Center for Marine Science Research
Univ. of North Carolina-Wilmington
7205 Wrightsville Avenue
Wilmington, NC 28403

Mark Bain
New York Cooperative
Fish and Wildlife Research Unit
Fernow Hall,Cornell University
Ithaca, NY 14853-3001

Mark R. Collins
S.C. Dept of Natural Resources
P.O. Box 12559
Charleston, SC, 29422-2559

Nancy Haley
National Marine Fisheries Service
212 Rogers Avenue
Milford, CT 06460

Boyd Kynard
Conte Anadromous Fish Research Lab
USGS/BRD 1 Migratory Way
Turners Falls, MA 01376

John C. O'Herron II
O'Herron Biological and
Environmental Consulting
220 Washington Street
Mount Holly, NJ 08060

Gordon Rogers
Satilla Management Associates/
Southern Resources and Environ. Serv.
Route 2, Box 7A-1
Waynesville, GA 31566

Thomas S. Squiers
Maine Dept. of Marine Resources
State House, Station Number 21
Augusta, ME 04333

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May 2000

U.S. Department of Commerce
William M. Daley, Secretary

National Oceanic and Atmospheric Administration
D. James Baker, Under Secretary for Oceans and Atmosphere

National Marine Fisheries Service
Penelope D. Dalton, Assistant Administrator for Fisheries

Abstract

Guidelines for handling and sampling of Atlantic coast sturgeons are needed to protect these fishes and to facilitate standardization of methodologies used by sturgeon researchers. The shortnose sturgeon, *Acipenser brevirostrum*, is a federally listed endangered species and the Atlantic sturgeon, *Acipenser oxyrinchus oxyrinchus*, is considered a species of special concern. Consequently, special techniques have been developed to reduce stress and mortality resulting from sampling and handling these species. In this document we review the most acceptable methods for short-term holding, identification and measurement, tagging, tissue sampling, gastric lavage, and collection using a variety of gear types. In addition, we provide a protocol for sampling to establish whether shortnose sturgeon are present in systems where their status is unknown.

Introduction

In recent years, a need has developed for standardization of sampling and handling methods for Atlantic coast sturgeons: shortnose (*Acipenser brevirostrum*) and Atlantic (*A. oxyrinchus oxyrinchus*). The shortnose sturgeon has been federally-listed as an endangered species since the Endangered Species Act of 1973. In the past few years the Atlantic sturgeon has been petitioned for listing and has been designated as a candidate species. Because the shortnose sturgeon has been listed for so long, it has been the subject of a relatively large number of research projects; however, this research has been conducted by only a handful of individuals. The Shortnose Sturgeon Recovery Plan (National Marine Fisheries Service 1998) specified the need for a sampling and handling protocol because of: 1) the likely increases in research on sturgeon in future years by a larger number of scientists and the concomitant need for standardization of methods, 2) the need for guidance in permitting research activities that may harm sturgeon, and 3) the need for minimum sampling requirements to determine that sturgeon are extant in a given system.

Sturgeon present some unique challenges for development of standardized methods. Both shortnose and Atlantic sturgeon may occur in a variety of habitats in Atlantic drainages from southern Canada (Saint John River) to northern Florida (St. Johns River). The differences in habitat both within and among river systems, and latitudinal differences in temperature and sturgeon life history, have resulted in sampling methods that are often specific to a given region or time of year. To make this document as comprehensive as possible, we have incorporated methodologies from research conducted across the entire range of habitats where these sturgeons occur and for the all sturgeon life stages that have been studied in the wild. We make no attempt here to suggest methodology for culture or long-term maintenance of sturgeon. In reviewing the literature and incorporating our own experiences in this protocol, we noted that innovations in research occur rapidly. Consequently, we emphasize that this protocol should be a living document that incorporates new techniques as they are developed and perfected. This protocol represents many years of collective experience in sampling and handling sturgeons and should provide useful guidelines for future research. Our intent is not to discourage development of new techniques or to limit or restrict sturgeon research.

Handling Methodologies

Both shortnose and Atlantic sturgeons are very hardy species. The ability of sturgeon to survive under extremely stressful conditions is well established and was exploited during early fisheries for their flesh and roe. The sturgeon's hardy nature also permits the use of research practices that stress these fish, potentially resulting in negative, but sub-lethal, impacts. For example, excessive handling of pre-spawning adults during their migration can result in interruption or even abandonment of upstream migration (Moser and Ross 1995). Moreover, sturgeon are very sensitive to handling during periods of high water temperature or low dissolved oxygen, and sturgeon can be lethally stressed in a short time if handled improperly during these conditions. The following handling protocol therefore includes guidelines for a variety of conditions.

Short-term holding

It is frequently necessary to hold sturgeon for short periods while fishing nets, tagging or collecting tissue samples. If possible, sturgeon should be held in floating net pens or live cars during processing. When fish are held on board the research vessel, they should be placed in flow-through tanks that allow total replacement of the water volume every 15 - 20 min. While total water volume in the tanks is not critical, adequate control of temperature and oxygen levels is absolutely essential. Fish should not be held on board for longer than 2 h when water temperatures are equal to or less than 27°C. If water temperature exceeds 27°C, sturgeon should never be held on board for longer than 30 min. Dissolved oxygen levels below 3 ppm are also stressful to sturgeon (Jenkins et al. 1993). Therefore, oxygenation of the water in holding tanks may be necessary during periods of high temperature or low dissolved oxygen and handling should be minimized. The use of an electrolyte bath (such as Stress Coat, marketed by aquaculture suppliers) can also help to reduce stress and restore the slime coat when fish are collected in fresh water. Sturgeon are very sensitive to chlorine; so, very thorough flushing is required if holding tanks are sterilized with bleach between sampling periods.

Sturgeon are physostomous and tend to inflate their swim bladder when stressed and in air. If this occurs, efforts should be made to return the fish to neutral buoyancy prior to or during release. This can often be achieved by propelling the fish rapidly downward during release. If the fish still has air in its bladder it will float and be susceptible to sunburn or bird attacks. Often the remaining air can be released by gently applying ventral pressure in a posterior to anterior direction.

Identification and measurement

Identification of sturgeon to species, sex and reproductive condition may involve use of both external and internal morphology. Juvenile Atlantic sturgeon and juvenile or adult shortnose sturgeon are easily confused and care should be taken in use of morphological characters for identification. The most consistently accurate external character is the ratio of bony inter-orbital width to mouth width (Moser et al. 1998). Use of other characters such as snout length and scute patterns can be misleading. For weight measurements, sturgeon should be supported using a sling or net and handling should be minimized throughout processing. Use of smooth rubber gloves is recommended to reduce abrasion of skin and removal of mucus.

Neither sturgeon species can be sexed on the basis of external morphology. A close magnifier at the end of a light beam (Bioscope) can be used to distinguish sexes and even to stage eggs without surgery. This instrument is gently inserted through the genital opening and rotated to view the gonads internally. This technique is quick, far less intrusive than surgical procedures, and with experience its use will allow differentiation of females that will spawn during the next spawning period from immature and post-spawned females. However, it cannot provide maturity stage data for males, nor differentiate between males and immature females.

Tagging

The life history, morphology, behavior, and physiology of sturgeons present a plethora of challenges for tagging studies. Sturgeon are long-lived; so, for many studies it is essential that tags be retained for extended periods. In addition, they exhibit very rapid juvenile growth rates and, in the case of Atlantic sturgeon, can achieve very large sizes (> 3 m). Therefore, tags must be retained even as the tag placement area changes size and shape. Moreover, sturgeon are adept at rubbing off external tags and can actually extrude internal tags through the body wall to rid themselves of tags placed in the body cavity (Kynard and Kieffer 1994). Our collective experiences with a variety of tagging methods and materials, in addition to laboratory studies of tag retention, were drawn upon to provide the following recommendations for tagging.

External tags generally have lower retention rates than internal tags, but are often needed in studies that require participation of people other than the researcher (such as tag-recapture studies that rely on tag returns from fishermen). A variety of external tag designs and placement sites have been used on both Atlantic and shortnose sturgeon. The first laboratory studies of tag retention by shortnose sturgeon indicated that Carlin tags placed just below the dorsal fin and internal anchor tags inserted laterally into the abdomen had the highest retention rates of the tags tested (Smith et al. 1990). More than 50 shortnose sturgeon marked with Carlin tags in the Hudson River from 1979-80 were recovered in recent research, indicating that these tags can have long retention times. About half of the tag disks were clearly legible and provided valuable data on fish at large for over 15 years. However, Carlin tag retention in both the Connecticut River and Delaware River has been poor when compared to passive integrated transponding (PIT) and anchor tags, respectively. Anchor tags placed at the base of the dorsal fin in 1981-87 are now being recovered in the Delaware River over a decade later. Collins et al. (1994) tested a variety of external tag designs in the laboratory and found that a T-anchor tag inserted into the lateral abdominal wall provided the greatest retention. However, it was noted that healing of the insertion wound was slow (or did not occur) for all tags that protruded through the skin. While external tags clearly have lower retention than internal tags, anchor tags in the dorsal musculature show the most promise for greatest longevity with least impact to the fish.

A number of sturgeon studies use PIT tags in addition to an external tag. These tags are injected just below the skin along the dorsal mid-line anywhere from the posterior edge of the fourth dorsal scute to the posterior edge of the dorsal fin. Due to the lack of standardization in placement of PIT tags, we recommend that the entire dorsal surface of each fish be scanned with a waterproof PIT tag reader to insure detection of fish tagged in other studies. We note that juvenile Atlantic sturgeon may grow around the PIT tag, making it difficult to get close enough to read the tag in later years. For this reason, the largest (highest power) PIT tags should be used for both sturgeon species, and tags should be placed posterior to the dorsal fin, where tissue growth is least. PIT tags far out perform external tags. However, laboratory studies indicate that sturgeon smaller than 200 mm TL shed PIT tags at a rate of over 50%, due to the lack of musculature at this size. The likelihood of high PIT tag loss should therefore be considered when marking sub-yearling sturgeon.

A variety of methods have been used to outfit sturgeon with sonic or radio transmitters. Due to their large body size, sturgeon can carry large transmitters having extended battery life. Consequently, it is important that these tags be retained for as long as possible. External attachment of the transmitters is the least intrusive method; however, a number of field studies have indicated that both sonic and radio tags are shed at rates of 15 - 60% within the first 4 – 6 mo. of external attachment (Smith 1988, Moser and Ross 1993, Kieffer and Kynard 1993, Rogers and Weber 1995). In a tank study using cultured shortnose sturgeon, externally-attached transmitter loss began on day 2, and 100% were lost by day 60. It was obvious that the sturgeon actively rubbed the transmitters on any available surface.

In spite of the problems with tag loss, only external attachment of transmitters should be used for pre-spawning fish in spring or those on the spawning ground. In addition, surgical implants should not be attempted when water temperature exceeds 27°C (to reduce handling stress) or is less than 7°C (incisions do not heal rapidly in low temperatures). External transmitters are retained longest when they are as small as possible and are attached through the dorsal fin using monofilament line or stainless steel leader and a PVC backing plate (Rogers and Weber 1995). The addition of a neoprene pad between the fish's body and the transmitter or backing plate helps to protect the fish.

Internal implantation of radio or sonic transmitters provides greater retention than external attachment. Radio range is maximized with a trailing antenna, however, there is less chance of infection if the antenna is also implanted internally. In a recent tank study, radio transmitters were surgically implanted in cultured shortnose sturgeon, but the antennas were externally trailing. After 90 days, all of the fish had openings around the antenna exit area and were still bleeding or obviously infected. In some cases the antenna had cut large wounds through the abdominal wall and the transmitter and internal organs were visible. Field trials using this method of attachment indicated less significant impacts to wild shortnose sturgeon in the upper Connecticut River. Eight fish tagged internally with transmitters having a trailing radio antenna were recaptured after 12 months at large. While the tissue at the antenna exit area was darkened, there was no sign of infection or of abrasion to the fins on any of these fish (Kynard et al. 1999). We conclude that radio transmitter antennas should be internally implanted whenever possible to minimize injury to the fish. However, when it is absolutely necessary to obtain maximal signal range (aerial surveys, passage studies around dams, etc.), trailing antennas may be used with caution. This method should not be used when tagging a significant percentage of a given population.

Surgery to implant transmitters should only be attempted when fish are in excellent condition. Methods of Summerfelt and Smith (1990) should be used as general guidelines for sturgeon anesthesia using tricaine methane sulfonate (MS-222); however, the dose should be reduced to only that needed to immobilize the fish during surgery, if at all. Placing fish upside down in a cradle or trough during surgery is often sufficient to immobilize them. Also, sturgeon may be safely immobilized using galvanonarcosis (low voltage DC). The transmitters and internally implanted coiled antennas can be coated with an inert elastomer (Silastic MDX4.4210) to reduce tissue irritation and subsequent tag rejection. However, some transmitter coatings are quite inert and do not need this treatment, and some transmitter models coated with Silastic have been expelled by cultured shortnose sturgeon in tank studies. Also, transmitters with externally trailing antennas should not be coated to allow sturgeon tissue to adhere to the tag and hold it in place in the body cavity (Kynard et al. 1999).

The transmitter and all surgical instruments should be sterilized immediately prior to use. A lateral incision approximately 30 mm long should be made 40 - 60 mm anterior to the pelvic fin and about 10 - 20 mm above the ventral row of scutes (although the specific location will vary with fish size). This location reduces abrasion of the transmitter on the incision. However, lateral muscle tissue in large adults may be quite thick, so a ventral incision is recommended for them. The incision should be closed with either absorbable or non-absorbable suture material (absorbable material is superior for tying knots but there has been no documented differences in healing of wounds with either suture type) and a large cutting needle. Individual sutures should be closed with separate, double, square knots so that the muscle tissue firmly touches but is not drawn tightly. After surgery the fish should be released as soon as it recovers from the anesthesia.

Tissue sampling

Tissue sampling is required for genetic evaluation, studies of contaminant loading, assays of physiological condition, and ageing. A 1 cm^2 pelvic fin clip is recommended for genetic analysis. Muscle samples for contaminant analysis or energetic evaluation should be taken from the thickest dorsal musculature using a mammalian tissue punch. First, a v-shaped flap of skin should be peeled back using a sterilized scalpel. The punch is then used to cut a small core of tissue, which may be removed with cutting pliers. The flap of skin should then be replaced and two sutures used to close the wound. Blood samples may be taken from the ventral caudal peduncle. Egg samples may also be removed using a large gauge hypodermic needle (as used for PIT tag insertion). The needle is inserted through a small ventral incision in the abdomen and a small number of eggs drawn out, if the female has ovulated (i.e., eggs are loose in the abdomen). A gonad biopsy for histological analysis can be obtained from either sex at any point in the reproductive cycle by making a small incision and inserting an Eppendorfer biopsy punch. These techniques should not be used in systems having small populations and should be limited to only a few individuals.

The removal of pectoral fin rays for ageing studies is controversial. Concerns raised include potential impacts to fish swimming performance in high current velocity areas and the equivocal data that may be obtained from these structures. In tank tests, ray regeneration was rapid and sturgeon swimming performance was unaffected (Collins and Smith 1996). Continued study of the impacts of ray removal on sturgeon performance, validation of annuli, and investigations into alternative methods of ageing are sorely needed.

Gastric lavage

A safe and effective technique for flushing food items from the stomach of live sturgeons has recently been developed (Haley 1998). Due to the morphology of the gut tract and the physostomous swim bladder, gastric lavage of sturgeons was previously considered a risky procedure. Consequently, diet information was only available from fish that had been killed. The new lavage method requires the careful use of a flexible, small diameter tubing (intramedic polyethylene, 1.57-mm inner diameter and 2.08 mm outer diameter). The fish is lightly anesthetized using MS-222 and the tube is directed past the pneumatic duct and into the alimentary canal until it can be felt on the ventral surface of the fish. Water is slowly injected into the tubing to flush the stomach. After lavage the fish are allowed to recover and are immediately released. This method is not recommended when water temperature exceeds 27°C and extreme caution should be taken to avoid damage to the swim bladder, which can result in mortality.

Sampling Methodologies

Preferred sampling methods for sturgeon are dictated by the habitat where they occur, season of capture, and life stage. In general, large juvenile and adult sturgeon are efficiently captured in stationary or drifting gillnets or trammel nets (Buckley and Kynard 1985, Hoff et al. 1988, Dovel et al. 1992, Geoghegan 1992, Kieffer and Kynard 1993, Moser and Ross 1995, Collins et al. 1996). Trawl sampling is also an effective means of capturing sturgeon, but much of the time this gear is not feasible for use, due to the rapid current conditions and excessive amount of bottom structure in riverine or estuarine sturgeon habitat. Sturgeon are also susceptible to pound nets, but this gear has not been used for research purposes, other than to assess commercial capture rates. Similarly, sturgeon are occasionally captured on hook and line (usually baited trotlines or via snagging); however, this gear has not been employed for research sampling. Baited trotlines are a safe and effective method for capturing white sturgeon (*A. transmontanus*), and this method probably has potential for shortnose and Atlantic sturgeon research as well (Elliott and Beamesderfer 1990).

Very small juveniles (larvae and young-of-the-year) are rarely captured in traditional survey sampling. Young sturgeon seek cover in gravel crevices and amongst structure for about 9 d after hatching and then the larvae move downstream. Sturgeon eggs and/or larvae have successfully been collected in some rivers using D-shaped drift nets (Kynard et al. 1999), epibenthic sleds, and textured pads to which the eggs adhere. Recent studies have been conducted to confirm that light traps are not effective for capture of sturgeon larvae.

Electrofishing has not proven to be an effective method for capture of sturgeon in most systems because the fish tend to sink immediately upon being stunned. This is unfortunate, because many resource agencies conduct regular survey sampling with this gear. In very shallow areas with clear water it may be possible to retrieve stunned sturgeon from the bottom with a long handled dipnet. The more widespread use of sophisticated electrofishing equipment that allows control of amperage, voltage, and waveform may result in development of electrofishing methods that are specific to sturgeon (such as those for specific collection of catfish). Moreover, Aadland and Cook (1992) have developed an electric trawl for use in sampling benthic river fishes that may be very useful for collecting sturgeon. Studies to examine the efficacy of electrofishing gear should be undertaken using hatchery fish.

Gillnets and trammel nets

Both shortnose and Atlantic sturgeon are very susceptible to gillnets and trammel nets as adults or large juveniles. These gears (especially gillnets) are size selective and therefore should be used with caution when determining sturgeon size or age distributions. However, length frequencies from studies using gillnets having different mesh sizes indicate that there is considerable overlap between size distributions of sturgeon collected with different mesh sizes (Figure 1). Sub-yearling sturgeon (200 –300 mm FL) have been captured using 5 cm (2”) stretched mesh nets in the Hudson, Cape Fear, Edisto and Savannah rivers but in all cases the catch rates were low. This was probably due to low abundance of

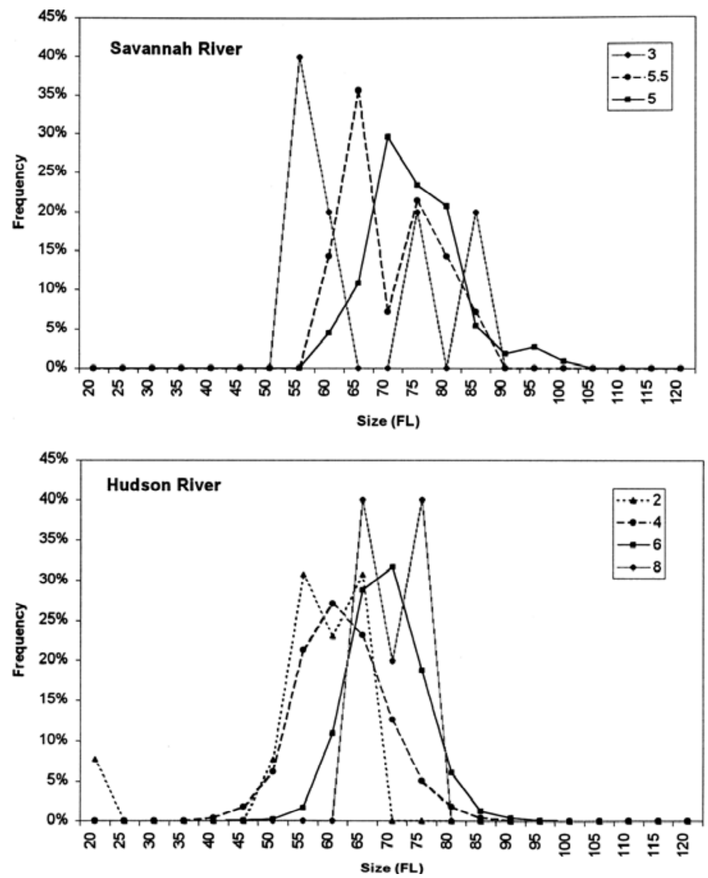
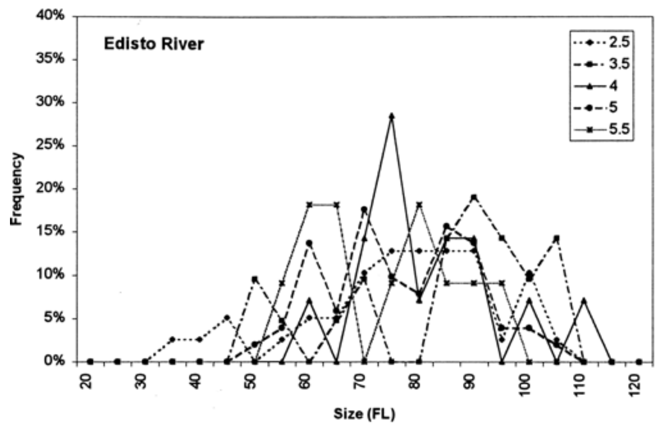
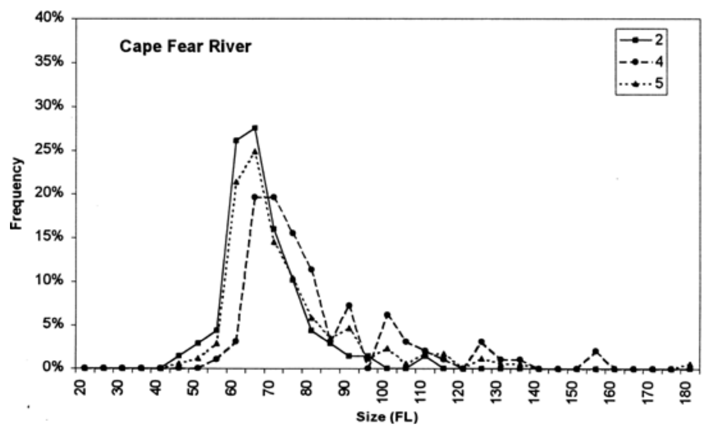


Figure 1. (Above and facing page) Size frequencies (in cm fork length) of shortnose and Atlantic sturgeon captured using various gillnet mesh sizes (in inches stretched mesh): 2 (5.1 cm), 2.5 (6.4 cm), 3 (7.6 cm), 3.5 (8.9 cm), 4 (10.2 cm), 5 (12.7 cm), 5.5 (14.0 cm), 6 (15.2 cm), and 8 (20.3 cm). Data from the Savannah River, S.C. and the Hudson River, N.Y. are for shortnose sturgeon captured in stationary gillnets. Data from the Edisto River, S.C. (J. McCord, S.C. Department of Natural Resources, unpubl. data) are for shortnose sturgeon caught in drifting gillnets. Data from the Cape Fear River, N.C. are for Atlantic sturgeon caught in stationary gillnets.

small size classes in these rivers, rather than gear selectivity. For post-yearlings, all mesh sizes greater than 6.4 cm (2.5") stretched mesh result in similar length frequencies (Figure 1). Trammel nets collect a wider size distribution than gillnets and are often less stressful than gillnets because the fish are frequently entangled rather than gilled.

Both monofilament and braided nylon mesh are effective for capture of sturgeon; however, twine size should be increased if large fish are targeted. Although fish are captured more effectively with light twine, sturgeon can easily break through webbing that is too light. Also, light twine is more likely to cut into the fish and cause injury. When targeting adults, heavy multifilament nylon (size 208 – 233) with 15 cm (6") stretched mesh can be used to reduce sturgeon injury.





Sturgeon are benthivores and generally are captured near the bottom unless they are actively migrating (McCleave et al. 1977, Moser and Ross 1995). Therefore stationary gillnets or trammel nets should be heavily weighted and allowed to contact the bottom. In low velocity areas, nets should be set perpendicular to the current. However, in areas of high velocity or having heavy debris loading, this is not feasible. In this case, nets should be set in back eddies, on the downstream side of islands, or parallel to the current in mid-channel (Buckley and Kynard 1985, Kieffer and Kynard 1993, Moser and Ross 1993, Kynard et al. 1999). In many southern rivers, trammel nets are set during slack tide periods only, to reduce stress on fish and debris loads.

Drifting gillnets can be used very effectively to capture sturgeon by drifting through relatively snag-free areas while dragging near or on the bottom (O'Herron and Able 1990, McCord 1998). Often this method results in lower debris loading because the nets drift along with the debris and do not intercept it. Generally, the short soak times and reduced pressure on driftnets also result in less injury to captured fish. This method can be used through upriver runs and pools without large entanglements by using very light leadline (just enough to take the net to the bottom). The net should be buoyed at the ends with large floats (8-15 L displacement) to facilitate operating the net and to avoid snags. In tidal areas, buoyancy should be reduced and the net dragged along the bottom wherever possible (McCord 1998).

Entanglement in gillnets or trammel nets can result in sturgeon mortalities (Kieffer and Kynard 1993, Moser and Ross 1993, Collins et al. 1996, Kynard et al. 1999). To reduce the risk of mortality, precautions should be taken to reduce stress to fish during netting. Gillnets and trammel net soak times should never exceed 2 hrs in water temperatures > 27°C. During lower water temperatures, soak times up to 24 h are acceptable, but soak times should be reduced as much as possible as temperature rises. Sturgeon should also not be exposed to air temperatures below 0°C for more than a few minutes. In these conditions, fish should be processed while held underwater to reduce the risk of freezing tissue. Every effort should be made to reduce stress during removal of fish from nets and net meshes should be cut to facilitate rapid removal of fish.

Trawls

Where conditions permit the use of trawls, this gear can be effective for the capture of sturgeon. Collins et al. (1996) found that 39% of all juvenile Atlantic sturgeon and 8% of the adult shortnose sturgeon tag returns from fish tagged in the Altamaha River, Georgia were from the commercial trawl fishery. Sampling of shortnose and Atlantic sturgeon was conducted in the tidal portion of the Hudson River from 1975 - 80 using a 6.4 m and 10.7 m semi-balloon otter trawl having mesh sizes of 1.3 – 6.5 cm (Dovel and Berggren 1983, Dovel et al. 1992). Fish >200-mm total length were regularly caught, with most fish around 500 mm. These trawls were fished for variable lengths of time (up to 50 min) at tow speeds of 4-km h^{-1} (2.2 knots). The Hudson River Utilities Monitoring Program has also conducted a standardized trawling survey since 1985 using a 3 m beam trawl with 1.3 - 3.8 cm mesh. This gear is towed for 5 min against the current and adult shortnose sturgeon (500 - 1000 mm fork length) are caught regularly. This sampling indicates that even a small trawl effectively captures sturgeon.

Drift nets

D-shaped or rectangular drift nets have been used effectively to catch shortnose sturgeon eggs and larvae in both northern (Kynard et al. 1999) and southern (Smith et al. 1993) rivers. Mesh sizes of 2 mm^2 trap sturgeon eggs and larvae while letting some debris pass through. The net is attached to a weighted and floated, 1 m diameter steel ring that has been flattened to maximize contact with the substrate (D-shaped, Kynard et al. 1999). A 1m square or 2 m 1m Neuston net can also be used. The net is attached to a Danforth or grapnel-type anchor via a short bridle. This arrangement allows the net to stand upright in currents of up to 1.0 m s^{-1}. Depending on the current velocity and amount of debris accumulation, such gear should be fished for 10 min – 1 h in areas of suspected spawning. A flow meter should be positioned in the mouth of the net to allow calculation of egg or larval densities per volume of water sieved. Such studies are best conducted with the aid of telemetry data from pre-spawning adults to identify likely spawning locations (Collins and Smith 1993, Kynard et al. 1999). Little to no mortality occurs with this gear type if the samples are processed in the field . The D-shaped nets have been used to capture eggs of Chinese sturgeon in the Yangtze River for four years. Tens of thousands of eggs have been captured when the nets have been set in areas occupied by telemetered fish. These eggs are reared to juvenile stages and released into the river (Wei and Kynard 1996). Egg samples can also be collected using artificial substrates to which they adhere (anchored buffer pads, Moser et al. 1998).

Minimum Sampling Required to Confirm Presence of Shortnose Sturgeon

Guidelines for minimum sampling necessary to confirm that shortnose sturgeon still exist in a system are desperately needed for management of this species. Shortnose sturgeon are no longer extant in many rivers where they historically occurred (Dadswell et al. 1984). However, the Shortnose Sturgeon Recovery Plan (NMFS 1998) stipulates that restoration efforts (stocking of cultured fish) should not be undertaken until it is confirmed that wild fish have been extirpated. In addition, sampling for the presence of shortnose sturgeon is often required when activities that jeopardize the existence of this fish are proposed in an area where their status is unknown. Consequently, the National Marine Fisheries Service and other regulatory agencies require guidelines for sampling efforts that are adequate to address such questions.

Unfortunately, it is impossible to absolutely confirm that shortnose sturgeon no longer exist in a given system due to their life history and problems associated with sampling them. Shortnose sturgeon are long-lived (over 30 yrs) and do not spawn every year (Dadswell et al. 1984). Therefore, sampling over multiple years is needed to insure that a strong year class has not been missed. Moreover, sturgeon are rarely captured using traditional survey sampling, so specialized sampling methods in specific habitats are needed, particularly in systems where sturgeon are very rare. Even studies specifically designed to capture sturgeon can only confirm their presence, as negative data does not necessarily indicate that the fish are extirpated. However, given adequate sampling, an acceptable degree of confidence that the fish are extirpated (or functionally extirpated) can be gained. Based on the types and amounts of effort conducted in other systems to date, we developed the following sampling guidelines as the best available approach to assessing shortnose sturgeon presence in areas where they historically occurred.

Research Survey

The first step in any system is to conduct a literature survey and to contact people who currently or historically fished in the area using gear that captures sturgeon. Often museum records, archeological remains (scutes in middens), or patterns in historical collections can provide vital clues to appropriate areas and times to sample for shortnose sturgeon. Personal contact with local fishers is also essential. They can provide detailed information on exact sampling locations that were historically productive, tricks to effective use of gear, and observations on the timing of sturgeon movements. In addition, people currently fishing in the system may have recently captured shortnose sturgeon as bycatch and be willing to provide anecdotal information on these captures or actual specimens (Collins and Smith 1993, Moser and Ross 1993, Collins et al. 1996, Moser et al. 1998). The U.S. Fish and Wildlife Service has successfully obtained shortnose sturgeon specimens by offering monetary rewards for live fish in Chesapeake Bay (J. Skejeveland, Maryland Fisheries Resources, personal communication). While this technique may put more fish at risk or result in targeted fishing for sturgeon, the ability to enlist the help of commercial fishers greatly increases the chances of documenting the presence of fish in areas where they are thought to be extirpated.

Finally, prior to any fieldwork, literature from neighboring systems should be reviewed. Patterns of sturgeon habitat use and movements are similar over small spatial scales (Dadswell et al. 1984). By mapping suspected aggregation areas (spawning grounds, wintering areas, summering sites) from adjoining systems, sites to sample in the study area can be more accurately identified. Any available maps of water quality or bottom substrate in the study area should be collected to help identify likely spawning sites and aggregation areas.

Patterns of habitat use and movements of shortnose sturgeon vary latitudinally. Therefore, our recommendations for minimum sampling are divided into two main groups: 1) northern rivers where < 7°C water temperature regularly occurs in winter and temperatures occasionally reach >27°C in summer (Chesapeake drainages north), and 2) southern rivers where >27°C occurs regularly in summer and temperatures seldom drop below 7°C in winter (south of Chesapeake drainages).

Minimum Sampling Requirements in Northern Rivers

Northern rivers having sturgeon habitat can be subdivided into two groups: northerly (systems in Maine and Canada), and north central (Chesapeake drainages to Massachusetts). It is necessary to subdivide the northern region because sturgeon in the most northerly rivers exhibit a greater degree of anadromy, venturing into high salinity regions. Shortnose sturgeon in north central rivers spend more time in freshwater and make only short forays into relatively low salinity areas to feed (Dadswell et al. 1984, Kynard 1997).

Sampling in northerly rivers (Maine and Canada) should be conducted for a minimum of two years. Attempts should first be made to capture pre-spawning adult shortnose sturgeon at the base of the first dam or falls that they would encounter. This sampling should be conducted weekly for 8 - 10 weeks during early spring when water temperatures range from 8 – 18ºC. Four to six, 100 m, 15.2 cm (6") stretched mesh, stationary sinking gillnets should be set as recommended in the sampling protocol for at least two days each week and checked at least every 24 h (minimum sampling effort = 128, 100 m net days). In the event that no fish are captured in the first spring, sampling should be conducted in the estuary (1 – 12 ppt) along marsh edges and in tidal creeks that summer and the following summer. This sampling should occur weekly with four to six, 100 m, 15.2 cm (6") stretched mesh sinking gillnets (2 - 3 day/week) in June – August (8 - 10 weeks) when water temperatures range from 20 – 25°C (minimum sampling effort = 128, 100 m net days). Telemetry studies are recommended so that any fish captured in the estuary can be tracked to their river of origin.

Sampling in north central rivers (Chesapeake drainages to Merrimack River) should initially concentrate on capture of pre-spawning adults with gillnets at the base of the first dam or falls (protocol as described for northerly rivers) for two years (minimum sampling effort = 128, 100 m net days). If no fish are collected in the first spring, sampling efforts should be directed to likely aggregation areas that summer. Areas targeted should be between the saltwater/freshwater interface and the first dam or falls. Habitats sampled should include the deepest part of the water body in every curve and around each island (Kynard et al. in press). Sampling should continue weekly through two summers (June – October) using four to six, 100 m, 15.2 cm (6") stretched mesh sinking gillnets set for at least 3 days each week (soak times should be 24 h unless water temperature exceeds 27°C, see previous section on gillnet methodology).

Minimum Sampling Requirements in Southern Rivers

Adult and juvenile shortnose sturgeon in southern rivers aggregate in deep areas near the saltwater/freshwater interface in summer (Hall et al. 1990, Weber 1996, Moser and Ross 1995, Collins et al. in press). Sampling for shortnose sturgeon should initially be focused in these summer aggregation areas, but extreme caution must be exercised to avoid killing any fish captured during high water temperatures. Sampling should begin in summer when temperature exceeds 27°C (July in most southern rivers) and continue until the temperature drops below 27°C (October in most southern rivers).

Three sinking gillnets of 13 –14 cm stretched mesh (5 – 5.5 in) or trammel nets with 5 – 8 cm (2 – 3 in) stretched mesh inner panels and 35 cm (14 in) stretched mesh outer panels should be set as specified in this sampling protocol. Nets should be 100 m long, or else shorter nets with the equivalent combined length of 300 m should be used (e.g., six, 50 m nets). All nets should be set for 2 h during the slack tide (neap tides are preferred) in the deepest part of the water body near the upper extent of the salt wedge (0 - 3 ppt) or up to 2 km above the saltwater-freshwater interface. In deltaic systems there may be more than one area that fits this definition. In this case all candidate sites should be sampled in random order during the summer. Sampling should be conducted 3 times per week for 8 - 10 weeks (minimum sampling effort = 288 net hours).

If no shortnose sturgeon are collected in the first summer of sampling at the saltwater/freshwater interface, sampling for pre-spawning adults should be initiated at the base of the first dam or falls in January – April. Some rivers on the coastal plain do not present such obstacles to migration and possible aggregation areas are unknown. In such cases, likely spawning habitats based on research in other southern rivers (as identified in Hall et al. 1993) should be identified and sampled. Three, 100 m sinking gillnets of 13 –14 cm stretched mesh (5 – 5.5 cm) or 100 m trammel nets with 5 – 8 cm (2 – 3") stretched mesh inner panels and 35 cm (14") stretched mesh outer panels should be set bi-weekly as specified in the sampling protocol. In many upriver areas it may be necessary to use shorter nets, in which case their total length should equal 100 m. Sampling should be conducted for at least 8 weeks in two years, with three days of effort per week (24 h sets) from January until the water temperature exceeds 18°C (minimum sampling effort = 144, 100 m net days).

Conclusion

Sampling and handling procedures for Atlantic coast sturgeons have evolved over the past 30 years and differ among systems and sampling situations. Minimum sampling requirements also vary across systems. While we have addressed latitudinal differences in developing sampling guidelines, inter-system differences in sturgeon abundance can also affect minimum sampling requirements. The amount of effort required to document sturgeon presence is negatively correlated with sturgeon abundance (Figure 2). Therefore, we have attempted to provide conservative estimates of effort required so that sturgeon presence may be detected in systems where these fish are rare.

The minimum sampling protocols will certainly be affected by the availability of reliable anecdotal/historical information on sturgeon occurrence. With this information, sampling can be directed to specific sites within the protocol framework. We emphasize that obtaining this information is critically important. Sturgeon fishing has become an activity of the past, and sturgeon fishers are aging. When they die, a wealth of information about historical occurrences of sturgeon, movement patterns, and capture methods will be lost.

New sampling and handling methodologies may be developed on the basis of information from fishers or via research innovations and experimentation. We reiterate that this protocol is to serve as a current set of guidelines for use with Atlantic Coast sturgeons, and should in no way restrict testing of new techniques. However, we recommend that cultured sturgeon be used first when testing new and potentially harmful methods.

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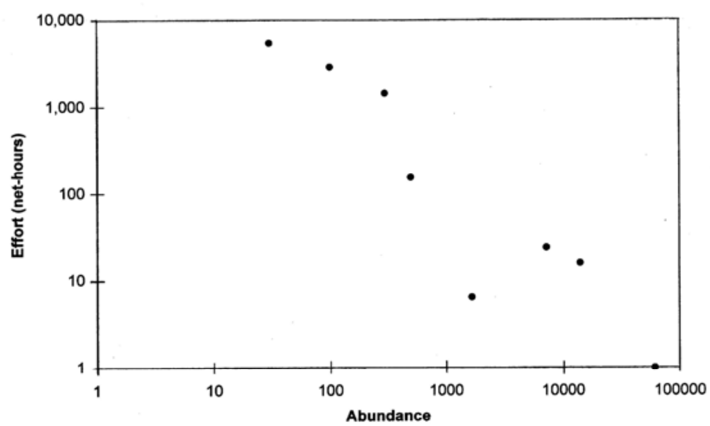

Figure 2. Effort expended (100 m gillnet set for 1 hour) to capture the first shortnose sturgeon in each of eight different systems vs. estimated shortnose sturgeon abundance in each system.

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National Marine Fisheries Service
Recommendations for the Contents of
Biological Assessments and Biological Evaluations
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When preparing a Biological Assessment (BA) or Biological Evaluation (BE), keep in mind that the people who read or review this document may not be familiar with the project area or what is proposed by the project. Therefore your BA or BE should present a clear line of reasoning that explains the proposed project and how you determined the effects of the project on each threatened or endangered species, or critical habitat, in the project area. Try to avoid technical jargon not readily understandable to people outside your agency or area of expertise. Remember, this is a **public document**. Some things to consider and, if appropriate, to include in your BA or BE, follow.

1. What is the difference between a Biological Evaluation and a Biological Assessment?

By regulation, a Biological Assessment is prepared for "major construction activities" — defined as "a construction project (or other undertaking having similar physical effects) which is a major Federal action significantly affecting the quality of the human environment (as referred to in the National Environmental Policy Act of 1969 (NEPA) [(42 U.S.C. 4332(2)(C)])." A BA is required if listed species or critical habitat may be present in the action area. A BA also may be recommended for other activities to ensure the agency's early involvement and increase the chances for resolution during informal consultation. Recommended contents for a BA are described in 50 CFR 402.12(f).

Biological Evaluation is a generic term for all other types of analyses in support of consultations. Although agencies are not required to prepare a Biological Assessment for non-major construction activities, **if a listed species or critical habitat is likely to be affected, the agency must provide the Service with an evaluation on the likely effects of the action.** Often this information is referred to as a BE. The Service uses this documentation along with any other available information to decide if concurrence with the agency's determination is warranted. Recommended contents are the same as for a BA, as referenced above.

The BAs and BEs should not be confused with Environmental Assessments (EA) or Environmental Impact Statements (EIS) which may be required for NEPA projects. These EAs and EISs are designed to provide an analysis of multiple possible alternative actions on a variety of environmental, cultural, and social resources, and often use different definitions or standards. However, if an EA or EIS contains the information otherwise found in a BE or BA regarding the project and the potential impacts to listed species, it may be submitted in lieu of a BE or BA.

2. What are you proposing to do?

Describe the project. A project description will vary, depending on the complexity of the project. For example, describing the construction or removal of a fixed aid-to-navigation in the Intracoastal Waterway, or the abandonment/dismantling of an oil-producing-platform may be relatively simple, but describing a the extent and amplitude of potential impacts of military training exercises involving different military assets, combinations of weaponry, locations, and seasons would necessarily be more detailed and complex. Include figures and tables if they will help others understand your proposed action and its relationship with the species' habitat.

How are you (or the project proponent) planning on carrying out the project? What tools or methods may be used? How will the site be accessed? When will the project begin, and how long will it last?

Describe the "action area" (all areas to be affected directly or indirectly by the Federal action and not merely the immediate areas involved in the action [50 CFR 402.02]). Always include a map (topographic maps are particularly helpful). Provide photographs including aerials, if available. Describe the project area (i.e., topography, vegetation, condition/trend).

Describe current management or activities relevant to the project area. How will your project change the area?

Supporting documents are very helpful. If you have a blasting plan, best management practices document, sawfish/sea turtle/sturgeon conservation construction guidelines, research proposal, NEPA or other planning document or any other documents regarding the project, attach them to the BA or BE.

3. What threatened or endangered species, or critical habitat, may occur in the project area?

A request for a species list may be submitted to the Service, or the Federal action agency or its designated representative may develop the list. If you have information to develop your own lists, the Service should be contacted periodically to ensure that changes in species' status or additions/deletions to the list are included. Sources of biological information on federally-protected sea turtles, sturgeon, Gulf sturgeon (and Gulf sturgeon critical habitat), and other listed species and candidate species can be found at the following website addresses: NMFS Southeast Regional Office, Protected Resources Division (http://sero.nmfs.noaa.gov/pr/protres.htm); NMFS Office of Protected Resources (http://www.nmfs.noaa.gov/pr/species); U.S. Fish and Wildlife Service (http://noflorida.fws.gov/SeaTurtles/seaturtle-info.htm); http://www.nmfs.noaa.gov/pr/; http://www.sad.usace.army.mil/protected%20resources/turtles.htm; http://endangered.fws.gov/wildlife.html#Species; the Ocean Conservancy (http://www.cmc-ocean.org/main.php3); the Caribbean Conservation Corporation (http://www.cccturtle.org/); Florida Fish and Wildlife Conservation Commission (http://floridaconservation.org/psm/turtles/turtle.htm); http://www.turtles.org; http://www/seaturtle.org; http://alabama.fws.gov/gs/; http://obis.env.duke.edu/data/sp_profiles.php; www.mote.org/~colins/Sawfish/SawfishHomePage.html; www.floridasawfish.com; http://www.flmnh.ufl.edu/fish/Sharks/sawfish/srt/srt.htm; www.flmnh.ufl.edu/fish/sharks/InNews/sawprop.htm; also, from members of the public or academic community, and from books and various informational booklets. Due to budget constraints and staff shortages, we are only able to provide general, state-wide, or country-wide (territory-wide) species lists.

Use your familiarity with the project area when you develop your species lists. Sometimes a species may occur in the larger regional area near your project, but the habitat necessary to support the species is not in the project area (including areas that may be beyond the immediate project boundaries, but within the area of influence of the project. If, for example, you know that the specific habitat type used by a species does not occur in the project area, it does not need to appear on the species list for the project. However, documentation of your reasoning is helpful for Service biologists or anyone else that may review the document.

4. Have you surveyed for species that are known to occur or have potential habitat in the proposed project area?

The "not known to occur here" approach is a common flaw in many BA/BEs. The operative word here is "known." Unless adequate surveys have been conducted or adequate information sources have been referenced, this statement is difficult to interpret. It begs the questions "Have you looked?" and "How have you looked?" Always reference your information sources.

Include a clear description of your survey methods so the reader can have confidence in your results. Answer such questions as:

How intensive was the survey? Did you look for suitable habitat or did you look for individuals? Did the survey cover the entire project area or only part of it? Include maps of areas surveyed if appropriate.

Who did the surveys and when? Was the survey done during the time of year/day when the plant is growing or when the animal can be found (its active period)? Did the survey follow accepted protocols?

If you are not sure how to do a good survey for the species, the Service recommends contacting species experts. Specialized training is required before you can obtain a permit to survey for some species.

Remember that your evaluation of potential impacts from a project does not end if the species is/are not found in the project area. You must still evaluate what effects would be expected to the habitat, even if it is not known to be occupied, because impacts to habitat that may result indirectly in death or injury to individuals of listed species would constitute "take".

5. Provide background information on the threatened or endangered species in the project area.

Describe the species in terms of overall range and population status. How many populations are known? How many occur in the project area? What part of the population will be affected by this project? Will the population's viability be affected? What is the current habitat condition and population size and status? Describe related items of past management for the species, such as stocking programs, habitat improvements, or loss of habitat or individuals caused by previous projects.

6. How will the project affect the threatened or endangered species or critical habitat that occur in the project area?

If you believe the project will not affect the species, explain why. Effects analyses must include evaluating whether adverse impacts to species' habitats, whether designated or not, could indirectly harm or kill listed species.

If you think the project may affect the species, explain what the effects might be. The Endangered Species Act requires you consider all effects when determining if an action funded, permitted, or carried out by a Federal agency may affect listed species. Effects you must consider include direct, indirect, and cumulative effects. Effects include those caused by interrelated and interdependent actions, not just the proposed action. Direct effects are those caused by the action and occur at the same time and place as the action. Indirect effects are caused by the action and are later in time but are reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no significant independent utility apart from the action under consideration. Interrelated or interdependent actions can include actions under the jurisdiction of other federal agencies, state agencies, or private parties. Cumulative effects are those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal actions subject to consultation.

Describe measures that have or will be taken to avoid or eliminate adverse effects or enhance beneficial effects to the species. Refer to conversations you had with species experts to achieve these results.

Consider recovery potential if the project area contains historic range for a species.

Evaluate impacts to designated critical habitat areas by reviewing any project effects to the physical or biological features essential to the conservation of the species.

7. What is your decision? The Federal action agency must make a determination of effect.

Quite frequently, effect determinations are not necessarily *wrong;* they simply are not justified in the assessment. The assessment should lead the reviewer through a discussion of effects to a logical, well-supported conclusion. Do not assume that the Service biologist is familiar with the project and/or its location and that there is no need to fully explain the impact the project may have on listed species. If there is little or no connection or rationale provided to lead the reader from the project description to the effect determination, we cannot assume conditions that are not presented in the assessment. Decisions must be justified biologically. The responsibility for making and supporting the determination of effect falls on the Federal action agency; however, the Service cannot merely "rubber stamp" the action agency's determination and may ask the agency to revisit its decision or provide more data if the conclusion is not adequately supported by biological information.

You have three choices for each listed species or area of critical habitat:

1. "No effect" is the appropriate conclusion when a listed species will not be affected, either because the species will not be present or because the project does not have any elements with the potential to affect the species. "No effect" does not include a *small* effect or an effect that is *unlikely* to occur: if effects are insignificant (in size) or discountable (extremely unlikely), a "may affect, but not likely to adversely affect" determination is appropriate. A "no effect" determination does **not** require written concurrence from the Service and ends ESA consultation requirements unless the project is subsequently modified in such manner that effects may ensue.

2. "May affect - is not likely to adversely affect" (NLAA) means that all effects are either beneficial, insignificant, or discountable. Beneficial effects have concurrent positive effects without any adverse effects to the species or habitat (i.e., there cannot be "balancing," wherein the benefits of the project would be expected to outweigh the adverse effects - see #3 below). Insignificant effects relate to the magnitude or extent of the impact (i.e., they must be small and would not rise to the level of a take of a species). Discountable effects are those extremely unlikely to occur. Based on best judgment, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur. A "NLAA" determination by the action agency requires **written** concurrence from the Service.

3. "May affect - is likely to adversely affect" means that all adverse effects cannot be avoided. A combination of beneficial and adverse effects is still "likely to adversely affect," even if the net effect is neutral or positive. Adverse effects do not qualify as discountable simply because we are not certain they will occur. The probability of occurrence must be extremely small to achieve discountability. Likewise, adverse effects do not meet the definition of insignificant because they are less than major. If the adverse effect can be detected in any way or if it can be meaningfully articulated in a discussion of the results, then it is not insignificant, it is likely to adversely affect. This requires formal consultation with the Service.

A fourth finding is possible for proposed species or proposed critical habitat:

4. "Is likely to jeopardize/destroy or adversely modify proposed species/critical habitat" is the appropriate conclusion when the action agency identifies situations in which the proposed action is likely to jeopardize a species proposed for listing, or destroy or adversely modify critical habitat proposed for designation. If this conclusion is reached, conference is required.

List the species experts you contacted when preparing the BE or BA but avoid statements that place the responsibility for the decision of "may affect" or "no effect" on the shoulders of the species experts. Remember, this decision is made by the Federal action agency.

Provide supporting documentation, especially any agency reports or data that may not be available to the Service. Include a list of literature cited.

Originally prepared: January 1997
U.S. Fish and Wildlife Service
Arizona Ecological Services Field Office

Revised: January 2006
National Marine Fisheries Service
Protected Resources Division
263 13th Avenue South
St. Petersburg, FL 33701
(727) 824-5312

OUTLINE EXAMPLE FOR A BIOLOGICAL ASSESSMENT OR BIOLOGICAL EVALUATION

Cover Letter - **VERY IMPORTANT** - Include purpose of consultation, project title, and consultation number (if available). A determination needs to be made for each species and for each area of critical habitat. You have three options: 1) a "no effect" determination; 2) request concurrence with an "is not likely to adversely affect" determination; 3) make a "may affect, is likely to adversely affect" determination, and request "formal" consultation. If proposed species or critical habitat are included, state whether the project is likely to result in jeopardy to proposed species, or the destruction or adverse modification of proposed critical habitat. If the critical habitat is divided into units, specify which critical habitat unit(s) will be affected.

Attached to Cover Letter: Biological Assessment or Biological Evaluation document, broken down as follows:

Title: e.g., BA (or BE) for "Project X"; date prepared, and by whom.

A. Project Description - Describe the proposed action and the action area. Be specific and quantify whenever possible.

For Each Species:

1. Description of affected environment (quantify whenever possible)
2. Description of species biology
3. Describe current conditions for each species
    a. Range-wide
    b. In the project area
    c. Cumulative effects of State and private actions in the project area
    d. Other consultations of the Federal action agency in the area to date
4. Describe critical habitat (if applicable)
5. Fully describe effects of proposed action on each species and/or critical habitat, and species' response to the proposed action.
    a. Direct effects
    b. Indirect effects
    c. Interrelated and interdependent actions
    d. Potential incidental take resulting from project activities

Factors to be considered/included/discussed when analyzing the effects of the proposed action on each species and/or critical habitat include: 1) Proximity of the action to the species, management units, or designated critical habitat units; 2) geographic area(s) where the disturbance/action occurs); timing (relationship to sensitive periods of a species' lifecycle; 3) duration (the effects of a proposed action on listed species or critical habitat depend largely on the duration of its effects); 4) disturbance frequency (the mean number of events per unit of time affects a species differently depending on its recovery rate); 5) disturbance intensity (the effect of the disturbance on a population or species as a function of the population or species' state after the disturbance); 6) disturbance severity (the effect of a disturbance on a population or species or habitat as a function of recovery rate – i.e., how long will it take to recover)

6. Conservation Measures (protective measures to avoid or minimize effects for each species)
7. Conclusions (effects determination for each species and critical habitat)
8. Literature Cited
9. Lists of Contacts Made/Preparers
10. Maps/Photographs

Guidance on Preparing an Initiation Package for Endangered Species Consultation

This document is intended to provide general guidance on the type and detail of information that should be provided to initiate consultation with U.S. Fish and Wildlife Service (USFWS) and/or National Marine Fisheries Service (NMFS). This is not intended to be an exhaustive document as specific projects may require more or less information in order to initiate consultation. Also, note that this contains guidance on the information required to initiate formal consultation procedures with USFWS and/or NMFS. Additional information needs may be identified during consultation. Texts in italics below are examples. Normal text is guidance. A glossary of terms is appended.

INTRODUCTION

Here is an example of introductory language:

The purpose of this initiation package is to review the proposed [project name] in sufficient detail to determine to what extent the proposed action may affect any of the threatened, endangered, proposed species and designated or proposed critical habitats listed below. In addition, the following information is provided to comply with statutory requirements to use the best scientific and commercial information available when assessing the risks posed to listed and/or proposed species and designated and/or proposed critical habitat by proposed federal actions. This initiation package is prepared in accordance with legal requirements set forth under regulations implementing Section 7 of the Endangered Species Act (50 CFR 402; 16 U.S.C. 1536 (c)).

Threatened, Endangered, Proposed Threatened or Proposed Endangered Species

Example language:

The following listed and proposed species may be affected by the proposed action:

common name (Scientific name) ***T***

common name (Scientific name) ***E***

common name (Scientific name) ***PT***

common name (Scientific name) ***PE***

This list should include all of the species from the species lists you obtained from USFWS and NMFS. If it doesn't, include a brief explanation here and a more detailed explanation in your record to help USFWS, NMFS and future staff understand your thought process for excluding a species from consideration.

Critical Habitat

Example language:

The action addressed within this document falls within Critical Habitat for [identify species].

CONSULTATION TO DATE

"Consultation" under the ESA consists of discussions between the action agency, the applicant (if any), and USFWS and/or NMFS. It is the sharing of information about the proposed action and related actions, the species and environments affected, and means of achieving project purposes while conserving the species and their habitats. Under the ESA, consultation can be either informal or formal. Both processes are similar, but informal consultation may result in formal consultation if there is a likelihood of unavoidable take. Formal consultation has statutory timeframes and other requirements (such as the submission of the information in this package and a written biological opinion by USFWS or NMFS).

Summarize any consultation that has occurred thus far. Identify when consultation was requested (if not concurrent with this document). Be sure to summarize meetings, site visits and correspondence that were important to the decision-making process.

DESCRIPTION OF THE PROPOSED ACTION

The purpose of this section is to provide a clear and concise description of the proposed activity and any interrelated or interdependent actions.

The following information is necessary for the consultation process on an action:

1. The action agency proposing the action.

2. The authority(ies) the action agency will use to undertake, approve, or fund the action.

3. The applicant, if any.

4. The action to be authorized, funded, or carried out.

5. The location of the action.

5. When the action will occur, and how long it will last.

6. How the action will be carried out

7. The purpose of the action.

8. Any interrelated or interdependent actions, or that none exist to the best of your knowledge.

Describe and specify: WHO is going to do the action and under what authority, include the name and office of the action agency and the name and address of the applicant; WHAT the project or action is; WHERE the project is (refer to attached maps); WHEN the action is going to take place, including time line and implementation schedules; HOW the action will be accomplished, including the various activities that comprise the whole action, the methods, and the types of equipment used; WHY the action is proposed, including its purpose and need; and WHAT OTHER interrelated and interdependent actions are known. This combination of actions are what is being consulted on for the 7(a)(2) analysis.

Include a clear description of all conservation measures and project mitigation such as avoidance measures, seasonal restrictions, compensation, restoration/creation (on-site and in-kind, off-site and in-kind, on-site and out-of-kind, off-site and out-of-kind), and use of mitigation or conservation banks.

Here are some examples of commonly overlooked items to include in your project description:

Type of project

Project location

Project footprint

Avoidance areas

Start and end times

Construction access

Staging/laydown areas

Construction equipment and techniques

Habitat status on site

Habitat between work areas and endangered species locations

Permanent vs. temporary impacts

Surrounding land-use

Hydrology and drainage patterns

Duration of "temporary" impacts

Prevailing winds and expected seasonal shifts

Restoration areas

Conservation measures

Compensation and set-asides

Bank ratios and amounts

Mitigation: what kind and who is responsible?

Dust, erosion, and sedimentation controls

Whether the project is growth-inducing or facilitates growth

Whether the project is part of a larger project or plan

What permits will need to be obtained

Action Area

Describe all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action. This includes any interrelated and interdependent actions. Remember that the action area is not based simply on the Federal action and should not be limited to the location of the Federal action. The same applies to the applicant's action. The action area is defined by measurable or detectable changes in land, air and water, or to other measurable factors that may elicit a response in the species or critical habitat.

To determine the action area, we recommend that you first break the action down into its components (*e.g.,* vegetation clearing, construction of cofferdams, storage areas, borrow areas, operations, maintenance, etc.,) to assess the potential impacts resulting from each component.

Determine the impacts that are expected to result from each component. For example, instream actions may mobilize sediments that travel downstream as increased turbidity and then settle out as sediments on the stream substrate. Sound levels from machinery may be detectable hundreds of feet, thousands of feet, or even miles away. Use these distances when delineating the extent of your action area. Note: don't forget to subsequently reconstruct the action to assess the combined stressors of the components. You may find that some stressors are synergistically minimized or avoided, whereas other stressors may increase.

Finally, describe the action area, including features and habitat types. Include photographs and an area map as well as a vicinity map. The vicinity map for terrestrial projects should be at a 1:24,000 scale with the USGS quad name included.

SPECIES ACCOUNTS AND STATUS OF THE SPECIES IN THE ACTION AREA

Provide local information on affected individuals and populations, such as presence, numbers, life history, etc. Identify which threats to the species' persistence identified at the time of listing are likely to be present in the action area. Identify any additional threats that are likely to be present in the action area.

If the species has a distribution that is constrained by limiting factors, identify where in the action area factors are present that could support the species and where they are absent or limiting. For example, if a species is limited to a narrow thermal range and a narrow humidity range, show where in the action area the temperatures are sufficient to support the species, where the humidity is sufficient to support the species, and where those areas overlap.

Include aspects of the species' biology that relate to the impact of the action, such as sensitivity to or tolerance of: noise, light, heat, cold, inundation, smoke, sediments, dust, etc. For example, if the species is sensitive to loud sounds or vibration, and your project involves loud tools or equipment, reference that aspect of their biology. Include citations for all sources of information

Describe habitat use in terms of breeding, feeding, and sheltering. Describe habitat condition and habitat designations such as: critical habitat (provide unit name or number, if applicable), essential habitat, important habitat, recovery area, recovery unit (provide unit name or number, if applicable). Also discuss habitat use patterns, including seasonal use and migration (if relevant), and identify habitat needs.

Identify and quantify the listed-species habitat remaining in the action area. GIS layers are useful here, as are land ownership patterns--especially local land trusts and open space designations.

Identify any recovery plan implementation that is occurring in the action area, especially priority one action items from recovery plans.

Include survey information. For all monitoring and survey reports, please clearly identify how it was done, when, where, and by whom. If survey protocols were followed, reference the name and date of the protocol. If survey protocols were modified, provide an explanation of how the surveying occurred and the reasoning for modifying the protocol.

Keep it relevant. It is unnecessary to discuss biology that is totally unrelated to project impacts--*e.g.*, discussion of pelage color, teat number, and number of digits fore and aft when the project is a seasonal wetland establishment.

Utilize the best scientific and commercial information available. Use and cite recent publications/journal articles/agency data and technical reports. Include local information, relative to the action area, views of recognized experts, results from recent studies, and information on life history, population dynamics, trends and distribution. Reference field notes, unpublished data, research in progress, etc.

Things to consider:

Existing threats to species

Fragmentation

Urban growth area

Drainage patterns

Information on local sightings and populations

Population trends

Home range and dispersal

Sensitivity of endangered species to: dust, noise, head, desiccation, etc.

Trap stress/mortality

Predators

ENVIRONMENTAL BASELINE AND CUMULATIVE EFFECTS

Provide information on past, present and future state, local, private, or tribal activities in the action area: specifically, the positive or negative impacts those activities have had on the species or habitat in the area in terms of abundance, reproduction, distribution, diversity, and habitat quality or function. Include the impacts of past and present federal actions as well. Don't forget to describe the impacts of past existence and operation of the action under consultation (for continuing actions).

Cumulative effects include the effects of future State, Tribal, local or private actions that are reasonably certain to occur in the action area. Future Federal actions that are unrelated (*i.e.,* not interrelated or interdependent) to the proposed action are not considered in this analysis because they will be subject to separate consultation pursuant to section 7 of the Act. (Note: Cumulative effects under ESA are ***not*** the same as the definition under NEPA. Be careful not to mix them up.) Describe the impacts of these cumulative effects in terms of abundance, reproduction, distribution, diversity, and habitat quality or function.

Present all known and relative effects to population, *e.g.,* fish stocking, fishing, hunting, other recreation, illegal collecting, private wells, development, grazing, local trust programs, etc. Include impacts to the listed and proposed species in the area that you know are occurring and that are unrelated to your action-- *e.g.,* road kills from off-road vehicle use, poaching, trespass, etc.

EFFECTS OF THE ACTION

The purpose of this section is to document your analysis of the potential impacts the proposed action will have on species and/or critical habitats. This analysis has two possible conclusions for listed species and designated critical habitat:

(1) May Affect, Not Likely to Adversely Affect – the appropriate conclusion when effects on a listed species are expected to be *discountable*, *insignificant*, or completely *beneficial*.

Beneficial effects – contemporaneous positive effects without any adverse effects

Insignificant effects – relate to the size of the impact and should never reach the scale where take would occur.

Discountable effects – those that are extremely unlikely to occur. Based on best judgment, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur.

(2) May Affect, Likely to Adversely Affect – the appropriate finding if *any* adverse effect may occur to listed species or critical habitat as a direct or indirect result of the proposed action or its interrelated or interdependent actions, and the effect is not discountable, insignificant, or beneficial.

A finding of "may affect" is the primary trigger for initiating section 7 consultation. Further analysis leads to one of the two conclusions above. In the case of a determination that an action is "not likely to adversely affect" a species or critical habitat, you can request USFWS and/or NMFS concurrence with this determination and consultation can be concluded upon receipt of our concurrence. Determinations of "likely to adversely affect" require further consultation between the action agency and USFWS and NMFS. These consultations typically lead to the preparation of a biological opinion, although they can also lead to incorporation of additional protective measures that render the project "not likely to adversely affect" listed species or designated critical habitat. Any actions that are likely to result in the incidental take of a listed species are automatically considered "likely to adversely affect."

In the case of proposed species or proposed critical habitat, the possible conclusions are:

<u>Species</u>

Likely to Jeopardize the Continued Existence

Not Likely to Jeopardize the Continued Existence

<u>Critical Habitat</u>

Likely to Destroy or Adversely Modify

Not Likely to Destroy or Adversely Modify

The effects analysis includes assessment of:

Direct and indirect effects (stressors) of Federal action

Direct and indirect effects (stressors) of applicant's action

Direct and indirect effects (stressors) of interrelated or interdependent actions

Direct and indirect effects (stressors) of conservation and minimization measures

Remember: Direct and indirect effects under ESA are **not** the same as direct and indirect effects under NEPA. Be careful not to mix them up. Under ESA, direct effects are those that are caused by the action(s) and occur at the time of the action(s), and indirect effects are those that are caused by the action(s) and are later in time, but are still reasonably certain to occur.

Based on the various components of your action that you used to determine the extent of the action area, this analysis assesses the potential stressors resulting from each component and predicts the likely responses species and critical habitat will have. Note: don't forget to subsequently reconstruct the action to assess the combined stressors of the components. You may find that some stressors are synergistically minimized or avoided, whereas other stressors may increase.

Describe the stressors that are expected to result from each component. For example, instream actions may mobilize sediments that travel downstream as increased turbidity and then settle out as sediments on the stream substrate. Sound levels from machinery may be detectable hundreds of feet, thousands of feet, or even miles away. Describe these stressors in terms of their intensity, frequency, and duration.

Once you have determined the expected stressors resulting from an activity, the next step is to assess the overlap between those stressors and individuals of the species or components of critical habitat. The purpose of determining this overlap is to accurately and completely assess the potential exposure of species and habitat to the stressors resulting from the action. This exposure is the necessary precursor to any possible response those species and habitat may have. Your conclusions of "not likely to adverse affect" or "likely to adversely affect" are based in large part on this response.

To determine exposure, here is a basic set of questions you might answer:

- What are the specific stressors causing the exposure
- Where the exposure to the stressors would occur
- When the exposure to stressors would occur
- How long the exposure to stressors would occur
- What is the frequency of exposure to stressor
- What is the intensity of exposure to stressor
- How many individuals would be exposed
- Which populations those individuals represent
- What life stage would be exposed

For critical habitat, the questions would be similar but would focus on constituent elements of critical habitat.

Remember that exposure to a stressor is not always direct. For example, in some cases individuals of a species may be directly exposed to the sediment mobilized during construction. However, in other cases, individuals of the species would be exposed indirectly when sediment mobilized during construction settles out in downstream areas, rendering those areas unusable for later spawning or foraging.

Here are some examples of stressors you should address:

Exposure to abiotic factors affecting land, air, or water

Exposure to biotic factors affecting species behavior

Spatial or temporal changes in primary constituent elements of critical habitat

Loss or gain of habitat--direct and indirect

Fragmentation of habitat

Loss or gain of forage and/or foraging potential

Loss or gain of shelter/cover

Loss or gain of access through adjacent habitat/loss of corridors determine the potential response or range of responses the exposed individuals or components of critical habitat will have to those levels and types of exposure.

This is where the use of the best scientific and commercial information available becomes crucial. Your analysis must take this information into consideration and the resulting document must reflect the use of this information and your reasoning and inference based on that information. Bear in mind that this analysis may not be the final word on the expected responses as further consultation with USFWS or NMFS may refine this analysis.

Be sure to describe the expected responses clearly and focus your analysis towards determining if any of the possible responses will result in the death or injury of individuals, reduced reproductive success or capacity, or the temporary or permanent blockage or destruction of biologically significant habitats (*e.g.*, foraging, spawning, or lekking grounds; migratory corridors, etc.,). Any of these above responses are likely to qualify as adverse effects. If the available information indicates that no observable response is expected from the levels and types of exposure, the action may be unlikely to adversely affect a species or critical habitat. However, remember that no observable response may actually mask an invisible internal response such as increased stress hormone levels, elevated heart rate, etc. Depending on the fitness of the exposed individual and the surrounding environment (including other threats), these "invisible" responses may lead to more serious consequences. We recommend working with your NMFS or USFWS contact to determine the appropriate conclusion.

Don't forget to consider:

Individual responses based on the species biology and sensitivity to exposure

The combined effects of existing threats and new exposure

The combined effects of limiting factors and new exposure

Disrupted reproduction and/or loss of reproduction

Exposure and response of species and critical habitat to interrelated and interdependent actions

Understanding and avoiding the common flaws in developing an effect determination will save you considerable time. These common flaws are: the "Displacement" Approach (*i.e.*, the species will move out of the way; there are plenty of places for them to go); the "Not Known to Occur Here" Approach (*i.e.*, looking at survey results, or lack of results, instead of the Recovery Plan for the species); the "We'll Tell You Later" Approach (*i.e.*, if we find any, then we'll let you know and that is when we will consult); or the "Leap of Faith" Approach (*i.e.*, the agency wants the USFWS or NMFS to accept a determination based on trust, rather than the best scientific and commercially available information.). Sticking to flawed determinations will cost everyone time, money, and aggravation.

Analysis of alternate actions

This analysis is required for actions that involve preparation of an EIS. For all other actions, a summary of alternatives discussed in other environmental documents is useful.

OTHER RELEVANT INFORMATION

Provide any other relevant available information the action, the affected listed species, or critical habitat. This could include local research, studies on the species that have preliminary results, and scientific and commercial information on aspects of the project.

CONCLUSION

This is where you put your overall effect determination after you have analyzed the exposure and response of species and habitat to the stressors resulting from the proposed action and interrelated or interdependent actions. Effect determinations must be based on a sound reasoning from exposure to response and must be consistent with types of actions in the project description, the biology in the species accounts, the habitat status and condition, changes to the existing environment, and the best scientific and commercial information available.

Again, the two potential conclusions for **listed species** are:

Not likely to adversely affect species

Likely to adversely affect species

The two potential conclusions for **designated critical habitat** are:

Not likely to adversely affect critical habitat

Likely to adversely affect critical habitat

The two potential conclusions for **proposed species** are:

Not likely to jeopardize species

Likely to adversely jeopardize species

The potential conclusions for **proposed critical habitat** are, under informal and formal consultation respectively:

Not likely to adversely affect species

Likely to adversely affect species

Not likely to destroy or adversely modify critical habitat

Likely to destroy or adversely modify critical habitat

Include the basis for the conclusion, such as discussion of any specific measures or features of the project that support the conclusion and discussion of species expected response, status, biology, or baseline conditions that also support conclusion.

If you make a "no effect" determination, it doesn't need to be in the assessment, but you might have to defend it. Keep the documentation for your administrative record.

LIST OF DOCUMENTS

Provide a list of the documents that have bearing on the project or the consultation, this includes relevant reports, including any environmental impact statements, environmental assessment, or biological assessment prepared for the project. Include all planning documents as well as the documents prepared in conformance with state environmental laws

IMPORTANT NOTE: Each of these documents must be provided with the initiation package consultation for the Services to be able to proceed with formal consultation.

LITERATURE CITED

We are all charged with using the best scientific and commercial information available. To demonstrate you did this, it is a good idea to keep copies of search requests in your record. If you used a personal communication as a reference, include the contact information (name, address, phone number, affiliation) in your record.

LIST OF CONTACTS/CONTRIBUTORS/PREPARERS

Please include contact information for contributors and preparers as well as local experts contacted for species or habitat information.

GLOSSARY

Action Area - all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action.

Beneficial Effects – contemporaneous positive effects without any adverse effects.

Cumulative Effects – are those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur in the action area of the Federal action subject to consultation.

Discountable Effects – those that are extremely unlikely to occur. Based on best judgment, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur.

Effects of the Action – refers to the direct and *indirect effects* of an action on the species or critical habitat, together with the effects of other activities that are *interrelated* or *interdependent* with that action, that will be added to the environmental baseline.

Environmental Baseline – includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions that are contemporaneous with the consultation in process.

Indirect Effects - Indirect effects are those that are caused by the action(s) and are later in time, but are still reasonably certain to occur.

Insignificant Effects – relate to the size of the impact and should never reach the scale where take would occur.

Interdependent Actions - Interdependent actions are those that have no significant independent utility apart from the action that is under consideration, *i.e.* other actions would not occur "but for" this action.

Interrelated Actions - Interrelated actions are those that are part of a larger action and depend on the larger action for their justification, *i.e.* this action would not occur "but for" a larger action.

Likely to Jeopardize the Continued Existence of – to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species.

May Affect, Likely to Adversely Affect – the appropriate finding if any adverse effect may occur to listed species or critical habitat as a direct or indirect result of the proposed action or its interrelated or interdependent actions, and the effect is not discountable, insignificant, or beneficial. Requires that a biological opinion be prepared by the Service.

May Affect, Not Likely to Adversely Affect – the appropriate conclusion when effects on a listed species are expected to be *discountable*, *insignificant*, or completely *beneficial*. Requires written concurrence from the Service.

No Effect – the appropriate conclusion when a listed species will not be affected, either because the species will not be present or because the project does not have any elements with the potential to affect the species. A "no effect" determination does **not** require written concurrence from the Service and ends

ESA consultation requirements. Action agency should document their reasoning for this conclusion in their file.

B.2 Section 106 Consultation Letters

On September 2, 2009, the U.S. Nuclear Regulatory Commission (NRC) sent letters to 16 American Indian tribes and organizations. The list of tribes and organizations (see Section 9.2) was provided by the North Carolina State Historic Preservation Office (SHPO). This section contains a sample of the outgoing NRC letter; the remaining NRC letters can be accessed via NRC's online document retrieval system (ADAMS) using the accession numbers in Table B-2. The two responses received by the NRC are also shown in the table, and copies of the response letters are included in this section.

Also included in this section are copies of Section 106 correspondence involving the North Carolina SHPO and the Advisory Council on Historic Preservation. Dates and accession numbers are shown in Table B-3.

Table B-2 NRC Correspondence with American Indian Tribes and Organizations

Tribe	ADAMS Accession Number(s)
Catawba Indian Nation	ML092120329
Cherokee Nation of Oklahoma	ML092120524
Coharie Indian Tribe	ML092150041
Cumberland County Association for Indian People	ML092150248
Eastern Band of Cherokee Indians	ML092150452
Guilford Native American Association	ML092160204
Haliwa-Saponi Indian Tribe	ML092160271, ML092160427
Lumbee Indian Tribe	ML092160427
Meherrin Indian Tribe	ML092160461
Metrolina Native American Association	ML092160756
Occaneechi Band of the Saponi Nation	ML092230748
Sappony Nation	ML092160873
Triangle Native American Society	ML092160934
Tuscarora Nation	ML092170004
United Keetoowah Band of Cherokee Indians	ML092170014
Waccamaw Siouan Indian Tribe	ML092170017
Response from Coharie Indian Tribe	ML092600484
Response from United Keetoowah Band of Cherokee Indians	ML093570295

Table B-3 Section 106 Correspondence with the North Carolina SHPO and the Advisory Council on Historic Preservation

Correspondence	ADAMS Accession Number
NRC to SHPO (April 29, 2009)	ML091100104
SHPO to NRC (June 2, 2009)	ML091630258
NRC to Advisory Council on Historic Preservation (September 1, 2009)	ML092380591

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

September 2, 2009

The Honorable Gene Faircloth, Chief
Coharie Indian Tribe
7531 N. U.S. Hwy 421
Clinton, NC 28328

SUBJECT: REQUEST FOR INFORMATION REGARDING TRIBAL HISTORIC AND CULTURAL RESOURCES POTENTIALLY AFFECTED BY THE PROPOSED GENERAL ELECTRIC-HITACHI GLOBAL LASER ENRICHMENT FACILITY NEAR WILMINGTON, NORTH CAROLINA

Dear Chief Faircloth:

On June 26, 2009, General Electric-Hitachi (GEH) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) for a license to authorize construction and operation of a uranium enrichment facility. The facility, if licensed, would use a laser-based technology to enrich the isotope uranium-235 in uranium hexafluoride (UF_6) up to 8 percent by weight. GEH proposes to locate the facility on the existing General Electric/Global Nuclear Fuel-Americas site near Wilmington, in New Hanover County, North Carolina (Wilmington site).

As established in Title 10 of the Code of Federal Regulations Part 51 (10 CFR 51), the NRC regulation that implements the National Environmental Policy Act of 1969, as amended, the NRC is preparing an Environmental Impact Statement (EIS) for the proposed action. The EIS will address the impacts associated with the construction, operation, and decommissioning of the proposed facility. As part of the environmental review, the NRC is requesting input from the Coharie Indian Tribe to facilitate the identification of Tribal historic sites or cultural resources that may be affected by the proposed action. Specifically, the NRC is interested in learning of any areas on the Wilmington site that you believe have traditional religious or cultural significance. Any input you provide will be used to enhance the scope and quality of our review in accordance with 10 CFR 51 and 36 CFR 800, the implementing regulation for Section 106 of the National Historic Preservation Act.

To support the license application, GEH submitted an Environmental Report (ER) that identifies 107 hectares (265 acres) of the 656 hectare (1621 acre) Wilmington site as the area for the construction, operation, and decommissioning of the proposed facility. The ER is publicly available in the NRC Public Document Room located at One White Flint North, 11555 Rockville Pike, Rockville, Maryland 20852, or from the NRC's Agencywide Documents Access and Management System (ADAMS). The ADAMS Public Electronic Reading Room is accessible at http://www.nrc.gov/reading-rm/adams.html. The accession number for the ER is ML090910573. For your convenience, we have enclosed the applicant's executive summary, as it appears in the ER, to provide you with background information.

We would appreciate any information you could provide about Tribal historic sites or cultural resources that may be affected by the proposed action. If you have any questions or comments, or need any additional information, please contact Ms. Christianne Ridge of my staff by telephone at 301-415-5673 or email at christianne.ridge@nrc.gov

Sincerely,

Patrice M. Bubar

Patrice M. Bubar, Deputy Director
Environmental Protection
and Performance Assessment Directorate
Division of Waste Management
and Environmental Protection
Office of Federal and State Materials
and Environmental Management Programs

Docket No.: 70-7016

Enclosure: GLE Environmental Report
Executive Summary

cc w/ enclosure:
Elizabeth Maynor, Executive Director
7531 N. U.S. Hwy. 421
Clinton, N.C. 28328

Coharie Intra-Tribal Council, Inc.

7531 North U.S. 421 Hwy.
Clinton, N. C. 28328

Phone (910) 564-4906
(910) 564-6909
Fax (910) 564-2701

Patrice M. Bubar
Deputy Director Environmental Protection
And Performance Assessment Directorate
Division of Waste Management
And Environmental Protection
Office of Federal and State materials
And Environmental Management Programs
11555 Rockville Pike,
Rockville, MD 20852

This is in response to you September 2, 2009 letter concerning Tribal historic and cultural affecting the proposed facility near Wilmington NC. We appreciate the opportunity to provide information on this project.

A search of our records indicates that our Tribe does not have any background of that area. While our Tribe does have connection to Coastal North Carolina, this connection is further north around the New Bern Area. Therefore, our Tribe does not have any religious or cultural attachment to this area.

We appreciate being included in this study. If you need additional information, please contact us.

Sincerely,

Elizabeth Maynor,
Executive Director.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

September 2, 2009

The Honorable George Wickliffe, Chief
United Keetoowah Band of Cherokee
P.O. Box 746
Tahlequah, OK 74464

RECEIVED NOV 2 3 2009

SUBJECT: REQUEST FOR INFORMATION REGARDING TRIBAL HISTORIC AND CULTURAL RESOURCES POTENTIALLY AFFECTED BY THE GENERAL ELECTRIC-HITACHI GLOBAL LASER ENRICHMENT PROPOSED URANIUM ENRICHMENT FACILITY IN WILMINGTON, NORTH CAROLINA

Dear Chief Wickliffe:

On June 26, 2009, General Electric-Hitachi (GEH) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) for a license to authorize construction and operation of a uranium enrichment facility. The facility, if licensed, would use a laser-based technology to enrich the isotope uranium-235 in uranium hexafluoride (UF_6) up to 8 percent by weight. GEH proposes to locate the facility on the existing General Electric/Global Nuclear Fuel-Americas site near Wilmington, in New Hanover County, North Carolina (Wilmington site).

As established in Title 10 Code of Federal Regulations Part 51 (10 CFR 51), the NRC regulation that implements the National Environmental Policy Act of 1969, as amended, the NRC is preparing an Environmental Impact Statement (EIS) for the proposed action. The EIS will address the impacts associated with the construction, operation, and decommissioning of the proposed facility. As part of the environmental review, the NRC is requesting input from the United Keetoowah Band of Cherokee to facilitate the identification of Tribal historic sites or cultural resources that may be affected by the proposed action. Specifically, the NRC is interested in learning of any areas on the Wilmington site that you believe have traditional religious or cultural significance. Any input you provide will be used to enhance the scope and quality of our review in accordance with 10 CFR 51 and 36 CFR 800, the implementing regulation for Section 106 of the National Historic Preservation Act.

To support the license application, GEH submitted an Environmental Report (ER) that identifies 107 hectares (265 acres) of the 656 hectare (1621 acre) Wilmington site as the area for the construction, operation, and decommissioning of the proposed facility. The ER is publicly available in the NRC Public Document Room located at One White Flint North, 11555 Rockville Pike, Rockville, Maryland 20852, or from the NRC's Agencywide Documents Access and Management System (ADAMS). The ADAMS Public Electronic Reading Room is accessible athttp://www.nrc.gov/reading-rm/adams.html. The accession number for the ER is ML090910573. For your convenience, we have enclosed the applicant's executive summary, as it appears in the ER, to provide you with background information.

The United Keetoowah Band of Cherokee Indians in Oklahoma has no objection to the referenced project. However, if any remains, artifacts or other items are inadvertnetly discovered, please cease construction immediately and contact us at 918-456-6533 or by letter.

NOV 2 ? 2009

Lisa C. Stopp, Tribal NAGPRA POC Date

TOTAL P.02

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

April 29, 2009

Mr. Peter Sandbeck
Deputy State Historic Preservation Officer
North Carolina State Historic Preservation Office
4617 Mail Service Center
Raleigh, NC 27699-4617

SUBJECT: INITIATION OF THE NATIONAL HISTORIC PRESERVATION ACT SECTION 106 PROCESS FOR GENERAL ELECTRIC-HITACHI GLOBAL LASER ENRICHMENT PROPOSED URANIUM ENRICHMENT FACILITY (STATE HISTORIC PRESERVATION OFFICE TRACKING NUMBER ER 07-2157)

Dear Mr. Sandbeck:

On January 30, 2009, General Electric-Hitachi Global Laser Enrichment (GLE) submitted an environmental report (ER) to the U.S. Nuclear Regulatory Commission (NRC). The ER is one part of an application for a license to authorize construction, operation, and decommissioning of a proposed uranium enrichment facility. The NRC is in the initial stages of developing an Environmental Impact Statement (EIS) for the proposed facility to be located on the existing General Electric/Global Nuclear Fuels-Americas site near Wilmington, North Carolina, in New Hanover County (Wilmington site). The facility, if licensed, would use a laser-based technology to enrich the isotope uranium-235 in uranium hexafluoride (UF_6) up to 8 percent by weight. The EIS that NRC is preparing will document the impacts associated with the construction, operation, and decommissioning of the proposed facility.

GLE's ER identified 107 hectares (265 acres) of the 656 hectare (1621 acre) Wilmington site as the Area of Potential Effect (APE) for direct effects resulting from the construction, operation, and decommissioning of the proposed facility. In October and November of 2007, GLE performed archeological surveys of the APE. As a result of the surveys, two new archaeological sites were recorded. GLE has concluded that one of these sites is potentially eligible for listing on the National Register of Historic Places. GLE has indicated that the potentially eligible site will not be affected by any planned activities related to the proposed uranium enrichment facility. We have enclosed additional background information relating to cultural resources, including a map showing the APE, as it appears in the GLE ER.

In its ER, GLE indicated it submitted the results of the archeological surveys to your office in March 2008. As required by 36 CFR 800.4(a), the NRC is requesting the views of the State Historic Preservation Officer on any further actions necessary to identify historic properties that may be affected by the construction, operation, and decommissioning of the proposed facility.

As part of the EIS preparation, the NRC will be hosting two public scoping meetings on Tuesday, May 19, 2009, in Ballroom 1 of the Warwick Center at the University of North Carolina at Wilmington, North Carolina, 28403. The first meeting will be held from 1:00 p.m. to approximately 4:00 p.m. and the second meeting will be held from 7:00 p.m. to approximately 10:00 p.m. The meetings will include NRC staff presentations on the safety and environmental review process, after which members of the public will be given the opportunity to present their comments on issues NRC should consider during its environmental review. The scoping information gathered at this meeting and in written public comments will be used with any information you provide to document environmental impacts of the proposed action in accordance with 36 CFR Part 800.4 and 800.5.

We intend to use the EIS process to comply with Section 106 of the National Historic Preservation Act of 1966, as described in 36 CFR Part 800.8. After assessing information you provide, we will determine what additional actions are necessary to comply with the Section 106 consultation process. If you have any questions or comments, or need any additional information, please contact Christianne Ridge of my staff at 301-415-5673.

Sincerely,

Andrea Kock, Chief
Environmental Review Branch
Division of Waste Management
and Environmental Protection
Office of Federal and State Materials
and Environmental Management Programs

Docket No.: 70-7016

Enclosure: As stated

cc without enclosure: see next page

North Carolina Department of Cultural Resources
State Historic Preservation Office
Peter B. Sandbeck, Administrator

Beverly Eaves Perdue, Governor
Linda A. Carlisle, Secretary
Jeffrey J. Crow, Deputy Secretary

Office of Archives and History
Division of Historical Resources
David Brook, Director

June 2, 2009

Andrea Kock
Environmental Review Branch
Division of Waste Management and
Environmental Protection
US Nuclear Regulatory Commission
Washington, DC 20555-0001

Re: Initiation of the National Historic Preservation Act Section 106 Process for General Electric-Hitachi Global Laser Enrichment Proposed Uranium Enrichment Facility, New Hanover County, ER 07-2157

Dear Ms. Kock:

Thank you for your letter of April 29, 2009, concerning the above project. We have reviewed the relevant sections of the GLE Environmental Report and offer the following comments.

The Environmental Report offers an accurate description and assessment of the cultural resources found to be located within the Area of Potential Effect (APE) for the proposed facilities. No additional identification activities are warranted for cultural resources in connection with this project. In our letter dated April 9, 2008, to Scott Seibel of Environmental Services, Inc., we concurred with his evaluation of archaeological site 31NH801 as eligible for inclusion in the National Register of Historic Places under Criterion D and with the adequacy of his report of the investigations.

The Environmental Report states that the access road adjacent to site 31NH801 will not be widened and the project, therefore, will have no effect upon the site. We request that final plans for the proposed facility and access roads be forwarded to us for our review as soon as they are available. We also request that we be informed of the measures now being taken and those to be taken in the future to ensure protection and preservation of the site from proposed and future ground disturbing activities.

If during construction, there are unanticipated discoveries of cultural resources, we recommend that all ground disturbing activities within the vicinity cease, and our office be notified as soon as possible. If unmarked burials or human skeletal remains are encountered, compliance with the provisions of North Carolina General Statutes Chapter 70, Article 3 should be undertaken.

Please note that archaeological site locations are protected under the provisions of North Carolina General Statutes 70-18 and should not be made available to the public. Maps depicting site locations should not be included in environmental or other documents made available to the public, as this constitutes a risk of harm.

We look forward to working with your staff and their consultants on this project.

Location: 109 East Jones Street, Raleigh NC 27601 **Mailing Address:** 4617 Mail Service Center, Raleigh NC 27699-4617 **Telephone/Fax:** (919) 807-6570/807-6599

The above comments are made pursuant to Section 106 of the National Historic Preservation Act and the Advisory Council on Historic Preservation's Regulations for Compliance with Section 106 codified at 36 CFR Part 800.

Thank you for your cooperation and consideration. If you have questions concerning the above comment, please contact Renee Gledhill-Earley, environmental review coordinator, at 919/807-6579. In all future communication concerning this project, please cite the above referenced tracking number.

Sincerely,

Renee Gledhill-Earley

Peter Sandbeck

cc: Christianne Ridge, Division of Waste Management and Environmnetal Protection
Clearinghouse

September 1, 2009

Ms. Charlene Dwin Vaughn
Assistant Director
Advisory Council on Historic Preservation
Office of Federal Agency Programs
1100 Pennsylvania Ave, NW, Suite 803
Washington, DC 20004

SUBJECT: NATIONAL HISTORIC PRESERVATION ACT SECTION 106 CONSULTATION PROCESS FOR GENERAL ELECTRIC-HITACHI PROPOSED URANIUM ENRICHMENT FACILITY

Dear Ms. Vaughn:

On June 26, 2009, General Electric-Hitachi (GEH) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) for a license to authorize construction and operation of a uranium enrichment facility. GEH proposes to locate the facility on the existing General Electric/Global Nuclear Fuel-Americas site near Wilmington, North Carolina (Wilmington site). The Wilmington site is located approximately 9.6 kilometers (6 miles) north of the city of Wilmington in New Hanover County, North Carolina, on Parcel number R01700-001-000. In an Environmental Report submitted in support of the application, GEH identified 107 hectares (265 acres) of the 656 hectare (1621 acre) Wilmington site as the Area of Potential Effects for direct effects resulting from the construction, operation, and decommissioning of the proposed facility.

As established in Title 10 of the Code of Federal Regulations, Part 51 (10 CFR 51), the NRC regulation that implements the National Environmental Policy Act of 1969, as amended, NRC is preparing an Environmental Impact Statement (EIS) to address the environmental impacts associated with the construction, operation, and decommissioning of the proposed facility. In accordance with 36 CFR 800.8(c), the EIS will include analyses of potential impacts to historic and cultural resources. We intend to use the EIS process to comply with Section 106 of the National Historic Preservation Act of 1966, as described in 36 CFR Part 800.8. As part of that process, the NRC has initiated consultation with the North Carolina State Historic Preservation Office.

Your office will receive a copy of the draft EIS along with a request for comments. The anticipated publication date for the draft EIS is March 2010.

If you have any questions or require additional information, please contact the Environmental Project Manager, Ms. Christianne Ridge, at 301-415-5673 or by e-mail at christianne.ridge@nrc.gov.

Sincerely,

Andrea Kock, Branch Chief
Environmental Review Branch
Environmental Protection
and performance Assessment Directorate
Division of Waste Management
and Environmental Protection
Office of Federal and State Materials
and Environmental Management Programs

Docket No.: 70-7016

cc: William Szymanski/DOE
Patricia Campbell/GEH
Robert Brown/GEH
Tammy Orr/GEH
Mike Giles/CFC
Tom Clements/FOTE
Doug Springer/CFRW
Stephen Rynas/NCDENR
Jennifer Braswell/New Hanover County
Christopher O'Keefe/New Hanover County
Bruce Shell/New Hanover County
Marty Lawing/Brunswick County
George Brown/Pender County
Bill Saffo/Wilmington
Malissa Talbert/Wilmington
Wanda Lagoe/NCOSH
Cameron Weaver/NCDENR
Emily Hughes/USACE
Lafayette Atkinson/NCOSH
David Weaver/New Hanover County

B.3 Other Consultation Letters

The U.S. Nuclear Regulatory Commission (NRC) sent consultation letters to several Federal, State, and local government agencies. This section contains copies of several of these letters. The North Carolina Department of Labor responded in a teleconference on July 14, 2009. The North Carolina Department of Environmental and Natural Resources (Radiation Protection Section) sent requested data on September 1, 2009; this data is not provided in this appendix but can be accessed via NRC's online document retrieval system (ADAMS). All of the NRC letters and agency responses can be accessed via ADAMS using the accession numbers in Table B-4.

Table B-4 Additional Consultations with Government Agencies

Agency (Date)	ADAMS Accession Number(s)
United States Army Corps of Engineers (August 13, 2009)	ML092160036
Response from United States Army Corps of Engineers (November 23, 2009)	ML093570306
North Carolina Department of Administration, State Environmental Review Clearinghouse (May 14, 2009)	ML091330018
Response 1 from North Carolina Department of Administration, State Environmental Review Clearinghouse (June 22, 2009)	ML091730327
Response 2 from North Carolina Department of Administration, State Environmental Review Clearinghouse (June 24, 2009)	ML091760350
Response 3 from North Carolina Department of Administration, State Environmental Review Clearinghouse (July 15, 2009)	ML091960418
North Carolina Department of Labor (June 15, 2009)	ML091620188
North Carolina Department of Environment and Natural Resources, Radiation Protection Section (July 28, 2009)	ML091960499
Responses from North Carolina Department of Environment and Natural Resources, Radiation Protection Section (September 1, 2009)	ML100630876 ML100630877 ML100630880 ML100630887 ML100630890 ML100630893 ML100630907
New Hanover County Planning Department (June 22, 2009)	ML091630272
Response from New Hanover County Planning Department (received August 20, 2009)	ML092360197

August 13, 2009

Mr. Tom Walker, Chief
Wilmington Regulatory Field Office
U.S. Army Corps of Engineers
Post Office Box 1890
Wilmington, NC 28402-1890

SUBJECT: NUCLEAR REGULATORY COMMISSION REQUEST FOR SCOPING INFORMATION REGARDING THE PROPOSED GLOBAL LASER ENRICHMENT FACILITY IN NEW HANOVER COUNTY, NORTH CAROLINA

Dear Mr. Walker:

On June 26, 2009, General Electric-Hitachi (GEH) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) for a license to authorize construction and operation of a uranium enrichment facility. GEH proposes to locate the facility on the General Electric/Global Nuclear Fuel-Americas site near Wilmington, in New Hanover County, North Carolina (Wilmington site). The facility, if licensed, would use a laser-based technology to enrich the isotope uranium-235 in uranium hexafluoride (UF_6) up to 8 percent by weight.

As established in Title 10 of the Code of Federal Regulations Part 51 (10 CFR 51), the NRC regulation that implements the National Environmental Policy Act of 1969, as amended, the NRC is preparing an Environmental Impact Statement (EIS) as part of its review of the proposed action. The EIS will address the impacts of the construction, operation, and decommissioning of the proposed facility. To support this review, the NRC staff is requesting scoping information from the U.S. Army Corps of Engineers about aquatic features on the Wilmington site that fall under jurisdiction of the Corps pursuant to its regulatory authority under Section 404 of the Clean Water Act.

The Wilmington site is located at 3901 Castle Hayne Road, Wilmington, North Carolina, 28401, bordering the Northeast Cape Fear River. In an Environmental Report (ER) submitted as part of the license application, GEH identified 107 hectares (265 acres) of the 656 hectare (1621 acre) Wilmington site as the area for the construction, operation, and decommissioning of the proposed facility. In the ER, the applicant indicates that the U.S. Army Corps of Engineers provided a notification of jurisdictional determination relevant to the proposed action as Corps Action SAW-2008-00188. For your convenience, we have enclosed a description of the applicant's anticipated water resources impacts, including maps of the site, as it appears in Section 4.4 of the applicant's ER. The full ER is available from the NRC's Agencywide Documents Access and Management System (ADAMS), which is accessible at http://www.nrc.gov/reading-rm/adams.html. The accession number for the ER is ML090910573.

On October 9, 2007 (Volume 73, *Federal Register* [FR], page 57416) and April 28, 2008 (73 FR 22786), NRC published changes to the NRC regulation implementing NEPA (10 CFR 51). The changes redefined the term "construction" to include only activities that are under the purview of NRC legislative authority. On December 8, 2008, GEH requested an exemption from certain NRC regulations (10 CFR 70.4 and 70.23(a)(7)) that are based on an alternate definition of construction in order to perform activities excluded from the definition of construction in

10 CFR 51. On May 8, 2009, NRC granted the exemption. The exemption allows GEH to begin certain activities that are not related to nuclear safety or security without additional authorization from the NRC. These activities include clearing 40 hectares (100 acres) of land, grading the site, implementing erosion control, building storm water retention ponds, building roadways and guardhouses, installing utilities, constructing parking lots, and building administrative buildings.

Because of the change in the NRC regulation implementing NEPA (10 CFR 51), many activities that may require a permit from the Corps are no longer part of the NRC definition of construction in 10 CFR 51 and will not be addressed as direct impacts of the proposed action in NRC's EIS. NRC will evaluate the environmental impacts of these activities as cumulative impacts of the proposed action. Any information you provide about aquatic features on the Wilmington site that fall under jurisdiction of the Corps will be used to improve the scope and content of our environmental review.

If you need any additional information related to this request, or have any questions about NRC's environmental review, please contact Ms. Christianne Ridge of my staff at 301-415-5673.

Sincerely,

/RA/

Andrea Kock, Chief
Environmental Review Branch
Environmental Protection and
Performance Directorate
Division of Waste Management and
Environmental Protection,
Office of Federal and State Materials and
Environmental Management Programs

Docket No.: 70-7016

Enclosure: Environmental Report

cc w/o enclosure: See next page

cc without enclosure:

William Szymanski/DOE
Bruce Shell/New Hanover County
Patricia Campbell/GEH
Marty Lawing/Brunswick County
Robert Brown/GEH
George Brown/Pender County
Tammy Orr/GEH
Bill Saffo/Wilmington
Al Kennedy/GEH
Mike Giles/CFC
Julie Olivier/GEH
Malissa Talbert/Wilmington
Tom Clements/FOTE
Wanda Lagoe/NCOSH
Doug Springer/CFRW
Cameron Weaver/NCDENR
Stephen Rynas/NCDENR
Lee Cox/SLO
Emily Hughes/USACE
David Weaver/New Hanover County
Christopher O'Keefe/New Hanover County
Dennis Ihnat/New Hanover County
Jennifer Braswell/New Hanover County
Alan Summerville/ICF
Ronald Sparks/Wilmington

DEPARTMENT OF THE ARMY
WILMINGTON DISTRICT, CORPS OF ENGINEERS
69 DARLINGTON AVENUE
WILMINGTON, NORTH CAROLINA 28403-1343

REPLY TO
ATTENTION OF:

November 23, 2009

Regulatory Division

Action ID No. SAW-2008-00188

Ms. Andrea Kock
Division of Waste Management
and Environmental Protection
Office of Federal and State Materials
and Environmental Management Programs
11545 Rockville Pike
Rockville Pike, Maryland 20852

Dear Ms. Kock:

Our Office received a copy of the document titled "GLE Environmental Report: Section 4.4 – Water Resource Impacts, December 2008" with a cover letter from you dated August 13, 2009 requesting comments regarding aquatic features within the proposed General Electric-Hitachi uranium enrichment facility project site in New Hanover County. The 265-acre project area is located at 3901 Castle Hayne Road, Wilmington, North Carolina bordering the Northeast Cape Fear River.

Our file records indicate that all jurisdictional features within the project area were delineated by RTI International and verified by Ms. Jennifer Frye of this office on October 16, 2007. A Notice of Jurisdictional Determination with corresponding signed plat was issued on January 22, 2008. A copy of this has been made available to General Electric-Hitachi Nuclear Energy Americas, LLC.

Based upon our review of the approved delineation and the information that you submitted, this office has determined that your project as proposed, will impact jurisdictional waters and/or wetlands regulated pursuant to Section 404 of the Clean Water Act and therefore, will require Department of the Army (DA) authorization. Proposed impacts include the discharge of fill material into an unnamed tributary to Prince George Creek and an unnamed tributary to the Northeast Cape Fear River. Both are tributaries to the Northeast Cape Fear River, a Traditionally Navigable Water of the United States. As you are aware, the issuance of Department of the Army (DA) authorization must precede any placement of excavated or fill material within any wetlands or waters of the United States. Unauthorized activity would be a violation of Federal law.

As this proposed project is located in one of the 20 coastal counties of North Carolina, a permit may be required by the North Carolina Division of Coastal Management. We recommend that you contact them at (910) 796-7215. For concerns and questions regarding biological resources and endangered species, please contact the U.S. Fish and Wildlife Service at (919) 856-4520.

If you should have any questions or comments or would like to schedule a pre-application meeting, please contact Emily Hughes at the Wilmington Field Office, Regulatory Division, telephone (910) 251-4635.

Sincerely,

William T. Walker, Chief
Wilmington Regulatory Field Office

Copies Furnished:

Ms. Christianne Ridge
Environmental Project Manager
Division of Waste Management
and Environmental Protection
U.S. Nuclear Regulatory Commission
Mail Stop: T7J8
Washington, DC 20555

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

May 14, 2009

Ms. Valerie McMillan
Director, State Environmental Review Clearinghouse
Department of Administration
1301 Mail Service Center
Raleigh NC 27699-1301

SUBJECT: REQUEST FOR SCOPING COMMENTS FOR AN ENVIRONMENTAL IMPACT STATEMENT REGARDNG THE PROPOSED GENERAL ELECTRIC-HITACHI GLOBAL LASER ERICHMENT (GLE) URANIUM ENRICHMENT FACILITY IN NEW HANOVER COUNTY, NORTH CAROLINA

Dear Ms. McMillan:

As we discussed on May 6, 2009, General Electric-Hitachi Global Laser Enrichment (GLE) has submitted an application to the U.S. Nuclear Regulatory Commission (NRC) for a license to authorize construction, operation, and decommissioning of a proposed uranium enrichment facility. The NRC staff is in the initial stages of developing an Environmental Impact Statement (EIS) for the proposed facility to be located on the existing General Electric/Global Nuclear Fuels-Americas site near Wilmington, North Carolina, in New Hanover County (Wilmington site). The facility, if licensed, would use a laser-based technology to enrich the isotope uranium-235 in uranium hexafluoride (UF_6) up to 8 percent by weight. The EIS will document the impacts associated with the construction, operation, and decommissioning of the proposed facility.

Thank you for your assistance in notifying appropriate North Carolina departments and programs of the public scoping meetings NRC will hold in Wilmington, North Carolina, on May 19, 2009. As we discussed on May 6, 2009, the North Carolina departments and programs you coordinate with are: 1) the Cape Fear Regional Council of Governments, 2) the Department of Environment and Natural Resources, 3) the Department of Agriculture, 4) the Department of Cultural Resources, 5) the Department of Transportation, and 6) Crime Control & Public Safety, Division of Emergency Management, Floodplain Management Program. By this letter, we are requesting that, within 30 days, these agencies provide comments to help determine the scope of our EIS. Any information you provide will be used with information gathered in written comments and at the public scoping meetings to help NRC analyze the environmental impacts of the proposed action.

As part of the NRC licensing process, GLE submitted an Environmental Report (ER) that describes the 656 hectare (1621 acre) Wilmington site and the anticipated environmental impacts of the construction, operation, and decommissioning of the proposed facility. The Wilmington site is located approximately 9.6 kilometers (6 miles) north of the city of Wilmington in New Hanover County, NC. We have enclosed 16 copies of additional background information relating to the proposed action and the Wilmington site, including a map showing the site, as it appears in the executive summary of the GLE ER.

If you have any questions or comments, or need any additional information, please contact Christianne Ridge of my staff at 301-415-5673.

Sincerely,

Andrea Kock, Chief
Environmental Review Branch
Division of Waste Management
and Environmental Protection
Office of Federal and State Materials
and Environmental Management Programs

Docket No.: 70-7016

Enclosure: As stated

cc without enclosure: see next page

cc list:

William Szymanski/DOE
Patricia Campbell/GEH
Robert Brown/GEH
Tammy Orr/GEH
AKennedy/GEH
JOlivier/GEH
Tom Clements/FOTE
Doug Springer/CFRW
Stephen Rynas/NCDENR
Emily Hughes/USACE
David Weaver/New Hanover County
Jennifer Braswell/New Hanover County
Bruce Shell/New Hanover County
Marty Lawing/Brunswick County
George Brown/Pender County
Bill Saffo/Wilmington
Mike Giles/CFC
Malissa Talbert/Wilmington
Wanda Lagoe/NCOSH
Cameron Weaver/NCDENR
Lee Cox/SLO
Kimberly Garvey/USACE
Christopher O'Keefe/New Hanover County

North Carolina
Department of Administration

Beverly Eaves Perdue, Governor | Britt Cobb, Secretary

June 22, 2009

Ms. Andrea Kock
U.S. Nuclear Regulatory Commission
FSME/DWMEP/ERB
T-8F05
Washington, DC 20555-0001

Re: SCH File # 09-E-0000-0336; SCOPING; Proposal for General Electric-Hitachi Global Laser Enrichment to construction, operation, decommissioning a uranium facility

Dear Ms. Kock:

The above referenced environmental impact information has been submitted to the State Clearinghouse under the provisions of the National Environmental Policy Act. According to G.S. 113A-10, when a state agency is required to prepare an environmental document under the provisions of federal law, the environmental document meets the provisions of the State Environmental Policy Act. Attached to this letter for your consideration are the comments made by agencies in the course of this review.

If any further environmental review documents are prepared for this project, they should be forwarded to this office for intergovernmental review.

Should you have any questions, please do not hesitate to call.

Sincerely,

Valerie McMillan (SJD)

Valerie W. McMillan, Director
State Environmental Review Clearinghouse

Attachments

cc: Region O

Mailing Address:
1301 Mail Service Center
Raleigh, NC 27699-1301

Telephone: (919)807-2425
Fax (919)733-9571
State Courier #51-01-00
e-mail valerie.w.mcmillan@doa.nc.gov

Location Address:
116 West Jones Street
Raleigh, North Carolina

North Carolina Department of Environment and Natural Resources

Beverly Eaves Perdue
Governor

Dee Freeman
Secretary

MEMORANDUM

TO: Valerie McMillan
State Clearinghouse

FROM: Melba McGee
Environmental Review Coordinator

RE: 09-0336 Scoping, Proposed Decommissioning of a Uranium Enrichment Facility in New Hanover County

DATE: June 17, 2009

The Department of Environment and Natural Resources has reviewed the proposed project. The attached comments are for the applicant's consideration. More specific comments will be provided during the environmental review process.

Thank you for the opportunity to respond. If during the preparation of the environmental document, additional information is needed, the applicant is encouraged to notify our respective divisions.

Attachments

1601 Mail Service Center, Raleigh, North Carolina 27699-1601
Phone: 919-733-4984 \ FAX: 919-715-3060 Internet: www.enr.state.nc.us

NCDENR

North Carolina Department of Environment and Natural Resources
Division of Coastal Management

Beverly Eaves Perdue
Governor

James H. Gregson
Director

Dee Freeman
Secretary

May 29, 2009

Melba McGee
Environmental Coordinator
Office of Legislative & Intergovernmental Affairs
Department of Environment and Natural Resources
1601 Mail Service Center
Raleigh, NC 27699-1601

SUBJECT: Comments Related to the Proposed Construction, Operation, and Decommissioning of a Uranium Enrichment Facility, Wilmington, New Hanover County, North Carolina (SCH#09-0336 and DCM#20090055 and DCM#20090067)

Dear Ms. McGee:
Thank you for the opportunity to review the scoping request for a proposed environmental document to evaluate the construction, operation, and decommissioning of a uranium enrichment facility in Wilmington, New Hanover County, North Carolina. According to the scoping request General Electric-Hitachi Global Laser Enrichment, LLC (GLE) will be applying for a license from the US Nuclear Regulatory Commission. This license would authorize GLE to possess and use nuclear material. The purpose of this review is to provide comments on the environmental and regulatory issues that the proposed environmental document will need to evaluate. Below are the comments of the North Carolina Division of Coastal Management.

- The proposed project will be occurring in, New Hanover County, one of North Carolina's twenty coastal counties. Furthermore this proposed project will require a Federal license. Consequently the proposed project, before it can be implemented, will require regulatory review from DCM under Subpart "D" of 15 CFR 930. However, in the event that the proposed project affects an Area of Environmental Concern (AEC) and qualifies as "*development*" under §113A-103(5)(a) of the Coastal Area Management Act (CAMA) the entire proposed project may require that a CAMA permit be required instead.
- Though not specifically required, we recommend that the environmental document comply with the information requirement of 15 CFR 930.58.
- According to the scoping request, the proposed environmental document will evaluate the construction, operation, and decommissioning of the facility. Considering proposed projects complexity and the length of time that the facility will probably be in operation; in terms of permitting, discrete permits may be required to authorize each phase of the project: (construction, operation, and decommissioning). We recommend that the environmental document evaluate the anticipated types of approvals required for each phase.

400 Commerce Ave., Morehead City, NC 28557-3421
Phone: 252-808-2808 \ FAX: 252-247-3330 Internet: www.nccoastalmanagement.net

- We suggest that the environmental document graphically delineate any AEC that may exist in the study area.
- We suggest that any wetland delineations (if required) separate coastal wetlands from Section 404 wetlands and specifically identify each wetland type.
- We suggest that the environmental document clearly define the construction activities and methods to build the proposed facility. Resource concerns related to this issue would be conformance with any moratorium periods, endangered species, conversion of habitat to urban uses, water quality, stormwater management, waste management, storage of nuclear material, and/or the potential to impact coastal resources (especially those within an AEC). Please see 15 CFR 930.11.
- We suggest that the environmental document assess operational issues such as groundwater uptake, discharges into public trust waters, potential closure of public access and/or public use of coastal waters, etc. Please see 15 CFR 930.11.

Thank you for your consideration of the North Carolina Coastal Management Program.

Sincerely,

Stephen Rynas, AICP
Federal Consistency Coordinator

cc: Doug Huggett, Division of Coastal Management
Steve Everhart, Division of Coastal Management
Christine Ridge, US Nuclear Regulatory Commission

JUN 10 2009

DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL HEALTH

Inter-Agency Project Review Response

Project Number **09-0336**

County **New Hanover**

Project Name **GE-Hitachi Global Laser Enrichment LLC (GLE)**

Type of Project **Construct & operate uranium-enhanced facility - Proposed GLE Facility.**

RECEIVED MAY 27 2009

Comments provided by:

☐ Regional Program Person

☒ Regional Supervisor for Public Water Supply Section

☐ Central Office program person

DJW 6/8/09

Name **Debra Benoy-Wilmington RO** Date **05/22/2009**

Telephone number: 910-796-7215

Program within Division of Environmental Health:

☑ Public Water Supply

☐ Other, Name of Program: ______

Response (check all applicable):

☐ No objection to project as proposed

☐ No comment

☐ Insufficient information to complete review

☐ Comments attached

☑ See comments below

Engineering plans and specifications may need to be submitted for prior approval before water lines can be extended to serve this facility

Return to:
Public Water Supply Section
Environmental Review Coordinator for the
Division of Environmental Health

DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL HEALTH

Project Number
09-0336
County
New Hanover

Inter-Agency Project Review Response

Project Name **GE-Hitachi Global Laser Enrichment LLC (GLE)**

Type of Project **Construct & operate uranium-enhanced facility - Proposed GLE Facility.**

☑ The applicant should be advised that plans and specifications for all water system improvements must be approved by the Division of Environmental Health prior to the award of a contract or the initiation of construction (as required by 15A NCAC 18C .0300et. seq.). For information, contact the Public Water Supply Section, (919) 733-2321.

☐ This project will be classified as a non-community public water supply and must comply with state and federal drinking water monitoring requirements. For more information the applicant should contact the Public Water Supply Section, (919) 733-2321.

☐ If this project is constructed as proposed, we will recommend closure of _____ feet of adjacent waters to the harvest of shellfish. For information regarding the shellfish sanitation program, the applicant should contact the Shellfish Sanitation Section at (252) 726-6827.

☐ The soil disposal area(s) proposed for this project may produce a mosquito breeding problem. For information concerning appropriate mosquito control measures, the applicant should contact the Public Health Pest Management Section at (919) 733-6407.

☐ The applicant should be advised that prior to the removal or demolition of dilapidated structures, an extensive rodent control program may be necessary in order to prevent the migration of the rodents to adjacent areas. For information concerning rodent control, contact the local health department or the Public Health Pest Management Section at (919) 733-6407.

☐ The applicant should be advised to contact the local health department regarding their requirements for septic tank installations (as required under 15A NCAC 18A. 1900 et. sep.). For information concerning septic tank and other on-site waste disposal methods, contact the On-Site Wastewater Section at (919) 733-2895.

☐ The applicant should be advised to contact the local health department regarding the sanitary facilities required for this project.

☑ If existing water lines will be relocated during the construction, plans for the water line relocation must be submitted to the Division of Environmental Health, Public Water Supply Section, Technical Services Branch, 1634 Mail Service Center, Raleigh, North Carolina 27699-1634, (919) 733-2321.

☒ For Regional and Central Office comments, see the reverse side of this form.

Jim McRight	PWSS	05/22/2009
Reviewer	Section/Branch	Date

NCDENR
North Carolina Department of Environment and Natural Resources
Division of Water Quality
Coleen H. Sullins
Director

Beverly Eaves Perdue
Governor

Dee Freeman
Secretary

June 4, 2009

MEMORANDUM

TO: Melba McGee
Department of Environment and Natural Resources

THRU: Dianne Reid, Supervisor
Basinwide Planning Unit and SEPA Program

FROM: Hannah Stallings, SEPA Coordinator
Basinwide Planning Unit and SEPA Program

SUBJECT: New Hanover County
GLE Environmental Report – Executive Summary
DWQ#14147; DENR#09-0336

The Division of Water Quality (DWQ) has reviewed the Executive Summary provided for the subject project. Without reviewing the entire Environmental Report, we cannot concur with GLE's conclusion that the project will only result in small impacts to water resources.

On April 9, 2009, DWQ issued a memo (attached) regarding a renewal of a special nuclear material license SNM-1097 for the GNF-A site, which the GLE will be located within. We have not received a reply to these comments and request that the concerns raised in our April memo be resolved prior to this GLE project proceeding.

DWQ's NPDES Eastern Unit recently renewed the discharge permit for the GNF-A facility. They were not advised of any increases in flow associated with this permit renewal. Therefore, if the currently proposed project will result in an increase in discharged flow, Ron Berry (ron.berry@ncdenr.gov, 807-6396) should be notified immediately.

Please contact me at 807-6434 if I can be of any additional help.
Thank you.

Attachment

Cc: Rick Shiver, Charlie Stehman – WiRO
Jeff Poupart, Ron Berry – NPDES
Nora Deamer – BPU

1617 Mail Service Center, Raleigh, North Carolina 27699-1617
Location: 512 N. Salisbury St. Raleigh, North Carolina 27604
Phone: 919-807-6300 \ FAX: 919-807-6492 \ Customer Service: 1-877-623-6748
Internet: www.ncwaterquality.org

NCDENR
North Carolina Department of Environment and Natural Resources
Division of Water Quality

Beverly Eaves Perdue
Governor

Coleen H. Sullins
Director

Dee Freeman
Secretary

April 9, 2009

MEMORANDUM

TO: Melba McGee
Department of Environment and Natural Resources

THRU: Dianne Reid, Supervisor
Basinwide Planning Unit and SEPA Program

FROM: Hannah Stallings, SEPA Coordinator
Basinwide Planning Unit and SEPA Program

SUBJECT: New Hanover County
EA for the Renewal of SNM-1097 for Global Nuclear Fuels-Americas (GNF-A), Wilmington Fuel Fabrication Facility
DWQ#14112; DENR#09-0247

The Division of Water Quality (DWQ) has reviewed the subject project. GNF-A holds a permit for the discharge of up to 1.8 MGD of process wastewater and 75,000 GPD of domestic wastewater, and there have not been any compliance issues with their discharge permit (NC0001228) that is also currently in the process of being renewed. However, the Division has the following comments that need to be addressed prior to a Finding of No Significant Impact (FNSI) being issued for this project:

1. The document should clarify whether "sanitary water" is the same as "wastewater."
2. Section 1.3 – Text states that GNF-A is pursuing the renewal of a 40 year license for the site to continue operation with "no major upgrades or refurbishment activities." DWQ is concerned that this EA and subsequent permits will allow for the future construction of the laser enrichment and tooling development buildings to piggyback on any approvals intended solely for GNF-A.
   a. This section should also mention the future tooling development center.
   b. If construction of these two facilities (the laser enrichment and tooling development centers) will be allowed by approval of this EA, please make that clear in the document.
   c. More explanation of the interrelatedness of the GNF-A facility and the laser enrichment and tooling development projects is required to understand how the impacts from the latter two projects can be viewed as cumulative impacts of the GNF-A renewal and not separate, direct impacts unto themselves.
3. Section 2.6 – DWQ requests to comment upon any license amendments the facility may pursue during the 40-year period for its license renewal.
4. Section 3.5.1 should include that the project is located in Cape Fear subbasin number 03-06-23.
5. Section 4.1 –
   a. Description of the land use impacts from the laser enrichment center needs to be added.

1617 Mail Service Center, Raleigh, North Carolina 27699-1617
Location: 512 N. Salisbury St. Raleigh, North Carolina 27604
Phone: 919-807-6300 \ FAX: 919-807-6492 \ Customer Service: 1-877-623-6748
Internet: www.ncwaterquality.org

b. Text in this section (page 34) says the tooling development center will impact 30 acres and need a new road. However, the first paragraph says that since the GNF-A facility already exists that short and long term impacts on land use will be small. While that this statement may be true, considering that the site is 1664 acres, impacts will not be minimized if construction occurs in or around wetland areas. Therefore, GNF-A needs to provide more detail on the proposed building impacts. (Please address in section 4.5 also).

6. Section 4.5 –
   a. Text in this section states "potential short-term surface water impacts … include changes in water quality in the Northeast Cape Fear River and its tributaries due to contaminated effluent discharges" and that liquid effluents are treated and discharged "in accordance with NPDES Permit NC0001228 and 10 CFR Part 20 requirements." It would seem that if effluents are in compliance with NPDES permit limits that the discharges would not be considered "contaminated." (Similar statements are found in section 2.4, pages 10-11.) Please clarify this issue.
   b. The lagoon system mentioned here should be mentioned in section under "Waste Management" discussions.
   c. The second paragraph states that wastewater from the tooling development center will be pumped to the GNF-A lagoons from treatment and then discharged to the Cape Fear River. Please reconcile this with text in section 2.4 (page 11) that describes how GNF-A is changing is wastewater treatment process to recycle its effluent, eliminating its discharge.
   d. Third paragraph – The second and fourth sentences contradict each other, in that the second sentence describes spills and leaks that have resulted in groundwater contamination and the fourth states that current producers "have effectively prevented their occurrence." Please amend this discussion so that it provides consistent statements regarding spills and resulting contamination events.
   e. Fourth paragraph – The first and third sentences contradict each other, in that the first sentence states that "Potential impacts to the water quality of wetlands are not anticipated from continued operations at the GNF-A site" and the third sentence states that "Water quality in wetlands in and around the GNF-A site could be affected by discharges of liquid effluents (e.g., storm water runoff) and gaseous emissions." Please amend the text so that it provides consistent statements about the likelihood for fouling the water quality of wetlands.
7. Section 4.12
   a. The tooling development center and its proposed 11,500 gpd discharge and additional stormwater should be addressed in this section.
   b. The second sentence of the second paragraph describes a co-mingling of waste streams that section 2.4 describes as being treated separately. Please reconcile these seemingly contradictory statements.
   c. Please correct the text to indicate that "changes in groundwater or soil quality due to releases of hazardous chemicals" is a direct operational impact of the project.
8. Section 6.0
   a. Text states that the proposed project "will not cause significant additional impact on the environment. The facility already exists, and no changes to the GNF-A facility of its operation are associated with the license renewal. The Proposed Action can be considered a continuation of impacts and was evaluated based on impacts from past operations … Cumulative impacts over the 40-year renewal period were also evaluated and determined to be SMALL to MODERATE."
      i. If approval of this project does implicitly sanction the construction of the tool and laser facilities, activities which appear beyond this license renewal, then the impacts from this project must be included in this document.
      ii. While the beginning of the quoted section states that impacts from the project will not be "significant," the last sentence states that the impacts will be "SMALL to MODERATE." The last sentence leads one to believe that there will be significant impacts resulting from this project.
         1. Please respond regarding this contradiction.
         2. If projected impacts are significant, DWQ requests that an EIS be prepared for this project.

Cc: Rick Shiver – WiRO

State of North Carolina
Department of Environment and Natural Resources

Reviewing Office: W:RO

INTERGOVERNMENTAL REVIEW - PROJECT COMMENTS

Project Number: 09-0336 Due Date: 6/15/09

After review of this project it has been determined that the ENR permit(s) and/or approvals indicated may need to be obtained in order for this project to comply with North Carolina Law. Questions regarding these permits should be addressed to the Regional Office indicated on the reverse of the form. All applications, information and guidelines relative to these plans and permits are available from the same Regional Office.

	PERMITS	SPECIAL APPLICATION PROCEDURES or REQUIREMENTS	Normal Process Time (statutory time limit)
☐	Permit to construct & operate wastewater treatment facilities, sewer system extensions & sewer systems not discharging into state surface waters.	Application 90 days before begin construction or award of construction contracts. On-site inspection. Post-application technical conference usual.	30 days (90 days)
☑	NPDES - permit to discharge into surface water and/or permit to operate and construct wastewater facilities discharging into state surface waters.	Application 180 days before begin activity. On-site inspection. Pre-application conference usual. Additionally, obtain permit to construct wastewater treatment facility-granted after NPDES. Reply time, 30 days after receipt of plans or issue of NPDES permit-whichever is later.	90-120 days (N/A)
☐	Water Use Permit	Pre-application technical conference usually necessary	30 days (N/A)
☐	Well Construction Permit	Complete application must be received and permit issued prior to the installation of a well.	7 days (15 days)
☐	Dredge and Fill Permit	Application copy must be served on each adjacent riparian property owner. On-site inspection. Pre-application conference usual. Filling may require Easement to Fill from N.C. Department of Administration and Federal Dredge and Fill Permit.	55 days (90 days)
☐	Permit to construct & operate Air Pollution Abatement facilities and/or Emission Sources as per 15 A NCAC (2Q.0100, 2Q.0300, 2H.0600)	N/A	60 days
☐	Any open burning associated with subject proposal must be in compliance with 15 A NCAC 20.1900	N/A	60 days (90 days)
☐	Demolition or renovations of structures containing asbestos material must be in compliance with 15 A NCAC 20.1110 (a) (1) which requires notification and removal prior to demolition. Contact Asbestos Control Group 919-707-5950.		
☐	Complex Source Permit required under 15 A NCAC 2D.0800		
☑	The Sedimentation Pollution Control Act of 1973 must be properly addressed for any land disturbing activity. An erosion & sedimentation control plan will be required if one or more acres to be disturbed. Plan filed with proper Regional Office (Land Quality Section) At least 30 days before beginning activity. A fee of ~~$50~~ 65 for the first acre or any part of an acre. An express review option is available with additional fees.		20 days (30 days)
☐	Sedimentation and erosion control must be addressed in accordance with NCDOT's approved program. Particular attention should be given to design and installation of appropriate perimeter sediment trapping devices as well as stable stormwater conveyances and outlets.		(30 days)
☐	Mining Permit	On-site inspection usual. Surety bond filed with ENR Bond amount varies with type mine and number of acres of affected land. Any arc mined greater than one acre must be permitted. The appropriate bond must be received before the permit can be issued.	30 days (60 days)
☐	North Carolina Burning permit	On-site inspection by N.C. Division Forest Resources if permit exceeds 4 days	1 day (N/A)
☐	Special Ground Clearance Burning Permit - 22 counties in coastal N.C. with organic soils	On-site inspection by N.C. Division Forest Resources required "if more than five acres of ground clearing activities are involved. Inspections should be requested at least ten days before actual burn is planned."	1 day (N/A)
☐	Oil Refining Facilities	N/A	90-120 days (N/A)
☐	Dam Safety Permit	If permit required, application 60 days before begin construction. Applicant must hire N.C. qualified engineer to: prepare plans, inspect construction, certify construction is according to ENR approved plans. May also require permit under mosquito control program. And a 404 permit from Corps of Engineers. An inspection of site is necessary to verify Hazard Classification. A minimum fee of $200.00 must accompany the application. An additional processing fee based on a percentage or the total project cost will be required upon completion.	30 days (60 days)

	PERMITS	SPECIAL APPLICATION PROCEDURES or REQUIREMENTS	Normal Process Time (statutory time limit)
☐	Permit to drill exploratory oil or gas well	File surety bond of $5,000 with ENR running to State of NC conditional that any well opened by drill operator shall, upon abandonment, be plugged according to ENR rules and regulations.	10 days N/A
☐	Geophysical Exploration Permit	Application filed with ENR at least 10 days prior to issue of permit. Application by letter. No standard application form.	10 days N/A
☐	State Lakes Construction Permit	Application fees based on structure size is charged. Must include descriptions & drawings of structure & proof of ownership of riparian property.	15-20 days N/A
☑	401 Water Quality Certification	N/A	60 days (130 days)
☐	CAMA Permit for MAJOR development	$250.00 fee must accompany application	55 days (150 days)
☐	CAMA Permit for MINOR development	$50.00 fee must accompany application	22 days (25 days)
☐	Several geodetic monuments are located in or near the project area. If any monument needs to be moved or destroyed, please notify: N.C. Geodetic Survey, Box 27687 Raleigh, NC 27611		
☐	Abandonment of any wells, if required must be in accordance with Title 15A. Subchapter 2C.0100.		
☐	Notification of the proper regional office is requested if "orphan" underground storage tanks (USTS) are discovered during any excavation operation.		
☑	Compliance with 15A NCAC 2H 1000 (Coastal Stormwater Rules) is required.		45 days (N/A)
☐	Tar Pamlico or Neuse Riparian Buffer Rules required.		
*	Other comments (attach additional pages as necessary, being certain to cite comment authority)		

REGIONAL OFFICES

Questions regarding these permits should be addressed to the Regional Office marked below.

☐ **Asheville Regional Office**
2090 US Highway 70
Swannanoa, NC 28778
(828) 296-4500

☐ **Mooresville Regional Office**
610 East Center Avenue, Suite 301
Mooresville, NC 28115
(704) 663-1699

☐ **Wilmington Regional Office**
127 Cardinal Drive Extension
Wilmington, NC 28405
(910) 796-7215

☐ **Fayetteville Regional Office**
225 North Green Street, Suite 714
Fayetteville, NC 28301-5043
(910) 433-3300

☐ **Raleigh Regional Office**
3800 Barrett Drive, Suite 101
Raleigh, NC 27609
(919) 791-4200

☐ **Winston-Salem Regional Office**
585 Waughtown Street
Winston-Salem, NC 27107
(336) 771-5000

☐ **Washington Regional Office**
943 Washington Square Mall
Washington, NC 27889

NORTH CAROLINA STATE CLEARINGHOUSE
DEPARTMENT OF ADMINISTRATION
INTERGOVERNMENTAL REVIEW

COUNTY: NEW HANOVER

H11: ENERGY RELATED FACILITIES/ACTIVITIES

STATE NUMBER: 09-E-0000-0336
DATE RECEIVED: 05/19/2009
AGENCY RESPONSE: 06/15/2009
REVIEW CLOSED: 06/19/2009

MS MELBA MCGEE
CLEARINGHOUSE COORDINATOR
DENR - COASTAL MGT
C/O ARCHDALE BLDG
RALEIGH NC

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DENR LEGISLATIVE AFFAIRS
DEPT OF AGRICULTURE
DEPT OF CULTURAL RESOURCES
DEPT OF TRANSPORTATION

PROJECT INFORMATION

APPLICANT: U.S. Nuclear Regulatory Commission
TYPE: National Environmental Policy Act
Scoping

DESC: Proposal for General Electric-Hitachi Global Laser Enrichment to construction, operation, decommissioning a uranium facility - entails using a laser-based technology to separate or enrich the naturally occurring isotopes of uranium; project to be located on existing General Electric Company/Global Nuclear Fuel - Americas near Wilmington, NC

The attached project has been submitted to the N. C. State Clearinghouse for intergovernmental review. Please review and submit your response by the above indicated date to 1301 Mail Service Center, Raleigh NC 27699-1301.

If additional review time is needed, please contact this office at (919)807-2425.

AS A RESULT OF THIS REVIEW THE FOLLOWING IS SUBMITTED: ☐ NO COMMENT ☐ COMMENTS ATTACHED

SIGNED BY: ______________________ DATE: ____________

Department of Environment and Natural Resources
Office of Legislative and Intergovernmental Affairs
Project Review Form

Project Number	County	Date Received	Date Response Due (firm deadline)
09-0336	New Hanover	5/20/09	6/15/09

Morehead City DCM

This project is being reviewed as indicated below:

Regional Office	Regional Office Area	In-House Review	
__ Asheville	✓ Air	__ Soil & Water	✓ Marine Fisheries
__ Fayetteville	✓ Water	✓ Coastal Management	
__ Mooresville	✓ Aquifer Protection	✓ Wildlife ________	
__ Raleigh	✓ Land Quality Engineer	✓ Forest Resources ________	
__ Washington		__ Water Resources	✓ Environmental Health
✓ Wilmington		✓ Parks & Recreation	✓ Waste Mgmt
__ Winston-Salem		✓ Water Quality	__ Radiation Protection
		__ Air Quality	__ Other

Manager Sign-Off/Region:	Date:	In-House Reviewer/Agency:

Response (check all applicable)

__ No objection to project as proposed

__ No comment

__ Insufficient information to complete review

__ Other (specify or attach comments)

RETURN TO:
Melba McGee
Environmental Coordinator
1601 Mail Service Center
Raleigh, NC 27699-1601

NORTH CAROLINA STATE CLEARINGHOUSE
DEPARTMENT OF ADMINISTRATION
INTERGOVERNMENTAL REVIEW

COUNTY: NEW HANOVER

H11: ENERGY RELATED FACILITIES/ACTIVITIES

STATE NUMBER: 09-E-0000-0336
DATE RECEIVED: 05/19/2009
AGENCY RESPONSE: 06/15/2009
REVIEW CLOSED: 06/19/2009

RECEIVED
MAY 20 2009
HISTORIC PRESERVATION OFFICE

MS RENEE GLEDHILL-EARLEY
CLEARINGHOUSE COORDINATOR
DEPT OF CULTURAL RESOURCES
STATE HISTORIC PRESERVATION OFFICE
MSC 4617 - ARCHIVES BUILDING
RALEIGH NC

ER 07-2157

A- DAH 6/1/09

REVIEW DISTRIBUTION

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DENR - COASTAL MGT
DENR LEGISLATIVE AFFAIRS
DEPT OF AGRICULTURE
DEPT OF CULTURAL RESOURCES
DEPT OF TRANSPORTATION

Due 6/10/09

PROJECT INFORMATION

APPLICANT: U.S. Nuclear Regulatory Commission
TYPE: National Environmental Policy Act
Scoping

DESC: Proposal for General Electric-Hitachi Global Laser Enrichment to construction, operation, decommissioning a uranium facility - entails using a laser-based technology to separate or enrich the naturally occurring isotopes of uranium; project to be located on existing General Electric Company/Global Nuclear Fuel - Americas near Wilmington, NC

The attached project has been submitted to the N. C. State Clearinghouse for intergovernmental review. Please review and submit your response by the above indicated date to 1301 Mail Service Center, Raleigh NC 27699-1301.

If additional review time is needed, please contact this office at (919)807-2425.

AS A RESULT OF THIS REVIEW THE FOLLOWING IS SUBMITTED: ☐ NO COMMENT ☒ COMMENTS ATTACHED

SIGNED BY: Renee Gledhill-Earley

DATE: 6.2.09

JUN 2009
RECEIVED
Secretary's Office
DOA

North Carolina Department of Cultural Resources
State Historic Preservation Office
Peter B. Sandbeck, Administrator

Beverly Eaves Perdue, Governor
Linda A. Carlisle, Secretary
Jeffrey J. Crow, Deputy Secretary

Office of Archives and History
Division of Historical Resources
David Brook, Director

June 2, 2009

Andrea Kock
Environmental Review Branch
Division of Waste Management and
Environmental Protection
US Nuclear Regulatory Commission
Washington, DC 20555-0001

Re: Initiation of the National Historic Preservation Act Section 106 Process for General Electric-Hitachi Global Laser Enrichment Proposed Uranium Enrichment Facility, New Hanover County, ER 07-2157

Dear Ms. Kock:

Thank you for your letter of April 29, 2009, concerning the above project. We have reviewed the relevant sections of the GLE Environmental Report and offer the following comments.

The Environmental Report offers an accurate description and assessment of the cultural resources found to be located within the Area of Potential Effect (APE) for the proposed facilities. No additional identification activities are warranted for cultural resources in connection with this project. In our letter dated April 9, 2008, to Scott Seibel of Environmental Services, Inc., we concurred with his evaluation of archaeological site 31NH801 as eligible for inclusion in the National Register of Historic Places under Criterion D and with the adequacy of his report of the investigations.

The Environmental Report states that the access road adjacent to site 31NH801 will not be widened and the project, therefore, will have no effect upon the site. We request that final plans for the proposed facility and access roads be forwarded to us for our review as soon as they are available. We also request that we be informed of the measures now being taken and those to be taken in the future to ensure protection and preservation of the site from proposed and future ground disturbing activities.

If during construction, there are unanticipated discoveries of cultural resources, we recommend that all ground disturbing activities within the vicinity cease, and our office be notified as soon as possible. If unmarked burials or human skeletal remains are encountered, compliance with the provisions of North Carolina General Statutes Chapter 70, Article 3 should be undertaken.

Please note that archaeological site locations are protected under the provisions of North Carolina General Statutes 70-18 and should not be made available to the public. Maps depicting site locations should not be included in environmental or other documents made available to the public, as this constitutes a risk of harm.

We look forward to working with your staff and their consultants on this project.

Location: 109 East Jones Street, Raleigh NC 27601 **Mailing Address:** 4617 Mail Service Center, Raleigh NC 27699-4617 **Telephone/Fax:** (919) 807-6570/807-6599

The above comments are made pursuant to Section 106 of the National Historic Preservation Act and the Advisory Council on Historic Preservation's Regulations for Compliance with Section 106 codified at 36 CFR Part 800.

Thank you for your cooperation and consideration. If you have questions concerning the above comment, please contact Renee Gledhill-Earley, environmental review coordinator, at 919/807-6579. In all future communication concerning this project, please cite the above referenced tracking number.

Sincerely,

Renee Gledhill-Earley

Peter Sandbeck

cc: Christianne Ridge, Division of Waste Management and Environmnetal Protection
Clearinghouse

North Carolina
Department of Administration

Beverly Eaves Perdue, Governor

Britt Cobb, Secretary

June 24, 2009

Ms. Andrea Kock
U.S. Nuclear Regulatory Commission
FSME/DWMEP/ERB
T-8F05
Washington, DC 20555-0001

Re: SCH File # 09-E-0000-0336; SCOPING; Proposal for General Electric-Hitachi Global Laser Enrichment to construction, operation, decommissioning a uranium facility

Dear Ms. Kock:

The above referenced environmental impact information has been submitted to the State Clearinghouse under the provisions of the National Environmental Policy Act. According to G.S. 113A-10, when a state agency is required to prepare an environmental document under the provisions of federal law, the environmental document meets the provisions of the State Environmental Policy Act. Attached to this letter for your consideration are **additional** comments made by agencies in the course of this review.

If any further environmental review documents are prepared for this project, they should be forwarded to this office for intergovernmental review.

Should you have any questions, please do not hesitate to call.

Sincerely,

Valerie McMillan (S76)

Valerie W. McMillan, Director
State Environmental Review Clearinghouse

Attachments

cc: Region O

Mailing Address:
1301 Mail Service Center
Raleigh, NC 27699-1301

Telephone: (919)807-2425
Fax (919)733-9571
State Courier #51-01-00
e-mail valerie.w.mcmillan@doa.nc.gov

Location Address:
116 West Jones Street
Raleigh, North Carolina

North Carolina Department of Environment and Natural Resources

Beverly Eaves Perdue
Governor

Dee Freeman
Secretary

MEMORANDUM

RECEIVED
JUN 2009
ENVIRONMENT OPERATIONS DOA

TO: Valerie McMillan
State Clearinghouse

FROM: Melba McGee
Project Review Coordinator

RE: 09-0336 General Electric-Hitachi Global Laser Enrichment Project in New Hanover County

DATE: June 23, 2009

The attached comments were received by this office after the response due date. These comments should be forwarded to the applicant and made a part of our previous comment package.

Thank you for the opportunity to respond.

Attachment

1601 Mail Service Center, Raleigh, North Carolina 27699-1601
Phone: 919-733-4984 \ FAX: 919-715-3060 Internet: www.enr.state.nc.us

07-0336

NCDENR

North Carolina Department of Environment and Natural Resources

Dexter Matthews, Director — **Division of Waste Management** — Beverly Eaves Perdue, Governor
Dee Freeman, Secretary

MEMORANDUM

June 16, 2009

TO: Dexter R. Matthews, Director
Division of Waste Management

THROUGH Jack Butler, P. E., Chief, [signature]
N. C. Superfund Section

FROM: S. Franch, Environmental Chemist, Superfund Section [signature]

SUBJECT: General Electric-Hitachi Global Laser Enrichment Project
(New Hanover County)

I have completed the review of the attached information on the subject project for the proximity to CERCLIS or inactive hazardous waste sites. The subject project involves the construction of a uranium enrichment facility and support facilities that uses laser-based technology to be situated on existing General Electric Company property that is located north of Wilmington, NC. This project would occupy 100 acres of the north-central section of the present property. Thirteen sites were identified within a four-mile radius of the project site. Twelve of these sites are located beyond two miles from the project. These sites are listed below and denoted on the attached map.

Five of the thirteen sites are on the CERCLIS database. They are: the Hercofina Site (NCD 990 734 055), the Northeast Chemical Company Site (NCSFN 040 6973), The VC Chemical-Almont Works Site (NC) 002 178 580), The Reasor Chemical Company Site (NCD 986 187 094), and the New Hanover County Airport Burn Pit Site (NCD 981 021 157). The latter two sites are on the National Priorities List and are located at least two miles from the project. The Hercofina site is undergoing remediation under the Registered Environmental Consultant program of the NC Inactive Hazardous Sites Branch (IHSB). The Northeast Chemical Site is undergoing remediation under CERCLA oversight. The VC Chemical-Almont Works Site is under CERCLA evaluation.

The remaining eight sites have been recently transferred from the NC Division of Water Quality (DWQ) to the NC IHSB. They are pending investigation, but have undergone evaluation under the DWQ. These sites are: APAC-Castle Hayne Asphalt Plant (NONCD 000 2779), Lowe Residence (NONCD 000 2787), Ritter Millworks Shop (NONCD 000 2404), Deutsch Relays (NONCD 000 1138), New Hanover County Wastec (NONCD 000 2198), CP&L Transformer Site (NONCD 000 1557), PCS Nitrogen (NONCD 000 2280) and the GE Site (NCD 050 409 150). The General Electric Site itself had three minor spills zones (two of chlorinated solvents; the other of uranyl nitrate and calcium floride) that resulted in installation of monitoring wells and soil capping under the supervision of the DWQ. It is recommended that consultations with Mr. John Walch, environmental supervisor, of the NC IHSB be initiated if there are any construction plans near these remediation areas. Attached are figures and some data pages illustrating the locations of these spill areas.

After reviewing the file information, I believe it is unlikely that the project will affect the sites or vice versa. If you have any questions, please call me at (919) 508-8455.

cc: Jim Bateson
attachments, 7 pages

1646 Mail Service Center, Raleigh, North Carolina 27699-1646
Phone: 919-508-8400 \ FAX: 919-715-4061 \ Internet: www.wastenotnc.org

One NorthCarolina *Naturally*

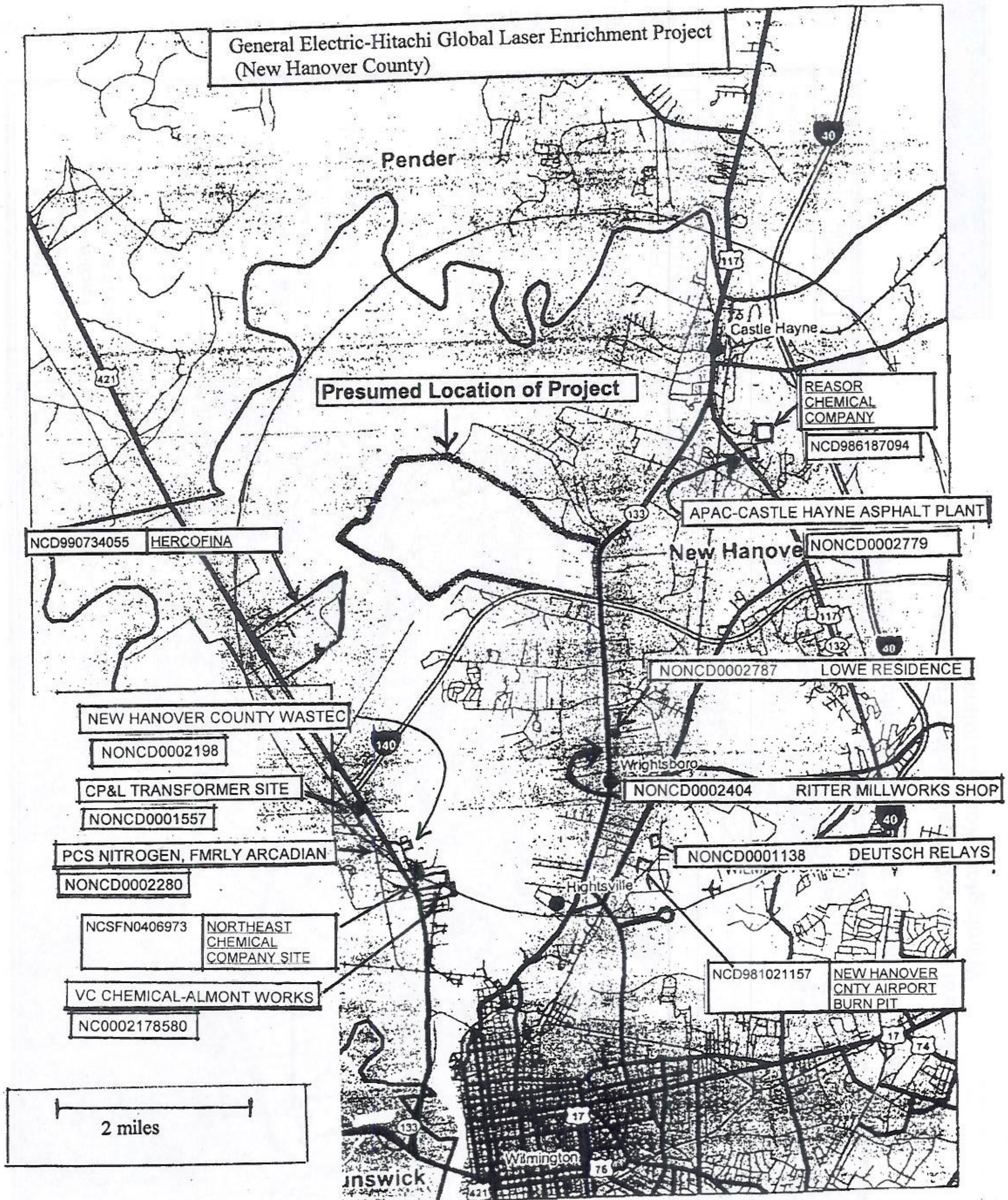

Figure ES-1. Wilmington Site location and vicinity.

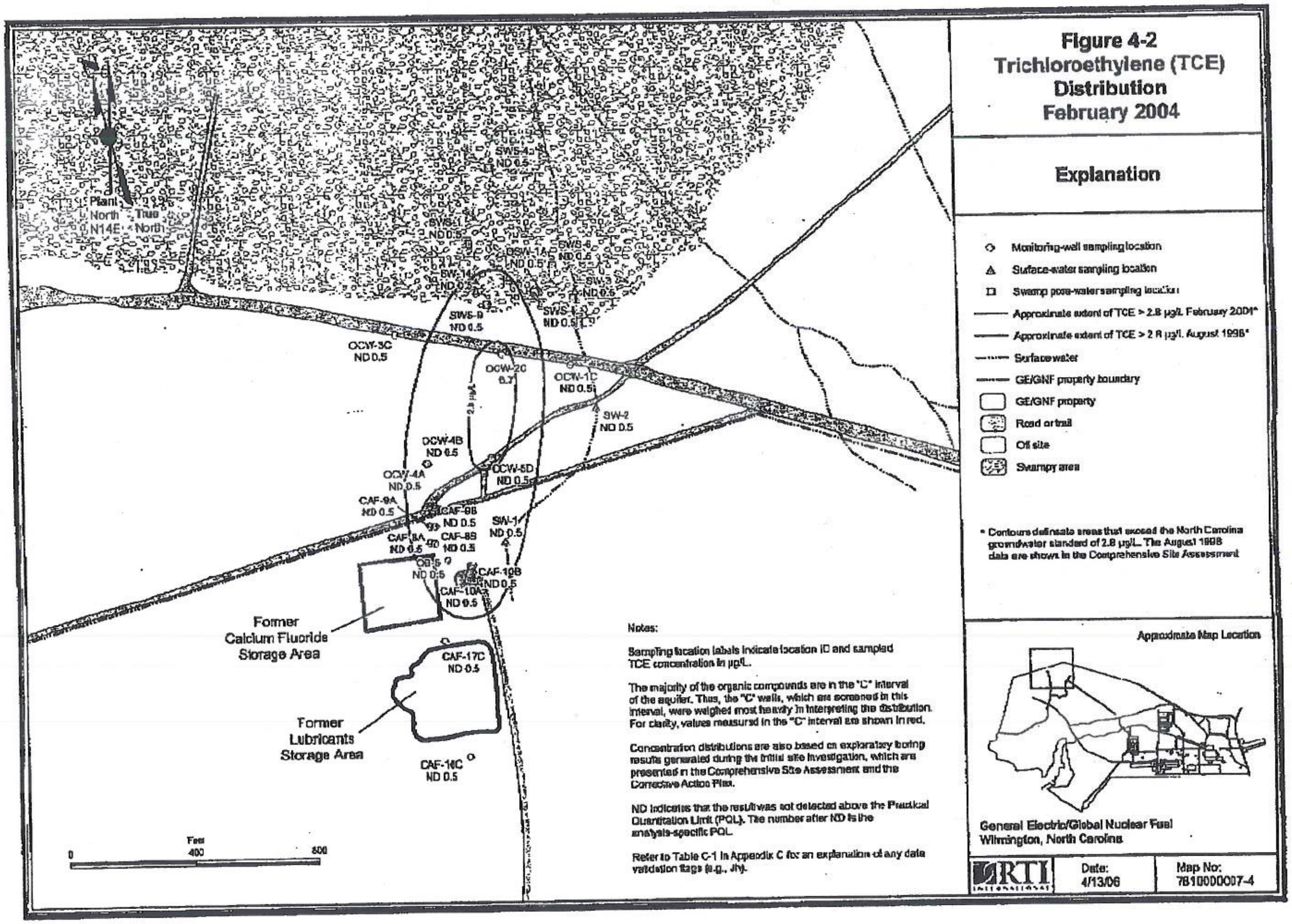
Figure 4-2
Trichloroethylene (TCE)
Distribution
February 2004
Explanation
Monitoring-well sampling location
Surface-water sampling location
Swamp pore-water sampling location
Approximate extent of TCE > 2.8 µg/L February 2004*
Approximate extent of TCE > 2.8 µg/L August 1998*
Surface water
GE/GNF property boundary
GE/GNF property
Road or trail
Off site
Swampy area
* Contours delineate areas that exceed the North Carolina groundwater standard of 2.8 µg/L. The August 1998 data are shown in the Comprehensive Site Assessment
Approximate Map Location
General Electric/Global Nuclear Fuel
Wilmington, North Carolina
RTI INTERNATIONAL
Date: 4/13/06
Map No: 7B10000007-4
Notes:
Sampling location labels indicate location ID and sampled TCE concentration in µg/L.
The majority of the organic compounds are in the "C" interval of the aquifer. Thus, the "C" wells, which are screened in this interval, were weighed most heavily in interpreting the distribution. For clarity, values measured in the "C" interval are shown in red.
Concentration distributions are also based on exploratory boring results generated during the initial site investigation, which are presented in the Comprehensive Site Assessment and the Corrective Action Plan.
ND indicates that the result was not detected above the Practical Quantitation Limit (PQL). The number after ND is the analysis-specific PQL.
Refer to Table C-1 in Appendix C for an explanation of any data validation flags (e.g., J/N).
Plant North N14E
True North
OCW-3C ND 0.5
SWS-9 ND 0.5
OCW-2C 6.7
OCW-1C ND 0.5
SW-2 ND 0.5
OCW-4B ND 0.5
OCW-4A ND 0.5
OCW-5D ND 0.5
CAF-9A ND 0.5
CAF-9B ND 0.5
CAF-8A ND 0.5
CAF-8S ND 0.5
SW-1 ND 0.5
ND 0.5
CAF-10B ND 0.5
CAF-10A ND 0.5
CAF-17C ND 0.5
CAF-16C ND 0.5
Former Calcium Fluoride Storage Area
Former Lubricants Storage Area
Feet
0
400
800

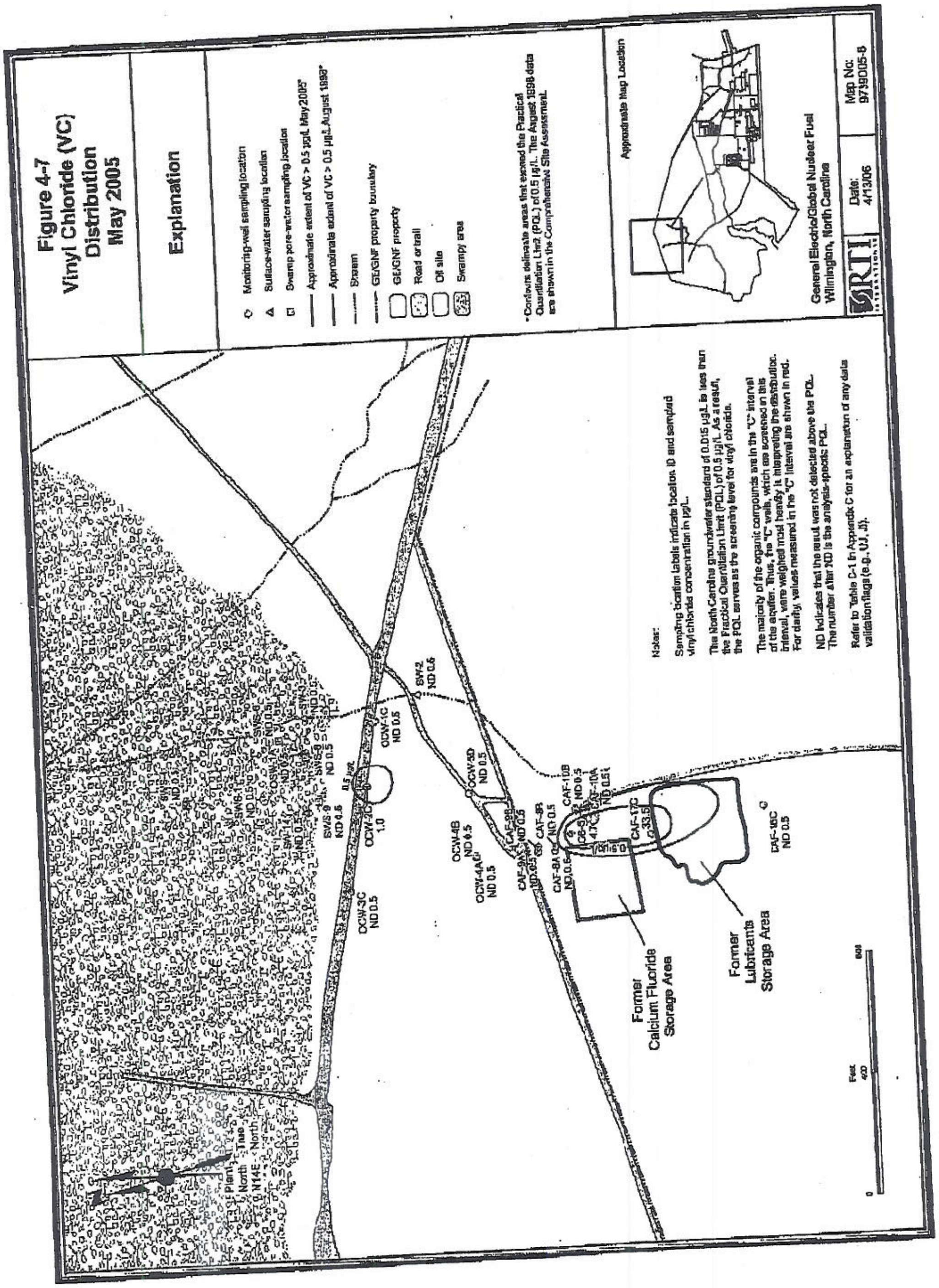
Figure 4-7
Vinyl Chloride (VC) Distribution
May 2005
Explanation
Monitoring-well sampling location
Surface-water sampling location
Swamp pore-water sampling location
Approximate extent of VC > 0.5 µg/L May 2005*
Approximate extent of VC > 0.5 µg/L August 1998*
Stream
GE/GNF property boundary
GE/GNF property
Road or trail
Off site
Swampy area
* Contours delineate areas that exceed the Practical Quantitation Limit (PQL) of 0.5 µg/L. The August 1998 data are shown in the Comprehensive Site Assessment.
Approximate Map Location
General Electric/Global Nuclear Fuel
Wilmington, North Carolina
RTI
Date: 4/13/06
Map No: 9739005-8
Notes:
Sampling location labels indicate location ID and sampled vinyl chloride concentration in µg/L.
The North Carolina groundwater standard of 0.015 µg/L is less than the Practical Quantitation Limit (PQL) of 0.5 µg/L. As a result, the PQL serves as the screening level for vinyl chloride.
The majority of the organic compounds are in the "C" interval of the aquifer. Thus, the "C" wells, which are screened in this interval, were weighed most heavily in interpreting the distribution. For clarity, values measured in the "C" interval are shown in red.
ND indicates that the result was not detected above the PQL. The number after ND is the analysis-specific PQL.
Refer to Table C-1 in Appendix C for an explanation of any data validation flags (e.g., UJ, J).
Former Calcium Fluoride Storage Area
Former Lubricants Storage Area
Plant North
True North
N14E
OCW-3C
ND 0.5
OCW-2C
1.0
OCW-1C
ND 0.5
SW-2
ND 0.6
OCW-4B
ND 0.5
OCW-4AC
ND 0.5
OCW-5D
ND 0.5
CAF-9B
ND 0.5
CAF-9A
ND 0.5
CAF-8B
ND 0.5
CAF-8A
ND 0.6
CAF-10B
ND 0.5
CAF-10A
CAF-17C
33.5
CAF-16C
ND 0.5
SWS-9
ND 0.6
Feet
0
400
800

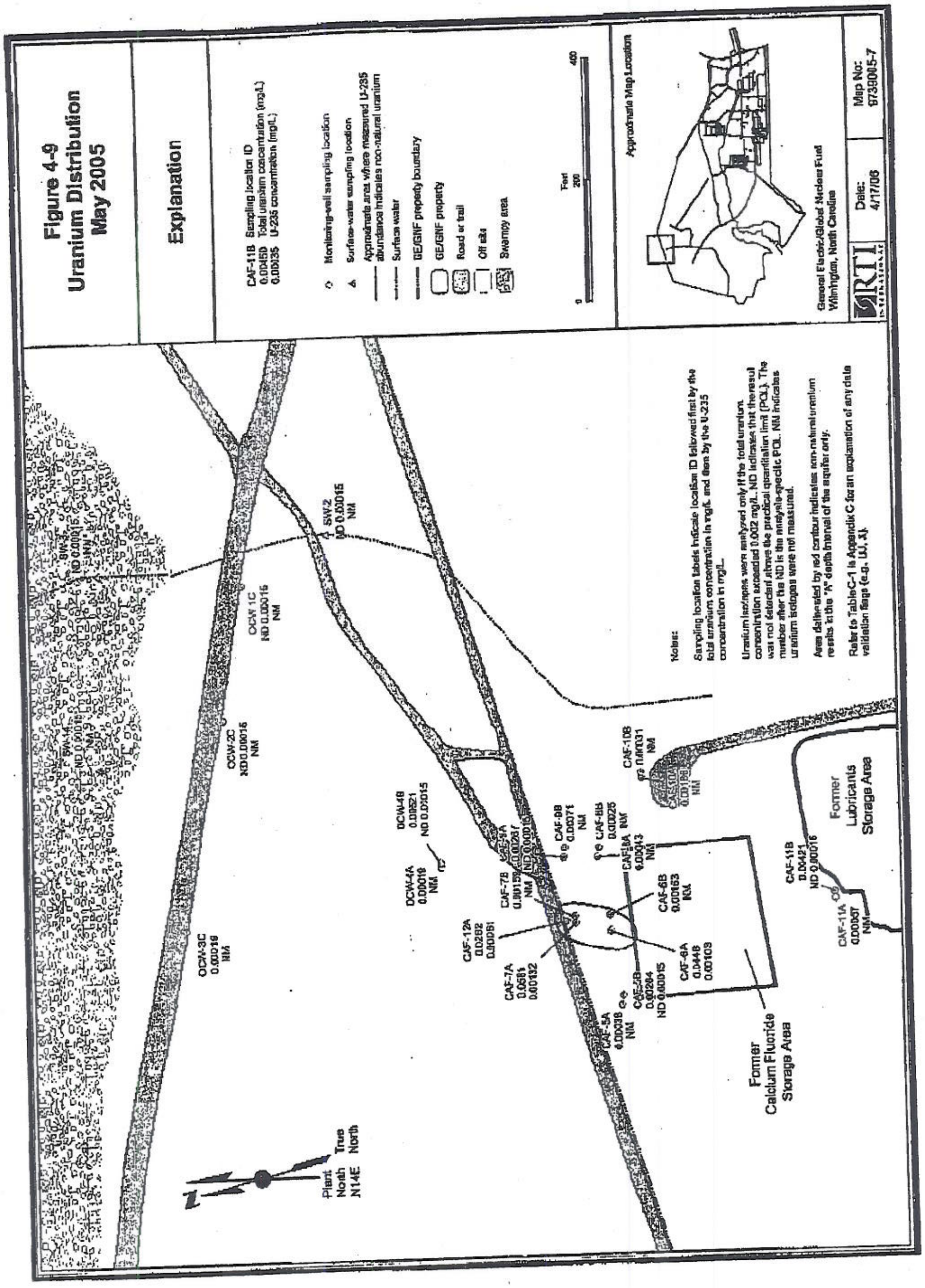
Figure 4-9
Uranium Distribution
May 2005
Explanation
CAF-11B Sampling location ID
0.00450 Total uranium concentration (mg/L)
0.00135 U-235 concentration (mg/L)
Monitoring-well sampling location
Surface-water sampling location
Approximate area where measured U-235 abundance indicates non-natural uranium
Surface water
GE/GNF property boundary
GE/GNF property
Road or trail
Off site
Swampy area
Feet
0
200
400
Approximate Map Location
General Electric/Global Nuclear Fuel
Wilmington, North Carolina
RTI
Date: 4/17/06
Map No: 9739005-7
Notes:
Sampling location labels indicate location ID followed first by the total uranium concentration in mg/L and then by the U-235 concentration in mg/L.
Uranium isotopes were analyzed only if the total uranium concentration exceeded 0.002 mg/L. ND indicates that the result was not detected above the practical quantitation limit (PQL). The number after the ND is the analyte-specific PQL. NM indicates uranium isotopes were not measured.
Area delineated by red contour indicates non-natural uranium results in the "A" depth interval of the aquifer only.
Refer to Table C-1 in Appendix C for an explanation of any data validation flags (e.g., UJ, J).
Plant North N14E
True North
OCW-3C
0.00019
NM
OCW-2C
ND 0.00015
NM
OCW 1C
ND 0.00015
NM
SW-2
ND 0.00015
NM
DCW-4A
0.00019
NM
DCW-4B
0.00521
ND 0.00015
CAF-12A
0.0282
0.00061
CAF-7A
0.0581
0.00132
CAF-7B
CAF-9B
0.00071
NM
CAF-8B
0.00025
NM
CAF-5A
0.00038
NM
CAF-5B
0.00264
ND 0.00015
CAF-6A
0.0448
0.00103
CAF-6B
0.00163
NM
CAF-10B
NM
Former
Calcium Fluoride
Storage Area
CAF-11B
0.00421
ND 0.00015
CAF-11A
0.00057
NM
Former
Lubricants
Storage Area

Table 4-2. Trend Analysis Results for Primary Organic Constituents

Location ID	Corresponding Figure in Appendix D	Start Date	End Date	Mann Kendall S Statistic	Sample Count	Probability (of no trend)	Numerical Average (ug/L)	Standard Deviation (ug/L)	Coefficient of Variation	Trend
Trichloroethylene										
OCW-2C	D-6	1/1/1998	12/31/2004	-154	19	<0.001	21.6789	3.5282	0.1627	Decrease
SW-14	D-11	1/1/2002	12/31/2004	-6	5	0.1172	0.5600	0.0268	0.0479	Inconclusive*
cis-1,2-Dichloroethylene										
CAF-17C	D-4	1/1/1998	12/31/2004	-154	20	<0.001	413.3750	83.3774	0.2017	Decrease
OB-5	D-5	1/1/1993	12/31/2004	-505	38	<0.001	228.9500	31.3493	0.1369	Decrease
OCW-2C	D-6	1/1/1998	12/31/2004	-89	19	<0.001	279.9526	33.4838	0.1196	Decrease
OSW-1A	D-9	1/1/1998	12/31/2004	129	21	<0.001	3.4343	0.2693	0.0784	Increase
		1/1/2001	*12/31/2005*	*-23*	*10*	*0.0230*	*6.0500*	*0.3637*	*0.0601*	*Decrease*
SW-14	D-11	1/1/2002	12/31/2004	8	5	0.0419	7.8600	1.0912	0.1388	Increase
Vinyl Chloride										
CAF-17C	D-4	1/1/1998	12/31/2004	30	20	0.1757	61.8250	9.3524	0.1513	Inconclusive*
		1/1/2002	*12/31/2005*	*-20*	*8*	*0.0069*	*66.7750*	*16.5021*	*0.2471*	*Decrease*
OB-5	D-5	1/1/1993	12/31/2004	101	38	0.1053	5.7266	0.1990	0.0347	Increase
		10/1/2001	*12/31/2005*	*-13*	*9*	*0.1089*	*8.0889*	*1.5630*	*0.1932*	*Decrease*
OCW-2C	D-6	1/1/1998	12/31/2004	36	19	0.1121	1.1663	0.0307	0.0263	Increase
		2/1/2002	*12/31/2005*	*-9*	*8*	*0.1666*	*1.2375*	*0.4022*	*0.3250*	*Decrease*
SW-14	D-11	1/1/2002	12/31/2004	3	5	0.3209	0.3600	0.1968	0.5466	Inconclusive*

* A review of the data and sensitivity analysis suggests that the statistical analysis is inconclusive due to data quality limitations identified through the data validation process and/or other issues such as varying laboratory practical quantitation limits. Procedures for evaluating and presenting analytical results are outlined in an RTI internal document (SOP 14). These procedures consider detection limits and data-validation qualifiers.

Notes:

- Statistical trend analysis was performed using the Mann-Kendall test for trend. The Mann-Kendall method is documented in Statistical Methods for Environmental Pollution Monitoring (Gilbert, 1987). For sample sizes greater than 40, the normal approximation described in Gilbert (1987) was used. For sample sizes less than or equal to 40, the Kendall's statistic lookup table was used as provided in Nonparametric Statistical Methods (Hollander and Wolfe, 1973).
- Trends were calculated for the full dataset through 2004. More recent trends, calculated for partial datasets, are displayed in *italics*.
- Trend analyses were performed on data collected from locations with a sufficient number of datapoints for analysis (4 or more) and detectable constituent levels during the reporting period.

Table 4-3. Trend Analysis Results for Total Uranium

Location ID	Corresponding Figure in Appendix D	Start Date	End Date	Mann Kendall S Statistic	Sample Count	Probability (of no trend)	Numerical Average (ug/L)	Standard Deviation (ug/L)	Coefficient of Variation	Trend
CAF-5B	D-16	1/1/1995	12/31/2004	-390	36	<0.001	7.26E-03	8.61E-04	0.1185	Decrease
CAF-6A	D-17	1/1/1995	12/31/2004	-352	36	<0.001	1.74E-01	2.68E-02	0.1540	Decrease
CAF-6B	D-18	1/1/1995	12/31/2004	-425	36	<0.001	1.25E-02	1.82E-03	0.1462	Decrease
CAF-7A	D-19	1/1/1995	12/31/2004	-42	35	0.2814	1.13E-01	7.18E-03	0.0636	None
		1/1/2001	*12/31/2005*	*-33*	*14*	*0.0396*	*1.32E-01*	*2.76E-02*	*0.2088*	*Decrease*
CAF-7B	D-20	1/1/1995	12/31/2004	-238	36	<0.001	8.54E-03	1.03E-03	0.1206	Decrease
CAF-8A	D-21	1/1/1995	12/31/2004	-114	36	0.0621	7.72E-04	8.21E-05	0.1062	Inconclusive*
		5/1/1996	*12/31/2005*	*-81*	*36*	*0.1391*	*5.05E-04*	*1.24E-05*	*0.0246*	*Decrease*
CAF-8B	D-22	1/1/1995	12/31/2004	-376	36	<0.001	2.03E-03	2.78E-04	0.1371	Decrease
CAF-9A	D-23	1/1/1995	12/31/2004	-168	35	0.0086	8.22E-03	1.20E-03	0.1464	Decrease
CAF-9B	D-24	1/1/1995	12/31/2004	-422	36	<0.001	3.30E-03	3.99E-04	0.1207	Decrease
CAF-10A	D-25	1/1/1995	12/31/2004	233	36	<0.001	3.53E-03	7.80E-05	0.0221	Increase
		1/1/2003	*12/31/2005*	*-20*	*8*	*0.0069*	*7.20E-03*	*1.32E-03*	*0.1837*	*Decrease*
CAF-12A	D-27	1/1/1995	12/31/2004	-153	34	0.0119	5.54E-02	4.30E-03	0.0777	Decrease

* A review of the data and sensitivity analysis suggests that the statistical analysis is inconclusive due to data quality limitations identified through the data validation process and/or other issues such as varying laboratory practical quantitation limits. Procedures for evaluating and presenting analytical results are outlined in an RTI internal document (SOP 14). These procedures consider detection limits and data-validation qualifiers.

Notes:

- Statistical trend analysis was performed using the Mann-Kendall test for trend. The Mann-Kendall method is documented in Statistical Methods for Environmental Pollution Monitoring (Gilbert, 1987). For sample sizes greater than 40, the normal approximation described in Gilbert (1987) was used. For sample sizes less than or equal to 40, the Kendall's statistic lookup table was used as provided in Nonparametric Statistical Methods (Hollander and Wolfe, 1973).
- Trends were calculated for the full dataset through 2004. More recent trends, calculated for partial datasets, are displayed in *italics*.
- Trend analyses were performed on data collected from locations with a sufficient number of data points for analysis (4 or more), calculated ^{235}U isotopic abundance exceeding natural levels, and detectable constituent levels during the reporting period. The calculated ^{235}U abundance exceeded natural levels only once in CAF-5A, CAF-11B, and OCW-4B. These abundance calculations are anomalous, and these three wells are not included above.

North Carolina
Department of Administration

Beverly Eaves Perdue, Governor

Britt Cobb, Secretary

July 15, 2009

Ms. Andrea Kock
U.S. Nuclear Regulatory Commission
FSME/DWMEP/ERB
T-8F05
Washington, DC 20555-0001

Re: SCH File # 09-E-0000-0336; SCOPING; Proposal for General Electric-Hitachi Global Laser Enrichment to construction, operation, decommissioning a uranium facility

Dear Ms. Kock:

The above referenced environmental impact information has been submitted to the State Clearinghouse under the provisions of the National Environmental Policy Act. Attached to this letter for your consideration are **additional** comments made by agencies after the review period ended.

If any further environmental review documents are prepared for this project, they should be forwarded to this office for intergovernmental review.

Should you have any questions, please do not hesitate to call.

Sincerely,

Valerie McMillan

Valerie W. McMillan, Director
State Environmental Review Clearinghouse

Attachments

cc: Region O

Mailing Address:
1301 Mail Service Center
Raleigh, NC 27699-1301

Telephone: (919)807-2425
Fax (919)733-9571
State Courier #51-01-00
e-mail valerie.w.mcmillan@doa.nc.gov

Location Address:
116 West Jones Street
Raleigh, North Carolina

NCDENR

North Carolina Department of Environment and Natural Resources

Beverly Eaves Perdue, Governor

Dee Freeman, Secretary

JUL 2009
RECEIVED
Secretary's Office
DOA

MEMORANDUM

TO: Valerie McMillan
State Clearinghouse

FROM: Melba McGee
Environmental Projects Officer

SUBJECT: #09-0336 GE-Hitachi Global Laser Enrichment LLC, New Hanover County

DATE: July 14, 2009

The attached comments were received by this office after the response due date. These comments should be forwarded to the applicant and made a part of our previous comment package.

Thank you for the opportunity to respond.

Attachment

1601 Mail Service Center, Raleigh, North Carolina 27699-1601
Phone: 919-733-4984 \ FAX: 919-715-3060 \ Internet: www.enr.state.nc.us/ENR/

One NorthCarolina Naturally

MEMORANDUM

TO: Dexter Matthews, Director
Division of Waste Management

FROM: Dennis Shackelford, Central District Supervisor
Solid Waste Section

DATE: June 10, 2009

SUBJECT: Hitachi Global Laser Enrichment – New Hanover County

The Solid Waste Section has reviewed the Orange Hitachi Global Laser Enrichment – New Hanover County and has seen no adverse impact on the surrounding community and likewise knows of no situations in the community, which would affect the project.

Hitachi Global should make every feasible effort to minimize the generation of waste, to recycle materials for which viable markets exist, and to use recycled products and materials in the development of this project where suitable. Any waste generated by this project that cannot be beneficially reused or recycled must be disposed of at a solid waste management facility permitted by the Division. The nearest permitted facilities to the project are the New Hanover County MSW landfill (permit 65-04) and WASTEC incinerator (65-05I), however supporting documents note that their production waste will go to other uranium conversion facilities.

Questions regarding solid waste management should be directed to Mr. Wes Hare, Environmental Senior Specialist, Solid Waste Section, at (910)796-7405.

cc: Wes Hare

NCDENR

North Carolina Department of Environment and Natural Resources
Division of Waste Management

Beverly Eaves Perdue
Governor

Dexter R. Matthews
Director

Dee Freeman
Secretary

JUL 2009
RECEIVED
Secretary's Office
DOA

May 29, 2009

To: Dexter Matthews, Director
Division of Waste Management

From: Ted Cashion, Supervisor
Eastern Region Compliance Branch

RE: RCRA comments on the GE-Hitachi Global Laser Enrichment LLC (GLE) Environmental Report
Project # 09-0336

The Hazardous Waste Section has reviewed the subject project. GE-Hitachi Global Laser Enrichment LLC (GLE) proposes 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 property near Wilmington, NC. The proposed facility would occupy ~100 acres.

The report states a combination of environmental control systems, treatment processes, monitoring programs, and work practices to protect workers, public health, and the environment would be utilized. Any gaseous releases would be captured and routed through a multi stage air emission control system. 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 to the existing permitted wastewater treatment facilities. Solid wastes would be managed according to applicable regulations and good management practices, and would be shipped offsite for recycling, recovery, or disposal to a licensed facility.

The Divisions of Air Quality, Water Quality, and Radiation Protection should be consulted for comments and possible permitting implications on this project as well.

Solid waste appears to be the most likely waste to be generated in constructing this project. The facility is reminded that if construction, rebuilding, or demolition of structures occurs, the waste that is generated will most likely be a solid waste, and the facility must determine if the waste is a hazardous waste.

It appears that very little hazardous waste, if any, will be generated from this proposed facility. The facility is reminded that if the facility generates >220 pounds of hazardous waste in a calendar month, the Hazardous Waste Section (HWS) must be notified, and the facility must comply with the small quantity generator requirements. If the facility generates ≥ 2200 pounds of hazardous waste in a calendar month, the HWS must be notified, and the facility must comply with the large quantity generator requirements.

The Hazardous Waste Section has no objection to the draft plan.

Should any questions arise, please contact me at 919-508-8557.

1646 Mail Service Center, Raleigh, North Carolina 27699-1646
Phone: 919-508-8400 \ FAX: 919-715-4061 \ Internet: www.wastenotnc.org

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

June 15, 2009

Ms. Wanda L. Lagoe, Chief
Bureau of Education, Training, and Technical Assistance
Division of Occupational Safety and Health
North Carolina Department of Labor
1101 Mail Service Center
Raleigh, NC 27699-1101

SUBJECT: CONSULTATION REGARDING LASER SAFETY FOR AN ENVIRONMENTAL IMPACT STATEMENT REGARDING THE PROPOSED GENERAL ELECTRIC-HITACHI GLOBAL LASER ENRICHMENT FACILITY

Dear Ms. Lagoe:

Thank you for meeting with my staff on May 28, 2008, to discuss the roles of the North Carolina Department of Labor, Division of Occupational Safety and Health (OSHNC) and the U.S. Nuclear Regulatory Commission (NRC) in regulating a laser-based uranium enrichment facility proposed by General Electric-Hitachi (GEH). If built, the facility would be located in New Hanover County, North Carolina. The proposed facility would use a laser-based technology to enrich the isotope uranium-235 in uranium hexafluoride (UF_6) up to 8 percent by weight. As you discussed with my staff in May 2008, OSHNC has been delegated by the Federal Occupational Safety and Health Administration to regulate the safety of laser systems in North Carolina.

On January 30, 2009, GEH submitted an Environmental Report (ER) to NRC as one part of its application for a license to authorize construction, operation, and decommissioning of the proposed facility. The applicant's ER is publicly available in the NRC Agencywide Documents Access and Management System (ADAMS) at http://www.nrc.gov/reading-rm/adams.html using accession number ML090910573.

As required by Title 10 Code of Federal Regulations Part 51 (10 CFR 51), the NRC regulation that implements the National Environmental Policy Act of 1969, as amended, NRC is preparing an Environmental Impact Statement (EIS) to document the impacts associated with the construction, operation, and decommissioning of the proposed facility. One aspect of NRC's EIS will be worker safety. To improve our understanding of potential impacts to worker safety during operation of the proposed facility, the NRC staff is requesting information regarding OSHNC plans to regulate laser safety at the proposed facility. Specifically, we request information about the applicable regulations, methods for implementing oversight, applicable worker exposure standards, required worker laser safety training, items required to protect workers, preventative and mitigative measures applicable to laser exposure, and major elements of the required safety program.

We would appreciate any information you could provide on these topics. If you would prefer to discuss these issues, we can arrange a teleconference. Ms. Christianne Ridge of my staff will contact you to discuss your preference. If you have any questions or comments, or need any additional information, please contact Ms. Ridge at 301-415-5673.

Sincerely,

Andrea Kock, Chief
Environmental Review Branch
Environmental Protection and
Performance Assessment Directorate
Division of Waste Management
and Environmental Protection
Office of Federal and State Materials
and Environmental Management Programs

Docket No.: 70-7016

cc: See next page

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001
July 28, 2009

Mr. James Albright, Branch Manager
Radioactive Materials Branch
Radiation Protection Section
North Carolina Department of
Environment and Natural Resources
1645 Mail Service Center
Raleigh, NC 27699-1645

SUBJECT: CONSULTATION REGARDING ENVIRONMENTAL RADIOLOGICAL MONITORING FOR AN ENVIRONMENTAL IMPACT STATEMENT FOR THE PROPOSED GENERAL ELECTRIC-HITACHI GLOBAL LASER ENRICHMENT FACILITY

Dear Mr. Albright:

On June 26, 2009, General Electric-Hitachi (GEH) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) for a license to authorize construction and operation of a uranium enrichment facility. The facility, if licensed, would use a laser-based technology to enrich the isotope uranium-235 in uranium hexafluoride (UF_6) up to 8 percent by weight. GEH proposes to locate the facility on the existing General Electric/Global Nuclear Fuel-Americas site near Wilmington, North Carolina (Wilmington site).

As required by Title 10 of the Code of Federal Regulations Part 51 (10 CFR 51), the NRC regulation that implements the National Environmental Policy Act of 1969, as amended, the NRC is preparing an Environmental Impact Statement (EIS) as part of our review of the proposed action. The EIS will document the impacts associated with the construction, operation, and decommissioning of the proposed facility. To support this review, the NRC staff is requesting environmental radiological monitoring data relevant to the Wilmington site collected by the North Carolina Department of Environment and Natural Resources, Emergency Response and Environmental Branch (EREB).

On June 22 and July 16, 2009, Ms. Christianne Ridge of my staff discussed radiological monitoring of the Wilmington site with Mr. Chris Fidalgo of EREB. Based on that discussion, the NRC staff requests available environmental monitoring measurements relevant to the Wilmington site collected from 1998 to 2003. Specifically, the staff requests available radiological measurements of groundwater, surface water, wastewater, air particulates on site and at the site boundary, sediments on site and near the site, soil, and vegetation, as well as thermoluminescence dosimeter data. In addition, the NRC staff requests similar data collected during the last 5 years. The NRC staff understands that measurements made during the last 5 years are not readily available but that measurements made in 2008 may be made available in the next 2 to 4 months.

Any information you provide will be used to improve our documentation of the existing radiological condition of the site and our analysis of potential cumulative effects of the proposed action. If you would like to discuss this request, or need any additional information, please contact Ms. Christianne Ridge at 301-415-5673.

Sincerely,

Andrea Kock, Chief
Environmental Review Branch
Environmental Protection and
Performance Assessment Branch
Division of Waste Management
and Environmental Protection
Office of Federal and State Materials
and Environmental Management Programs

Docket No.: 70-7016

cc: See next page

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

June 22, 2009

Mr. Christopher O'Keefe, Director
New Hanover County Planning Department
New Hanover County Government Center
230 Government Center Dr., Suite 105
Wilmington, NC 28403

SUBJECT: REQUEST FOR INFORMATION REGARDING LAND USE IN THE VICINITY OF THE PROPOSED GENERAL ELECTRIC-HITACHI GLOBAL LASER ENRICHMENT FACILITY

Dear Mr. O'Keefe:

It was a pleasure to meet with you on May 18, 2009, to discuss the U.S. Nuclear Regulatory Commission's (NRC's) licensing process for General Electric-Hitachi's (GEH's) proposed Global Laser Enrichment (GLE) facility. As we discussed during that meeting, GEH has proposed to build a commercial uranium enrichment facility on the existing General Electric/Global Nuclear Fuels-Americas site, approximately 9.6 kilometers (6 miles) north of the city of Wilmington in New Hanover County, North Carolina. If licensed, the facility would use a laser-based technology to enrich the isotope uranium-235 in uranium hexafluoride (UF_6) up to 8 percent by weight.

On January 30, 2009, GEH submitted an Environmental Report (ER) to NRC as one part of an application for a license to construct, operate, and decommission the proposed facility. We have enclosed additional information about the proposed action as it appears in the Executive Summary of the applicant's ER (Enclosure 1). The applicant's ER is publicly available in the NRC Agencywide Documents Access and Management System (ADAMS) at http://www.nrc.gov/reading-rm/adams.html using accession number ML090910573.

As required by the National Environmental Policy Act of 1969, as amended, and NRC's implementing regulations at Title 10 of the Code of Federal Regulations, Part 51 (10 CFR 51), NRC is preparing an Environmental Impact Statement (EIS) to document the impacts associated with the construction, operation, and decommissioning of the proposed facility. To support the development of the EIS, the NRC staff is requesting that the New Hanover County Planning Department provide information about reasonably foreseeable future local activities that may add, cumulatively, to the impacts to resources affected by the proposed facility.

In addition, the NRC staff is requesting specific information regarding the implications of land designations relevant to North Carolina's Coastal Area Management Act of 1974. As depicted in Figure 3.1-7 of the applicant's ER (Enclosure 2), the *Wilmington-New Hanover County Joint Coastal Area Management Plan 2006 Update*, developed by New Hanover County in conjunction with the City of Wilmington, designates portions of the Wilmington Site as an Aquifer Resource Protection Area and portions as a Wetland Resource Protection Area. The NRC staff is requesting information about whether these designations would impose any limitations on the proposed development on the Wilmington site.

We appreciate any information you can provide on these topics. After analyzing the information you provide, with information provided by other agencies and public comments, NRC will prepare a draft EIS and publish it for public comment.

If you have any questions or comments, or need any additional information, please contact Christianne Ridge of my staff at 301-415-5673.

Sincerely,

Andrea Kock, Chief
Environmental Review Branch
Environmental Protection and
Performance Assessment Directorate
Division of Waste Management
and Environmental Protection
Office of Federal and State Materials
and Environmental Management Programs

Docket No.: 70-7016

Enclosures:
1. Executive Summary of the Environmental Report for the GLE Commercial Facility (GE-Hitachi Global Laser Enrichment LLC, 2008)
2. Figure 3.1-7 of the Environmental Report for the GLE Commercial Facility (GE-Hitachi Global Laser Enrichment LLC, 2008)

cc w/o enclosures:
See next page

cc without enclosures:

William Szymanski/DOE
Bruce Shell/New Hanover County
Patricia Campbell/GEH
Marty Lawing/Brunswick County
Robert Brown/GEH
George Brown/Pender County
Tammy Orr/GEH
Bill Saffo/Wilmington
AKennedy/GEH
Mike Giles/CFC
JOlivier/GEH
Malissa Talbert/Wilmington
Tom Clements/FOTE
Doug Springer/CFRW
Cameron Weaver/NCDENR
Stephen Rynas/NCDENR
Lee Cox/SLO
EHughes/USACE
Kimberly Garvey/USACE
David Weaver/New Hanover County
Dennis Ihnat/New Hanover County
Jennifer Braswell/New Hanover County

New Hanover County
Planning Department

New Hanover County Government Center
230 Government Center Drive, Suite 150
Wilmington, NC 28403
P 910.798.7165
F 910.798.7053

Chris O'Keefe
Planning Director

Ms. Andrea Kock, Chief
Environmental Review Branch
Environmental Protection and Performance Assessment Directorate
Division of Waste Management and Environmental Protection
Office of Federal and State Materials and Environmental Management Programs
United States Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Reply To: REQUEST FOR INFORMATION REGARDING LAND USE IN THE VICINITY OF THE PROPOSED GENERAL ELECTRIC-HITACHI GLOBAL LASER ENRICHMENT FACILITY

Dear Ms. Kock:

I too enjoyed meeting with you and the rest of the NRC staff on May 18, 2009. The meeting provided me with a more thorough knowledge of the review process which General Electric-Hitachi must complete before they will be permitted to operate as described in the documents attached to your June 22, 2009 letter. In regards to the letter, I have addressed the issues identified below:

Issue #1: "Staff is requesting that the New Hanover County Planning Department provide information about reasonably foreseeable future local activities that may add, cumulatively, to the impacts to resources affected by the proposed facility"

A new Elementary and Middle School have been constructed in Castle Hayne. The elementary school is scheduled to open its doors to students this fall. The Middle School should follow suit in fall 2010.

Extension of Water and Sewer into north central New Hanover County. Currently much of central New Hanover County lacks the benefits of a public water and sewer system. Despite this fact, the area has seen a fair amount of development which relied on individual or community wells and septic systems. Recently water and sewer in Wilmington and New Hanover County was consolidated and an authority, the Cape Fear Public Utility Authority, was formed to operate the unified system. Although no firm plans exist for the above mentioned expansion there is a great deal of momentum and support in the private development community. The Authority appears to be receptive to partnerships which propose funding to aid in infrastructure expansion. In better times the County participated in planning for innovative financing options to achieve this objective. Regardless of the mechanism which ultimately brings about this expansion we anticipate that within the next 5 years increased water and sewer capacity will be available to serve development in proximate to GE.

Proposed residential Development Projects: As mentioned above, the area surrounding the GE property is anticipated to experience growth. Current projects in the area include Sunset Reach a 53 lot residential subdivisions with a community boating facility, Rose Hill Plantation which is adjacent and to the south of GE with approximately 600 lots and a nursing home, Blue Clay Farms a planned development with 1800 units proposed and Parson's Mill with 300 lots in a residential subdivision.

More Speculative Projects: Speculation associated with the proposed expansion of GE has spurned several legitimate development proposals for the area immediately across Castle Hayne Road from the facility. One project, referred to as Swartville, hopes to take advantage of the GE expansion to lure light industrial, commercial and medium density residential to areas across Hwy 117 from GE. This potential development would occur on approximately 1000 acres of currently undeveloped land. Timing would rely on water and sewer being made available to the area. The timing of GE's expansion plans will also determine how quickly things happen in this area.

Other factors that should be mentioned:

I-140 currently passes to the south of the GE property. Eventually that roadway will Extend across the cape fear river and into Brunswick County. The amount of traffic on the roadway will increase significantly.

Possible **Passenger Rail** utilizing existing CSX rail ROW. This has been in discussion for a long time.

Increased use of the NE Cape Fear River for recreational watercraft. This is happening. We have not measured or studied the increase in usage.

Increased use of the NE Cape Fear River for commercial barge traffic associated with proposed Titan Cement Facility. At this time the proposed cement facility plans to utilize rail and truck for the bulk of their transport. Barges may be used in the future.

Issue #2 in your letter involves the County's Coastal Area Management Plan 2006 Update. The plan is used to guide decision makers as they review development proposals or capital investments that the County may make. As noted, portions of the GE property fall within areas classified as either *aquifer resource protection* (ARP) or *wetland resource protection (WRP)*. All of the resource protection sub classifications are intended to provide for the preservation and protection of important natural, historic, scenic, wildlife and recreational resources. The Resource Protection class has been developed in recognition of the fact that New Hanover County, one of the most urbanized counties in the State, still contains numerous areas of environmental or cultural sensitivity which merit protection from urban land uses.

In order to provide better protection for separate resources, sub classifications were developed. The ARP sub class is designed to protect the resource from diminished recharge and contamination of the aquifer by inappropriate land uses. The focus of strategies to protect this Resource Protection subclass is encouraging larger lot development if septic systems are used to prevent cross contamination of wells, extension of water and sewer service to curtail septic system use, prevention of uses that pose risk of spill of hazardous materials, and encouraging development practices that promote sustained recharge.

The WRP subclass is designed primarily to prevent the loss of wetland areas to development. The primary resource protection strategies focus on encouraging preservation of wetlands and wetland functions.

Generally these policy directives are implemented by consideration of how well the resources are accounted for in the development process. According to the Executive Summary of the Environmental Report the impact on the aquifers either from contamination or drawdown would be minimal. The facility plans to contain, treat and or dispose of all of its byproducts in a way that prevents contamination. The report further states that changes in pumping required for the proposed action would not notably impact the supply of water to other users in the area. Therefore the plans for the GLE facility appear to be consistent with our policies for protection of the ARP.

Similarly, the WRP strategies involve the identification and protection to the greatest extent practicable of wetlands. From the Executive Summary it is clear that the plan for development of the GLE facility has accounted for wetland areas and has attempted to avoid them where possible.

Unlike Florida, in North Carolina Land Use Plans do not carry the same authority as Law. This plan serves as a guide for future growth and development. The plan is not a regulatory tool therefore the plan itself does not impose any limitations on the proposed development. Generally, the plan is utilized for projects that require zoning changes or special use permits. The plan is also referred to for consistency determinations by North Carolina's Division of Coastal Management and the Corp of Engineers.

I hope the information in this letter is useful. If you need additional information or if you would like to discuss any of this please do not hesitate to call at your earliest convenience.

Sincerely,

Chris O'Keefe, AICP
Planning Director

cc. Bruce Shell, County Manager
Dave Weaver, Asst. County Manager

APPENDIX C

RADIOLOGICAL AND CHEMICAL IMPACT ASSESSMENT METHODOLOGY AND IMPACTS

APPENDIX C
RADIOLOGICAL AND CHEMICAL IMPACT ASSESSMENT METHODOLOGY AND IMPACTS

C.1 Introduction

This appendix discusses the methodology, data, and results for the potential impacts to workers as well as members of the general public resulting from preconstruction and construction activities, and normal operations of the proposed General Electric (GE)-Hitachi Global Laser Enrichment LLC (GLE) Facility.

Radiological impacts during preconstruction and construction activities would be accrued primarily to the workers. Exposures to the offsite public would not be expected due to the distance from construction emission sources. However, the public would be exposed to emissions from the proposed GLE Facility during the overlap period of construction and early operations.

Preconstruction and construction activities would not generate any radiological contamination, but they could disturb areas previously contaminated due to deposition of contaminated particulates on soil from air effluent releases of past operation of the Fuel Manufacturing Operation (FMO) Facility as well as to the current air emissions from FMO facility operations. Preconstruction and construction workers could also be exposed to external gamma radiation from stored depleted uranium (DU) cylinders, low-enriched uranium (LEU) product cylinders, natural feed cylinders and empty cylinders relating to the existing FMO operations. Construction workers would also be exposed to air effluent releases from the proposed GLE Facility and external radiation from cylinder storage (DU, LEU, etc.) during the period when construction and early operation overlap.

Radiation impacts to members of the general public would result from the atmospheric release of uranium from normal operations as well as external gamma radiation associated with stored cylinders. Potential long-term, low-level, hydrogen fluoride (HF) and uranium exposures to members of the public would be the primary offsite chemical exposures of concern.

Potential radiation impacts to GLE radiation workers include internal exposures associated with uranium enrichment operations, external exposures to DU and LEU product cylinders, as well as external exposures associated with process operations. Radiation dosimetry associated with similar operational facilities will be used to assess operational worker doses at the proposed GLE Facility.

C.2 Pathway Assessment Methodology

For calculating the doses to workers from existing soil contamination, the RESRAD code Version 6.5 (Yu et al., 2001) was used in conjunction with contamination data from site environmental reports (GNF-A, 2007) and the environmental assessment for the license renewal for the Global Nuclear Fuels-Americas (GNF-A) FMO Facility (NRC, 2009). The CAP88-PC computer code was used to estimate the dose from existing FMO operations and air effluent releases from the proposed GLE Facility. The CAP88-PC code also calculates airborne concentrations in picocuries per cubic meter for each radionuclide at user-defined locations. These concentrations can be converted to micrograms per cubic meters for the purpose of evaluating the chemical toxicity of uranium. Similarly, the chemical toxicity from HF emissions can be evaluated. For estimating the external dose from the cylinder storage yard, the RESRAD-BUILD code Version 3.5 (Yu et al., 2003) was used. The GENII Version 2 computer code was used to estimate the doses for the public from liquid effluent releases (Napier, 2007).

C.2.1 Construction Workers

The primary exposure pathways for construction workers from existing soil contamination are:

- inhalation of contaminated dust resuspended by construction activities in contaminated soils
- external exposure from previously contaminated soils

The primary exposure pathways for construction workers from existing FMO operations are:

- external radiation from stored DU tails, LEU product, and natural feed and empty cylinders from FMO operations
- external gamma radiation due to plume submersion
- external gamma radiation due to deposition
- inhalation of uranium compounds due to plume passage
- inhalation of uranium compounds due to resuspension

The additional exposure pathways for construction workers associated with continued construction operations while the proposed GLE Facility is operational include:

- external radiation from stored DU tails, LEU product, and natural feed and empty cylinders from operation of the proposed GLE Facility
- external gamma radiation due to plume submersion
- external gamma radiation due to deposition
- inhalation of uranium compounds due to plume passage
- inhalation of uranium compounds due to resupension

C.2.2 Members of the General Public

Radiological impacts to members of the general public from air effluent releases were estimated for the following receptors:

- nearest resident
- hypothetical persons residing outside the Wilmington Site boundary

The following exposure pathways were included in the dose assessment:

- external gamma radiation due to plume submersion

- external gamma radiation due to deposition

- inhalation of uranium compounds due to plume passage

- inhalation of uranium compounds due to resuspension

- ingestion of plant foods grown onsite and/or within the region of the proposed GLE Facility

- ingestion of meat products raised onsite and/or within the region of the proposed GLE Facility

- ingestion of milk produced onsite and/or within the region of the proposed GLE Facility

Radiological impacts to the public were also estimated from liquid effluent releases. It was assumed that a member of the public was exposed to contaminated surface water from recreational activities and from ingestion of fish grown in the contaminated surface water. The recreational activities considered were swimming, boating, and use of shoreline. The following exposure pathways were included in the dose assessment:

- external exposure from swimming

- external exposure from boating

- external exposure from contaminated shoreline sediment

- inadvertent ingestion of contaminated surface water during swimming

- ingestion of fish grown in contaminated surface water

C.2.3 GLE Radiation Workers

Radiological impacts to GLE radiation workers were estimated on the basis of dosimetry records from historical operations from similar facilities. The GLE radiation workers will be monitored under a radiation dosimetry program that measures both external and internal radiation doses.

C.2.4 Dose Assessment Methodology for Existing Soil Contamination

For calculating the doses to workers from the existing soil contamination, the RESRAD code Version 6.5 (Yu et al., 2001) was used. RESRAD incorporates pathway analysis models to evaluate the dose from direct exposure, inhalation of particulates and radon, and ingestion of plant foods, meat, milk, aquatic foods, water, and soil. Preconstruction and construction workers were assumed not ingest any foods grown onsite; therefore, only doses from direct external exposure and inhalation pathways were considered. The contamination in RESRAD changes are due to soil erosion, leaching, and in-growth and decay of radionuclides in the decay chain.

The external pathway dose for an outside receptor in the RESRAD code is calculated as:

$$D(t) = \sum_n F_i C_n(t) DCF_{ext,n} FCD_n FA_n FS_n \qquad \text{(Eq. 1)}$$

where

F_i	=	fraction of time spent outside near the source
$C_n(t)$	=	yearly average concentration of radionuclide n present at time *t* (picocuries per gram)
$DCF_{ext,n}$	=	external dose conversion factor for infinite volume source for radionuclide *n* (millirems per year per picocuries per gram)
FCD_n	=	depth-and-cover factor that corrects for the depth of contamination and any cover on top of contamination of radionuclide *n*
FA_n	=	area factor corrects for the area of contamination for radionuclide *n*
FS_n	=	shape factor corrects for the irregular shape of the contaminated area for radionuclide *n*

In the RESRAD code for external pathway dose estimation, the depth-and-cover factor is calculated from the thickness of contamination and the thickness of cover material. The area factor is calculated from the contaminated area, and the shape factor is calculated if the contamination is not circular. All three factors are radionuclide-dependent.

The inhalation pathway dose for an outside receptor in the RESRAD code is calculated as:

$$D(t) = \sum_n F_i * C_n(t) * DCF_{inh,n} * FCD * FA * ASR * FI \qquad \text{(Eq. 2)}$$

where

F_i	=	fraction of time spent outdoors
$C_n(t)$	=	yearly average concentration of radionuclide *n* present at time *t* (picocuries per gram)
$DCF_{inh,n}$	=	inhalation dose conversion factor for radionuclide *n* (millirems per picocurie)
FCD	=	depth-and-cover factor that corrects for the depth of contamination and any cover on top of contamination
FA	=	area factor corrects for the area of contamination
ASR	=	average mass loading of airborne contaminated soil particles (grams per cubic meter
FI	=	annual intake of air (cubic meters per year)

In the RESRAD code for inhalation pathway dose estimation, the depth-and-cover factor is calculated from the thickness of contamination and the thickness of cover material. The area factor is calculated from the size of the contaminated area. Both parameters are radionuclide-independent. The detailed discussion on yearly average concentration calculations and these pathways can be found in the RESRAD manual (Yu et al., 2001).

C.2.5 Dose Assessment Methodology for Air Effluent Releases

The CAP88-PC code (Version 3) was used to estimate the radiological impacts associated with the atmospheric transport of uranium isotope air emission during normal operations (Rosnick, 2007). CAP88-PC estimates the total effective dose associated with the external, inhalation, and ingestion pathways. Version 3 of the code has incorporated dose conversion and risk factors from Federal Guidance Report Number 13 (FGR-13) (EPA, 1999), which utilized dose conversion factors from the International Commission on Radiological Protection (ICRP) publication Number 72 (ICRP-72) (ICRP, 1996).

The CAP88-PC code incorporates a modified version of the AIRDOS-EPA program to calculate the environmental transport of radionuclides. Relevant sections of the CAP88-PC Version 3 user guide are reproduced in this section as referenced.

At the center of the atmospheric transport model is the Gaussian plume model of Pasquill as modified by Gifford:

$$\chi = \frac{Q}{2\pi\sigma_y\sigma_z\mu}\exp\left[-\frac{1}{2}\left(\frac{y}{\sigma_y}\right)^2\right]\left(\exp\left[-\frac{1}{2}\left(\frac{z-H}{\sigma_z}\right)^2\right]+\exp\left[-\frac{1}{2}\left(\frac{z+H}{\sigma_z}\right)^2\right]\right) \quad \text{(Eq. 3)}$$

where

- χ = concentration in air (chi) at *x* meters downwind, *y* meters crosswind and *z* meters above ground (curies per cubic meter)
- Q = Release rate from stack (curies per second)
- μ = wind speed (meters per second)
- σ_y = horizontal dispersion coefficient (meters)
- σ_z = vertical dispersion coefficient (meters)
- H = effective stack height (meters)
- y = crosswind distance (meters)
- z = vertical distance (meters)

The effective release height used in Equation 3 considers the buoyant plume rise due to compounds being released above ambient temperatures. For the proposed GLE Facility, any released uranium compounds are assumed to be at ambient temperatures and the effective stack height is assumed to be the height of the release point.

Annual average meteorological data sets usually include frequencies for several wind-speed categories for each wind direction and Pasquill atmospheric stability category. The CAP88-PC code uses reciprocal averaged wind speeds in the atmospheric dispersion equations that permit a single calculation for each wind speed category. Equation 3 is applied to ground-level concentrations in the air at the plume centerline by setting *y* and *z* to zero, which results in:

$$\chi = \frac{Q}{\pi \sigma_y \sigma_z \mu} \exp\left[-\frac{1}{2} \left(\frac{H}{\sigma_z} \right)^2 \right] \qquad \text{(Eq. 4)}$$

The average ground-level concentration in air over a sector of 22.5° can be approximated by:

$$\chi_{avg} = \frac{\int_0^\infty \exp\left[-\left(\frac{0.5}{\sigma_y{}^2} \right) y^2 \right] dy}{x \tan(11.25^o)} * \frac{Q}{\pi \sigma_y \sigma_z \mu} \exp\left[-\frac{1}{2} \left(\frac{H}{\sigma_z} \right)^2 \right] \qquad \text{(Eq. 5)}$$

which can be reduced further to:

$$\chi_{avg} = \frac{Q}{0.15871 \pi \, x \sigma_z \mu} \exp\left[-\frac{1}{2} \left(\frac{H}{\sigma_z} \right)^2 \right] \qquad \text{(Eq. 6)}$$

The CAP88-PC code considers both dry and wet deposition as well as radioactive decay. Plume depletion is accounted for by substituting a reduced release rate *Q*' for the original release rate for each downwind distance *x* (Slade, 1968). The ratio of the reduced release rate to the original is the depletion fraction. The overall depletion fraction used in CAP88-PC is the product of the depletion fractions for precipitation, dry deposition, and radioactive decay.

Ground surface soil concentrations are calculated on an annual basis, with in-growth and decay of progeny radionuclides calculated using Bateman's equations for the entire decay chain. Radionuclide concentrations in meat, milk, and vegetables are calculated using elemental transfer factors from Report 123 of the National Council on Radiation Protection and Measurements (NCRP, 1996). The concentration in soil for each isotope is multiplied by the appropriate elemental transfer factor to generate a concentration in each of the ingestion pathway media for that isotope in that sector.

C.2.6 Dose Assessment Methodology for External Dose from Cylinder Storage Yard

For estimating the external dose from the cylinder storage yard, the RESRAD-BUILD code Version 3.5 (Yu et al., 2003) was used. RESRAD-BUILD is a pathway analysis model developed to evaluate the potential radiation dose incurred by an individual who works or lives in a building contaminated with radioactive material. The code includes seven exposure pathways:

- external exposure directly from the source
- external exposure to the material deposited on the floor
- external exposure due to air submersion
- inhalation of airborne radioactive particulates

- inhalation of aerosol indoor radon progeny

- inadvertent ingestion of radioactive material directly from the sources

- inadvertent ingestion of materials deposited on the surfaces

For estimating the dose from the cylinder storage yard, a preconstruction and construction worker working outside is assumed to have been exposed directly to a large uniformly contaminated line source. Since the receptor is outside, only the dose from the direct external pathway was calculated.

The yearly average external dose at any time *t* from a contaminated line source is calculated as:

$$D_n(t) = 24\, ED\, F_i\, \overline{C_n(t)} \sum_j y_{nj}\, E_{nj}\, B(\mu_a t_a')\, d \left[\frac{\mu_{en}(E_{nj})}{\rho}\right]_{air} A_L \qquad \text{(Eq. 7)}$$

A_L is given as,

$$A_L = e^{-\mu_c t_c} \int_{line} \frac{e^{-\mu_a \sqrt{x^2 + t_a^2}}}{4\pi(x^2 + t_a^2)}\, dx \qquad \text{(Eq. 8)}$$

where

24	= time conversion factor (h/d)
ED	= exposure duration (d)
μ_a	= attenuation coefficient in air (cm^{-1})
B	= buildup factor
F_i	= fraction of time spent near the source
$\overline{C_n(t)}$	= average line source concentration of radionuclide *n* at time *t* (pCi/m)
y_{nj}	= yield for gamma *j* from radionuclide *n*
E_{nj}	= energy for gamma *j* from radionuclide *n* (MeV)
d	= unit dose rate per energy absorption.
μ_c	= attenuation coefficient in shielding material (cm^{-1})
$\left[\frac{\mu_{en}(E_{nj})}{\rho}\right]_{air}$	= mass energy absorption coefficient in air (cm^2/g)
t_a	= perpendicular distance to receptor
$t_{a'}$	= distance from the receptor to the midpoint of the line source

A detailed discussion on calculating the external dose from line sources is provided in the RESRAD-BUILD user's manual (Yu et al., 2003).

C.2.7 Liquid Effluent Dose Assessment Methodology

For calculating doses to the public from liquid effluent releases, the GENII code Version 2.06 (Napier, 2007) was used. The code has been developed by Pacific Northwest National

Laboratory for the U.S. Environmental Protection Agency (EPA) for calculating dose and risk from radionuclide releases in the environment. GENII Version 2 incorporates internal dosimetry models recommended by the International Commission on Radiological Protection (ICRP), and the related risk factors published in FGR-13 (EPA, 1999). The GENII code includes a set of programs for calculating radiation dose and risk from radionuclides released to the environment. GENII implements the U.S. Nuclear Regulatory Commission (NRC) models in the LADTAP computer code for surface water doses. The Northeast Cape Fear River would receive the liquid effluent discharges from the proposed GLE Facility. There are no public water intakes on the river downstream of the discharge point, so only the fish ingestion and recreational water use-related exposure pathways were analyzed (GLE, 2009b).

The GENII code calculates the average media concentration at the exposure location, the pathway-specific intake parameter, and the pathway dose. The following equations for dose estimations from different applicable pathways used in this analysis are taken directly from the GENII *User's Guide* (Napier, 2007).

C.2.7.1 Swimming Exposure

The evaluation of the recreational swimming immersion intake parameter is performed as follows:

$$I_{wrig}(T) = C_{wri}(T) \times FE_{wrg} \times TE_{wrg} \times TC_s \qquad \text{(Eq. 9)}$$

where

$I_{wrig}(T)$ = average exposure factor over time period *T* for radionuclide *i* from swimming at recreational swimming location *r* for individuals in age group *g* (Bq/L)

$C_{wri}(T)$ = average water concentration over time period *T* for radionuclide *i* in surface water at the recreational swimming location *r* (Bq/L)

FE_{wrg} = frequency of swimming events at recreational swimming location *r* for individuals in age group *g* (events/day)

TE_{wrg} = duration of an average swimming event at recreational swimming location *r* for individuals in age group *g* (hours/event)

T_{wrg} = annual exposure factor for swimming at recreational swimming location *r* for individuals in age group *g* (days)

TC_s = time correction set equal to T_{wrg}/8760 hours/year

For this pathway, the daily exposure factor may be represented as the product of the event frequency, FE_{wrg}, and the event duration, TE_{wrg}.

The effective dose from external exposure to swimming in contaminated water is calculated in the GENII code as follows (Napier, 2007):

$$IE_{wrig}(T) = I_{wrig}(T) \times E_{iaw} \times TE_w \times 3.15 \times 10^7 \qquad \text{(Eq. 10)}$$

where

$IE_{wrig}(T)$ = effective dose from external exposure to radionuclide *i* in contaminated water at recreational water usage location *r* for an individual in age group *g* (Sv)
$I_{wrig}(T)$ = external exposure average water concentration for radionuclide *i* for recreational water usage location *r* for individuals in age group *g* (Bq/L)
E_{iaw} = effective dose equivalent factor for external exposure from water immersion (w) for radionuclide *i* for an adult (Sv-L per Bq-s)
TE_w = time of exposure (year)
3.15×10^7 = units correction (seconds/year)

C.2.7.2 Boating Exposure

The evaluation of the recreational boating exposure intake parameter is performed as follows:

$$I_{brig}(T) = C_{bri}(T) \times SB \times FE_{brg} \times TE_{brg} \times TC_b \quad \text{(Eq. 11)}$$

where

$I_{brig}(T)$ = average exposure factor over the period *T* for radionuclide *i* from boating at recreational boating location *r* for individuals in age group *g* (Bq/L)
C_{bri}(T) = average water concentration of radionuclide *i* at recreational boating location *r* (Bq/L)
SB = shielding factor for boating exposures (dimensionless)
FE_{brg} = average frequency of daily boating events at recreational boating location *r* for individuals in age group *g* (events/day)
TE_{brg} = duration of an average boating event at recreational boating location *r* for individuals in age group *g* (hours/event)
TC_b = time correction set equal to T_{brg}/8760 hours/year
T_{brg} = annual exposure factor for boating at recreational boating location *r* for individuals in age group *g* (days)

For this pathway the daily exposure factor may be represented as the product of the event frequency, FE_{brg}, and the event duration, TE_{brg}.

The effective dose from external exposure to boating in contaminated water is calculated in the GENII code as follows (Napier, 2007):

$$IE_{brig}(T) = I_{brig}(T) \times E_{iaw} \times TE_b \times 3.15 \times 10^7 / 2 \quad \text{(Eq. 12)}$$

where

$IE_{brig}(T)$ = effective dose from external exposure to radionuclide *i* from boating in contaminated water at recreational water usage location *r* for an individual in age group *g* (Sv)
$I_{brig}(T)$ = external exposure average water concentration for radionuclide *i* for recreational water usage location *r* for individuals in age group *g* (Bq/L)

E_{iaw}	=	effective dose equivalent factor for external exposure from water immersion (w) for radionuclide *i* for an adult (Sv-L per Bq-s)
TE_b	=	time of exposure (year)
2	=	factor to account for being at the water surface rather than immersed (dimensionless)
3.15×10^7	=	units correction (seconds/year)

C.2.7.3 External Exposure to Shoreline Sediment

The sediment concentration at the end of a year is calculated in the GENII code as follows (Napier, 2007):

$$C_{sri}(T_{yr}) = \frac{TC \times C_{ri}(T_{yr}) \times (1 - e^{-\lambda_i T_{yr}})}{\lambda_i} \quad \text{(Eq. 13)}$$

where

$C_{sri}(T_{yr})$	=	concentration of radionuclide *i* in sediment after one year of accumulation, from deposition on the shoreline at recreational water usage location *r* (Bq/m^2)
TC	=	transfer rate constant from water to sediment (L/m^2/year)
$C_{ri}(T_{yr})$	=	average (constant) annual water concentration for radionuclide *i* at recreational water usage location *r* (Bq/L)
T_{yr}	=	one year integrating period for deposition to sediments (year)

The external exposure parameter is evaluated by determination of the average sediment concentration during a year, as follows:

$$C_{sri}(T_{yr}) = \int_0^{T_{yr}} \frac{C_{ri}(t)dt}{T_{yr} \times d_{sed} \times \rho_{sed}} \quad \text{(Eq. 14)}$$

where

$C_{sri}(T_{yr})$	=	shoreline sediment time integral of exposure for radionuclide *i* evaluated at the recreational usage location *r* (Bq/kg)
d_{sed}	=	thickness of shoreline sediments (meters)
ρ_{sed}	=	density of shoreline sediments (kg/m^3)
T_{yr}	=	one year exposure period (year)

The evaluation of the recreational shoreline exposure intake parameter is performed as follows:

$$I_{srig}(T) = C_{sri}(T) \times SW_r \times FE_{srg} \times TE_{srg} \times T_{srg} / 8760 \quad \text{(Eq. 15)}$$

where

$I_{srig}(T)$	=	average exposure factor over the period *T* for radionuclide *i* from shoreline exposure at recreational shoreline location *r* for individuals in age group *g* (Bq/kg)

$C_{sri}(T)$ = average shoreline sediment concentration of radionuclide *i* at recreational shoreline location *r* (Bq/kg)
SW_r = shoreline width factor for the recreational shoreline location *r* (dimensionless)
FE_{srg} = shoreline use event frequency at recreational shoreline location *r* for individuals in age group *g* (events/day)
TE_{srg} = duration of each shoreline exposure event at recreational shoreline location *r* for individuals in age group *g* (hours/event)
T_{srg} = annual exposure factor for shoreline exposure at recreational shoreline location *r* for individuals in age group *g* (days)
8760 = unit correction (hours/year)

For this pathway, the daily exposure factor may be represented as the product of the event frequency, FE_{srg}, and the event duration, TE_{srg}.

The effective dose from external exposure to shoreline sediment is calculated in the GENII code as follows (Napier, 2007):

$$IE_{srig}(T) = I_{srig}(T) \times EC_{iag} \times TE_s \times 3.15 \times 10^7 \times \rho_s \times d_s \qquad \text{(Eq. 16)}$$

where

$IE_{srig}(T)$ = effective dose from external exposure to radionuclide *i* in shoreline sediment at recreational water usage location *r* for an individual in age group *g* (Sv)
$I_{srig}(T)$ = external exposure average shoreline sediment concentration for radionuclide *i* for recreational water usage location *r* for individuals in age group *g* (Bq/kg)
EC_{iag} = effective dose equivalent factor for external exposure from contaminated soil (g) for radionuclide *i* for an adult (Sv-m^2 per Bq-s)
TE_s = time of exposure, T_{yr} (years)
ρ_s = surface soil bulk density (kg/m^3)
d_s = thickness of surface soil layer (meter)
3.15×10^7 = units correction (seconds/year)

C.2.7.4 Water Ingestion Pathway

The water concentration at the point of consumption is evaluated as follows:

$$C_{dwi}(T_{yr}) = C_{wi}(T_{yr}) \times TF_i \times e^{-\lambda_i \times Th_w \times 2.74 \times 10^{-3}} \qquad \text{(Eq. 17)}$$

where

$C_{dwi}(T_{yr})$ = concentration of radionuclide *i* in water at water usage location *w* at the time of consumption (Bq/L)
TF_i = water treatment purification factor giving the fraction of radionuclide *i* remaining in the water after treatment (dimensionless)
λ_i = radiological decay constant for radionuclide *i* (year^{-1})
Th_w = holdup time between the water intake plant and the water point of water use (days)

2.74×10^{-3} = units conversion factor (years/day)

Evaluation of the drinking water intake parameter is performed as follows:

$$I_{dwig} = C_{dwi}(T) \times U_{dw} \times T_{dwg} \times TC_w \times ED_{dwg} \quad \text{(Eq. 18)}$$

where

$I_{dwig}(T)$ = total intake of radionuclide *i* from drinking water ingestion over the period *T* at water usage location *w* for individuals in age group *g* (Bq)
$C_{dwi}(T)$ = average concentration of radionuclide *i* in drinking water at water usage location *w* (Bq/L)
U_{dw} = drinking water ingestion rate (L/d)
T_{dwg} = annual intake factor giving days per year that water is consumed (days/year)
TC_w = time correction equal to ED_{dwg}
ED_{dwg} = exposure duration for the drinking water pathway at usage location *w* for individuals in age group *g* (years)

The effective dose from ingestion of drinking water is calculated in the GENII code as follows (Napier, 2007):

$$IE_{dwig}(T) = I_{dwig}(T) \times EC_{igoc} \quad \text{(Eq. 19)}$$

where

$IE_{dwig}(T)$ = effective dose from ingestion intake of radionuclide *i* in drinking water at water usage location *w* for an individual in age group g for exposure over time period *T* (Sv)
$I_{dwig}(T)$ = ingestion intake of radionuclide *i* in drinking water at water usage location *w* for individuals in age group *g* for exposure over time period *T* (Bq)
EC_{igoc} = effective dose coefficient for ingestion intake of radionuclide *i* of class *c* for an individual in age group *g* (Sv/Bq)

C.2.7.5 Fish Ingestion Pathway

Aquatic food products may become contaminated when grown in contaminated surface waters. The concentration in an aquatic food is based on the average surface water concentration for the current year, as follows:

$$C_{hqi}(T_{yr}) = C_{wi}(T_{yr}) \times B_{qi} \quad \text{(Eq. 20)}$$

where

$C_{hqi}(Tyr)$ = concentration of radionuclide *i* in aquatic food type *q* at time of harvest (Bq/kg)
B_{qi} = bioaccumulation factor for radionuclide *i* in the edible portions of aquatic food type *q* (Bq/kg wet fish per Bq/L water)

The concentration at the start of the consumption period is evaluated accounting for decay during holdup as follows:

$$C_{fwi}(T_{yr}) = C_{hqi}(T_{yr}) \times e^{-\lambda_i \times Th_q \times 2.74 \times 10^{-3}} \quad \text{(Eq. 21)}$$

where

$C_{fwi}(T_{yr})$ = concentration of radionuclide *i* in aquatic food type *q* at water location *w* the time of consumption (Bq/kg wet weight)
Th_q = holdup delay time between harvest and consumption for aquatic food type *q* (days)
λ_i = radiological decay constant for radionuclide *i* (year^{-1})
2.74×10^{-3} = units conversion factor (years/day)

The evaluation of the aquatic food intake parameter is performed as follows:

$$I_{fwig} = C_{fwi}(T) \times U_{fwg} \times T_{fwg} \times ED_{fwg} \quad \text{(Eq. 22)}$$

where

$I_{fwig}(T)$ = total intake of radionuclide *i* from ingestion of aquatic food *f* over the period *T* at aquatic food location *w* for individuals in age group *g* (Bq)
$C_{fwi}(T)$ = average concentration in aquatic food *f* at aquatic food location *w* for radionuclide *i* (Bq/kg)
U_{fwg} = ingestion rate of aquatic food *f* at aquatic food location *w* by an individual in age group *g* (kg/day)
T_{fwg} = annual intake factor giving the days per year that aquatic food *f* is eaten at aquatic food location *w* by individuals in age group *g* (days/year)
ED_{fwg} = exposure duration for consumption of aquatic food *f* at aquatic food location *w* for individuals in age group *g* (years)

The effective dose from ingestion of aquatic foods is calculated in the GENII code as follows (Napier, 2007).

$$IE_{fwig}(T) = I_{wfig}(T) \times EC_{igoc} \quad \text{(Eq. 23)}$$

where

$IE_{fwig}(T)$ = effective dose from ingestion intake of radionuclide *i* in aquatic food *f* at water usage location *w* for an individual in age group *g* for exposure over time period *T* (Sv)
$I_{fwig}(T)$ = ingestion intake of radionuclide *i* in aquatic food *f* at water usage location *w* for individuals in age group *g* for exposure over time period *T* (Bq)
EC_{igoc} = effective dose coefficient for ingestion intake of radionuclide *i* of class *c* for an individual in age group *g* (Sv/Bq)

In this analysis, effective dose for the adult member of the public is calculated.

C.3 Impact Assessment Input

The data and results of the radiological impacts are provided below for the following groups:

- preconstruction and construction workers
- nearest resident
- persons residing adjacent to the site boundary
- persons that use the Northeast Cape Fear River near the Wilmington Site for fishing or other recreational activities.

Inputs required are for the RESRAD code to evaluate the dose from existing soil contamination, for the CAP88-PC code to model the air effluent releases from operations of the existing FMO Facility and the proposed GLE Facility, for the RESRAD-BUILD code to model the dose from the uranium hexafluoride (UF_6) cylinder storage pads, and for the GENII code to model doses from the liquid effluent releases.

C.3.1 RESRAD Inputs

To estimate the external and inhalation pathway doses using the RESRAD code, it was assumed that a 1-hectare (2.5-acre) area of soil was contaminated to a depth of 15 centimeters (6 inches) and that preconstruction and construction workers would spend 2000 hours in one year onsite. The inhalation rate of the construction worker was assumed to be 1.4 cubic meters per hour (1.8 cubic yards per hour), which is characteristic for a worker (EPA, 1997). The mass loading for respirable particulates due to construction activity was assumed to be 1×10^{-4} grams per cubic meter (1.7×10^{-7} pounds per cubic yard), and the most restrictive lung clearance class was used for inhalation dose conversion factors. Table C-1 lists the radionuclide-specific parameters used in the radiological impact assessment. The rest of the parameters were RESRAD default values.

C.3.2 CAP-88 Code Inputs

This section provides the parameters used in dose estimations for preconstruction and construction workers and for the hypothetical receptor at the site boundary and the nearest resident. Parameters provided include Wilmington Site characteristics, emission characteristics of the existing FMO facility and proposed GLE Facility, receptor time fractions and locations, agricultural input parameters, and radionuclide-specific inputs. For chemical toxicity calculations from HF emissions, it was assumed that the concentration at the GLE stack is 7.8 micrograms per cubic meter (1.3×10^{-8} pounds per cubic yard) (see Section 4.2.11.2). The dimension of the stack diameter and exit velocity were used to calculate the HF release rate.

C.3.2.1 FMO and GLE Stack Characteristics and Releases

Table C-2 includes the stack and vent characteristics, site-specific parameters, and annual release rates assumed in dose modeling (GLE, 2008). For FMO operations, actual air effluent releases for 2007 were used (GLE, 2009a). There are multiple release points for FMO

Table C-1 Radionuclide-Specific Parameters Used in the RESRAD Code for Radiological Impact Assessment

Parameter Name	Radionuclide			
	Uranium-234	Uranium-235	Uranium-236	Uranium-238
Lung clearance class	S	S	S	S
Inhalation dose conversion factor (mrem/pCi)[a,b]	3.48×10^{-2}	3.15×10^{-2}	3.22×10^{-2}	2.96×10^{-2}
External dose conversion factor (mrem/yr per pCi/g)[a,b]	3.44×10^{-4}	6.60×10^{-1}	1.78×10^{-4}	7.96×10^{-5}
Soil concentration (pCi/g)[b,c]	3.21	1.25×10^{-1}	1.40×10^{-3}	4.57×10^{-1}

[a] The latest dose factors from Federal Guidance Report 13 (EPA, 1999) and ICRP 72 (ICRP, 1996) were used.
[b] To convert millimeters to millisieverts, divide by 100. To convert picocuries to becquerels, multiply by 0.037.
[c] Soil concentration is calculated from the site environmental reports (GNF-A, 2007) and environmental assessment for the license renewal for the GNF-A (NRC, 2009).

Table C-2 FMO and GLE Emissions and Site Characteristics Used in Modeling

Input Parameter	FMO	GLE
Stack diameter (meters)[a]	NR	1.2
Stack release height (meters)[b]	NR	15.24
Velocity (meters per second)	NR	12.3
Source area (square meters)[a]	2500	
Temperature	Ambient	Ambient
^{234}U emission rate	1.86×10^{-5} (curies per year)[a]	1.25×10^{-13} (curies per second)[c]
Uranium-235 emission rate	7.27×10^{-7} (curies per year)	4.88×10^{-15} (curies per second)[c]
Uranium-236 emission rate	8.20×10^{-9} (curies per year)	5.49×10^{-17} (curies per second)[c]
Uranium-238 emission rate	2.65×10^{-6} (curies per year)	1.77×10^{-14} (curies per second)[c]
Ambient temperature (°C)	17.7	17.7
Annual precipitation (centimeters)[d]	144.96	144.96

[a] To convert meters to feet, multiply by 3.28. To convert square meters to square feet, multiply by 10.76. To convert curies to becquerels, multiply by 3.7×10^{10}.
[b] Stack could be higher (21–27 meters) (GLE, 2009a), but the lower value (GLE, 2008) was used because it is conservative.
[c] Emission rates are converted to curies per year by multiplying 3.156×10^{7} seconds per year conversion factor for input in the CAP88-PC code.
[d] 100 centimeters = 1 meter.
Sources: GLE, 2008, 2009a.

operations, the heights of the release points are all different, and the CAP88-PC code does not account for building wake effects. Therefore, releases were assumed to occur at ground level, resulting in larger air concentrations of radionuclides for receptors near the source than for elevated releases. The GLE stack could be higher (21–27 meters [69–89 feet]) (GLE, 2009a), but the lower value (GLE, 2008) was used because it is conservative. For conservatism, the same quantity of uranium release from the GLE stack was assumed to be released during the combined construction and operational phase in order to estimate the maximum dose potential construction workers would incur.

C.3.2.2 Exposure Time Fractions and Receptor Locations

The CAP88-PC code assumes that the individual spends an entire year at the locations provided. The assumption that the individual spends 8760 hours at the job site is overly conservative when it comes to evaluating the construction worker dose, since on average, a worker is assumed to spend approximately 2000 hours per year at a job site. In order to account for this limitation, construction worker doses were scaled down by a factor of 4.38 ($24 \times 365.25/2000$). The preconstruction and construction workers would be located, on average, a distance no less than 250 meters (820 feet) from the stack release points. The construction workers would be closest to the FMO stack releases during the construction of the access road (average distance greater than 250 meters [820 feet]) (Figure 2-2), for a period of about one month. For GLE stack releases, construction workers would be beyond the controlled area fence (average distance greater than 250 meters [820 feet] from the GLE stack release) (Figure 6-1). For the purposes of analyses, these workers were conservatively assumed to be at 250 meters (820 feet) from the release point.

The hypothetical site boundary receptor was chosen so that a person would receive the maximum dose and this individual could be considered a maximally exposed individual. The dose was modeled in 16 compass directions at the site boundary. The dose was also calculated for the nearest resident from the proposed GLE Facility stack. A hypothetical receptor and a resident are assumed to be at that location for an entire year. Table C-3 provides a listing of the locations used to estimate the radiological impacts to the nearest resident and the hypothetical receptor at the site boundary from operation of the proposed GLE Facility.

C.3.2.3 Agricultural Productivity

The ingestion of vegetables, meat and milk was considered in the radiological impact assessment for the hypothetical receptor and for the nearest resident. The EPA rural food source scenario option within CAP88-PC was selected in the assessment for the hypothetical receptor and the nearest resident. For preconstruction and construction workers the EPA regional food source option within CAP88-PC was used. Preconstruction and construction workers are not expected to consume any food grown onsite. On the basis of regional food production, estimates were derived for the beef cattle density, milk cattle density, and land fraction cultivated by vegetables. Table C-4 provides a listing of the agricultural parameters used in CAP88-PC for the radiological impact assessment.

Table C-3 Receptor Location for Radiation Dose and Chemical Toxicity Estimation from GLE Stack Releases

Location	Direction	Distance (meters)
Site boundary	North	3.99×10^2
Site boundary	North-northwest	5.73×10^2
Site boundary	Northwest	9.24×10^2
Site boundary	West-northwest	1.49×10^3
Site boundary	West	1.72×10^3
Site boundary	West-southwest	2.30×10^3
Site boundary	Southwest	1.81×10^3
Site boundary	South-southwest	1.89×10^3
Site boundary	South	1.42×10^3
Site boundary	South-southeast	1.71×10^3
Site boundary	Southeast	2.66×10^3
Site boundary	East-southeast	1.27×10^3
Site boundary	East	6.71×10^2
Site boundary	East-northeast	4.27×10^2
Site boundary	Northeast	3.53×10^2
Site boundary	North-northeast	3.46×10^2
Nearest resident	East-southeast	1.35×10^3

C.3.2.4 Radionuclide-Specific Input

The radiological impacts were estimated using the CAP88-PC Version 3.0 computer code. This code uses the newer FGR-13/ICRP-72-based dose conversion factors. The most restrictive “slow” lung clearance classes were assigned to each uranium isotope.

Radionuclide transfer factors were used to model the update of radionuclides by plants and animals. The transfer factors are element-dependent rather than radionuclide-dependent. The

default vales for uranium found in CAP88-PC were used for the radiological impact assessment. A listing of the elemental and radionuclide-specific factors used for all radiological impact modeling is provided in Table C-5.

C.3.3 RESRAD-BUILD Code Inputs

For estimating the external dose from the cylinder storage yard, RESRAD-BUILD code Version 3.5 (Yu et al., 2003) was used. Preconstruction and construction workers initially would only be exposed to the dose from the stored cylinders from the existing FMO facility and during

Table C-4 Agricultural Input Parameters Used in the Radiological Impact Assessment

Parameter	Vegetable	Meat	Milk	Scenario
Fraction from assessed area	1.0	1.0	1.0	Preconstruction and construction worker
Fraction home produced	0.0	0.0	0.0	Preconstruction and construction worker
Fraction from assessed area	0.7	0.44	0.4	Hypothetical receptor and nearest resident
Fraction home produced	0.3	0.56	0.6	Hypothetical receptor and nearest resident
Cattle density (number/km^2)	NA[a]	0.102	0.0126	All scenarios
Land fraction cultivated for vegetables	0.00632	NA	NA	All scenarios

[a] NA = not applicable.

Source: Rosnick, 2007.

the overlap period would be additionally exposed to the dose from the cylinders stored at the proposed GLE Facility. Natural uranium cylinders, natural uranium heel cylinders, tails cylinders, tails heel cylinders, and product cylinders are typically stored at a uranium enrichment site. The external dose depends on the number and type of cylinders stored, shielding, and the distance to the receptor. The dose does not depend on the facility that generated the cylinders. Typically, more tails cylinders are present compared to other types of cylinders.

Following are the inputs used in the code:

- source location, $x = 0$, $y = 0$, $z = 0$

- source direction, x

- source length, 300 meters (984 feet) (estimated from the tails pad length)

- receptor location, $x = 0$, $z = 1$, $y = 100$ meters (328 feet) (this parameter was varied depending on the distance of the receptor from the source)

- source shielding thickness = 1.59 centimeters, shielding density = 7.8 g/cm^3, material = iron, and time onsite = 2000 hours

- The shielding thickness was estimated from actual Type 48Y cylinders. The line source concentration was estimated from actual uranium concentration in the cylinders.

Table C-5 Radionuclide-Specific Inputs Used in the Radiological Impact Assessment

Parameter Name	Radionuclide				Element Uranium
	Uranium-234	Uranium-235	Uranium-236	Uranium-238	
Lung clearance class	S	S	S	S	NA[a]
Inhalation dose conversion factor (millirems per picocurie)[b]	3.48×10^{-2}	3.14×10^{-2}	3.23×10^{-2}	2.97×10^{-2}	NA
Ingestion dose conversion factor (millirems per picocurie)	1.83×10^{-4}	1.73×10^{-4}	1.73×10^{-4}	1.65×10^{-4}	NA
Immersion dose conversion factor (mrem cm^3/μCi-yr)[b,c]	7.14×10^{5}	7.55×10^{8}	4.51×10^{5}	2.92×10^{5}	NA
Ground surface dose conversion factor (mrem cm^2/μCi-yr)	6.83×10^{2}	1.63×10^{5}	5.86×10^{2}	4.94×10^{2}	NA
Deposition velocity (meters per second)[b]	1.8×10^{-3}	1.8×10^{-3}	1.8×10^{-3}	1.8×10^{-3}	NA
Particle size (micrometers)[d]	1	1	1	1	
Milk transfer factor	NA	NA	NA	NA	4×10^{-4}
Meat transfer factor	NA	NA	NA	NA	8×10^{-4}
Forage uptake factor (pCi/kg dry forage/pCi/kg dry soil)[b]	NA	NA	NA	NA	0.1
Edible update factor (pCi/kg wet weight per pCi/kg dry soil)	NA	NA	NA	NA	0.002

[a] NA = not applicable.
[b] To convert millirems to millisieverts, divide by 100. To convert picocuries to becquerels, multiply by 0.037. To convert microcuries to becquerels, multiply by 3.7×10^4. To convert meters to feet, multiply by 3.28. To convert kilograms to pounds, multiply by 2.2.
[c] 100 centimeters = 1 meter.
[d] 10^6 micrometers = 1 meter.
Source: Rosnick, 2007.

C.3.4 GENII Code Inputs

The radionuclide concentration in the surface water was calculated at three potential exposure locations from the uranium concentrations in the liquid effluent releases from the proposed GLE Facility and the dilution factor in the receiving water body (GLE, 2009b). Table C-6 shows the estimated radionuclide concentrations in the surface water at three exposure locations. Table C-7 lists the estimated number of people involved in recreational activities, which was estimated based on regional recreational activity data (GLE, 2009b). It is expected that the same number of people would be involved at all three exposure locations. Table C-8 lists the radionuclide-specific parameters used in the GENII code for radiological impact assessment.

Dose conversion factors (DCFs) based on ICRP 60 methodology (ICRP, 1991) were used to estimate effective dose. Table C-9 lists other exposure parameters used in estimating the doses from different exposure pathways. Since the surface water concentrations were known,

Table C-6 Estimated Radionuclide Concentrations in Surface Water at Exposure Locations

Exposure Location	Radionuclide concentration (pCi/L)[a]						
	Uranium-238	Uranium-235	Uranium-234	Thorium-234	Protactinium-234	Protactinium-234m	Thorium-231
Confluence with Unnamed Tributary #1 to Northeast Cape Fear River	1.08×10^{-3}	9.38×10^{-5}	1.01×10^{-6}	1.08×10^{-3}	3.55×10^{-6}	1.07×10^{-3}	9.38×10^{-5}
Just South of GE Wilmington Site Boundary	1.08×10^{-3}	9.38×10^{-5}	1.01×10^{-6}	1.08×10^{-3}	3.55×10^{-6}	1.07×10^{-3}	9.38×10^{-5}
NC 133 Bridge	1.04×10^{-3}	9.06×10^{-5}	9.76×10^{-7}	1.04×10^{-3}	3.43×10^{-6}	1.04×10^{-3}	9.06×10^{-5}

[a] To convert picocuries (pCi) to becquerels (Bq), multiply by 0.037.

Note: Isotopic weight fractions used were: Uranium-234: 8.64×10^{-4}, Uranium-235: 8.02×10^{-2}, and Uranium-238: 9.19×10^{-1}. Short-lived progeny of uranium-238 (thorium-234, protactinium-234, and protactinium-234m) and uranium-235 (thorium-231) are assumed to be in equilibrium with the parent radionuclide.

Source: GLE, 2009b.

Table C-7 Estimated Number of People Involved in Different Recreational Activities[a]

Recreational Activity	Number of People Involved
Fish ingestion	1414
Swimming	1906
Boating	1244
Shoreline	1231

[a] Recreational survey data representative of the southeast United States were used to estimate the number of people involved in different recreational activities at each exposure location (GLE, 2009c). People involved in swimming that would spend a significant amount of time in shoreline activities are assumed to be counted in shoreline activities. Recreational activities such as sunbathing and fishing result in external exposure from sediment contamination while onshore. The pathways considered during swimming were external exposure from water immersion and water ingestion. The pathway considered during boating was water exposure at the surface.
Source: GLE, 2009c.

the surface water dissolved module in GENII code (WCF) was used in estimating the public dose.

C.4 Results of the Radiological and Chemical Impact Analyses

This section provides the results of the radiological impact analyses. Radiological impacts were estimated for the following:

- GLE Facility preconstruction and construction workers
- nearest resident
- hypothetical receptor at the site boundary
- member of the public and population that uses northeast Cape Fear River for recreational activities
- GLE Facility operational workers

Table C-10 provides the estimated annual effective dose from the air emissions due to the proposed GLE Facility at different receptor locations. The estimated annual effective dose for a preconstruction and construction worker from the air emissions associated with the existing FMO operation was 2.8×10^{-5} millisievert per year (2.8×10^{-3} millirem per year). For calculating this dose, it was assumed that the worker was onsite for 2000 hours in one year.

Table C-8 Radionuclide-Specific Parameters Used in the GENII Code for Radiological Impact Assessment

Parameter	Uranium-238	Uranium-235	Uranium-234	Thorium-234	Protactinium-234	Protactinium-234m	Thorium-231
Ingestion dose conversion factor, (rem/pCi)	1.65×10^{-7}	1.73×10^{-7}	1.83×10^{-7}	1.26×10^{-8}	1.94×10^{-9}	0.00×10^{0}	1.24×10^{-9}
External exposure from contaminated soil dose conversion factor, (Sv/s per Bq/m^2)	4.24×10^{-19}	1.40×10^{-16}	5.86×10^{-19}	7.50×10^{-18}	1.80×10^{-15}	1.08×10^{-16}	1.56×10^{-17}
External exposure from water immersion dose conversion factor, (Sv/s per Bq/m^3)	7.79×10^{-14}	1.90×10^{-10}	1.85×10^{-13}	8.75×10^{-12}	2.52×10^{-9}	2.64×10^{-11}	1.35×10^{-11}
Fish bioaccumulation factor, (Bq/kg wet fish per Bq/L water)	1.00×10^{1}	1.00×10^{1}	1.00×10^{1}	1.00×10^{2}	1.00×10^{2}	1.00×10^{1}	1.00×10^{2}

Source: Napier, 2007.

Table C-9 Exposure Parameters for Different Activities

Parameter	Shoreline Use	Boating	Swimming	Fish Ingestion
Frequency, events/day	1	1	1	NA
Duration of event, hours	2	2	2	NA
Event days, days	50	50	50	NA
Shielding factor	NA	1	NA	NA
Ingestion of water while swimming, L/hour	NA	NA	0.021	NA
Shoreline width factor	0.2	NA	NA	NA
Shoreline sediment density, kg/m^2	15	NA	NA	NA
Transfer rate constant from water to sediment, L/m^2/yr	25,400	NA	NA	NA
Soil layer thickness, cm	35	NA	NA	NA
Fish ingestion rate, grams/day	NA	NA	NA	44
Fish consumption period, days	NA	NA	NA	365
Fish holdup time, days	NA	NA	NA	1

Table C-11 shows modeled uranium and HF concentrations at various onsite and offsite locations after dispersion. For calculating the total uranium concentrations, individual isotope concentrations were multiplied by the specific activities and added together.

Table C-12 shows the estimated doses at various distances from the storage pad, assuming that the receptor was at the location for 2000 hours in one year. In actuality, construction workers would be at many different locations and distances from the cylinder storage pads. Based on the locations of the FMO facility and the proposed GLE Facility, it is highly unlikely that the same construction workers would be close to the storage pads from both facilities when onsite. Table C-12 demonstrates that the external dose decreases rapidly with distance, and it is expected that the dose would be even smaller at longer distances. The construction workers would be closest to the existing FMO facility storage pads during construction of the access road (average distance greater than 250 meters [820 feet]) (Figure 2-2) for a period of about one month. The entire perimeter of the storage pad constructed for the proposed GLE Facility would be fenced (GLE, 2008) and construction workers are assumed to be located beyond the controlled area boundary and would not spend significant time near it. For conservatism, construction workers are assumed to be located at the minimum distance of 250 meters (820 feet) from the cylinder storage pads for all 2000 hours in one year.

The maximum dose that a member of a public would receive from liquid effluent releases from the proposed GLE Facility would occur just south of the Wilmington Site boundary. Table C-13 provides the estimated annual effective dose for an exposed member of the public from different surface water exposure pathways, along with the estimated annual effective population doses.

Table C-10 Annual Effective Dose from Proposed GLE Facility Stack Releases at Different Receptor Locations

Location	Direction	Distance (meters)[b]	Dose (millirems per year)[c]
Site boundary	North	399	8.5×10^{-5}
Site boundary	North-northwest	573	6.2×10^{-5}
Site boundary	Northwest	924	2.1×10^{-5}
Site boundary	West-northwest	1493	4.7×10^{-6}
Site boundary	West	1717	1.7×10^{-5}
Site boundary	West-southwest	2302	1.4×10^{-5}
Site boundary	Southwest	1806	2.3×10^{-5}
Site boundary	South-southwest	1892	2.2×10^{-5}
Site boundary	South	1416	3.9×10^{-5}
Site boundary	South-southeast	1708	2.5×10^{-5}
Site boundary	Southeast	2664	1.8×10^{-5}
Site boundary	East-southeast	1270	1.5×10^{-5}
Site boundary	East	671	4.9×10^{-5}
Site boundary	East-northeast	427	8.3×10^{-5}
Site boundary	Northeast	353	1.1×10^{-4}
Site boundary	North-northeast	346	9.4×10^{-5}
Onsite construction worker[a]	South	250	3.2×10^{-5}
Nearest resident	East-southeast	1352	1.4×10^{-5}

[a] Onsite construction worker in the south direction got the maximum dose. For calculating the dose for the onsite construction worker, the worker was assumed to be onsite for 2000 hours in one year.
[b] To convert meters to feet, multiply by 3.28.
[c] To convert millirems to millisieverts, divide by 100.

Table C-11 Predicted Airborne Concentrations of Uranium and HF from the Proposed GLE Facility Stack Releases at Different Receptor Locations

Location	Direction	Distance Meters[a]	Uranium-234 (pCi/m^3)[b]	Uranium-235 (pCi/m^3)[b]	Uranium-236 (pCi/m^3)[b]	Uranium-238 (pCi/m^3)[b]	Total Uranium (µg/m^3)[c]	HF[d] (µg/m^3)
Site boundary	North	4.0×10^{2}	2.6×10^{-7}	1.0×10^{-8}	1.1×10^{-10}	3.6×10^{-8}	1.1×10^{-7}	2.2×10^{-4}
Site Boundary	North-northwest	5.7×10^{2}	1.2×10^{-7}	4.6×10^{-9}	5.1×10^{-11}	1.7×10^{-8}	5.2×10^{-8}	1.0×10^{-4}
Site boundary	Northwest	9.2×10^{2}	6.1×10^{-8}	2.4×10^{-9}	2.7×10^{-11}	8.6×10^{-9}	2.7×10^{-8}	5.3×10^{-5}
Site boundary	West-northwest	1.5×10^{3}	3.3×10^{-8}	1.3×10^{-9}	1.5×10^{-11}	4.7×10^{-9}	1.5×10^{-8}	2.9×10^{-5}
Site boundary	West	1.7×10^{3}	5.0×10^{-8}	2.0×10^{-9}	2.2×10^{-11}	7.1×10^{-9}	2.2×10^{-8}	4.4×10^{-5}
Site boundary	West-southwest	2.3×10^{3}	4.1×10^{-8}	1.6×10^{-9}	1.8×10^{-11}	5.7×10^{-9}	1.8×10^{-8}	3.5×10^{-5}
Site boundary	Southwest	1.8×10^{3}	6.7×10^{-8}	2.6×10^{-9}	2.9×10^{-11}	9.5×10^{-9}	3.0×10^{-8}	5.8×10^{-5}
Site boundary	South-southwest	1.9×10^{3}	6.6×10^{-8}	2.6×10^{-9}	2.9×10^{-11}	9.4×10^{-9}	2.9×10^{-8}	5.7×10^{-5}
Site boundary	South	1.4×10^{3}	1.2×10^{-7}	4.5×10^{-9}	5.1×10^{-11}	1.6×10^{-8}	5.1×10^{-8}	1.0×10^{-4}
Site boundary	South-southeast	1.7×10^{3}	4.2×10^{-8}	1.7×10^{-9}	1.9×10^{-11}	6.0×10^{-9}	1.9×10^{-8}	3.7×10^{-5}
Site boundary	Southeast	2.7×10^{3}	2.5×10^{-8}	9.6×10^{-10}	1.1×10^{-11}	3.5×10^{-9}	1.1×10^{-8}	2.1×10^{-5}
Site boundary	East-southeast	1.3×10^{3}	4.4×10^{-8}	1.7×10^{-9}	1.9×10^{-11}	6.2×10^{-9}	1.9×10^{-8}	3.8×10^{-5}
Site boundary	East	6.7×10^{2}	1.5×10^{-7}	5.8×10^{-9}	6.5×10^{-11}	2.1×10^{-8}	6.5×10^{-8}	1.3×10^{-4}
Site boundary	East-northeast	4.3×10^{2}	2.5×10^{-7}	9.7×10^{-9}	1.1×10^{-10}	3.5×10^{-8}	1.1×10^{-7}	2.1×10^{-4}
Site boundary	Northeast	3.5×10^{2}	3.4×10^{-7}	1.3×10^{-8}	1.5×10^{-10}	4.8×10^{-8}	1.5×10^{-7}	3.0×10^{-4}
Site boundary	North-northeast	3.5×10^{2}	2.8×10^{-7}	1.1×10^{-8}	1.2×10^{-10}	4.0×10^{-8}	1.2×10^{-7}	2.4×10^{-4}
Onsite member of the public	South	2.5×10^{2}	4.3×10^{-7}	1.7×10^{-8}	1.9×10^{-10}	6.1×10^{-8}	1.9×10^{-7}	3.7×10^{-4}
Nearest resident	East-southeast	1.4×10^{3}	4.2×10^{-8}	1.6×10^{-9}	1.8×10^{-11}	5.9×10^{-9}	1.8×10^{-8}	3.6×10^{-5}

[a] To convert meters to feet, multiply by 3.28.
[b] To convert picocuries to becquerels, multiply by 0.037.
[c] 10^6 micrograms = 1 gram.
[d] HF concentrations are based on dispersion of a release point concentration of 7.8 µg/m^3, or twice that estimated for the 3-million-separative work unit (SWU) proposed National Enrichment Facility (NRC, 2005).

Table C-12 Estimated Doses from Cylinder Storage Pad

Receptor Distance (meters)	External Dose (millirems per year)[a]
50	218
100	83.5
150	40.3
200	19.8
250	10.5
500	0.721
1000	7.67×10^{-3}

[a] To convert millirems to millisieverts, divide by 100.

C.4.1 GLE Preconstruction and Construction Workers

The maximum estimated dose for each of exposure pathway was calculated for an annual exposure period. These estimated doses are:

- internal dose from inhalation of resuspended contaminated soil: $<6 \times 10^{-5}$ millisievert per year (6×10^{-3} millirem per year)

- external dose from contaminated soil: $<3.2 \times 10^{-4}$ millisievert per year (3.2×10^{-2} millirem per year)

- estimated dose from air emissions associated with FMO operations: $<2.8 \times 10^{-5}$ millisievert per year (2.8×10^{-3} millirem per year)

- estimated dose from air emissions associated with proposed GLE operations: $<3.2 \times 10^{-7}$ millisievert per year (3.2×10^{-5} millirem per year) (see Table C-10)

- external dose from the existing site sources: $<1.05 \times 10^{-1}$ millisievert per year (10.5 millirems per year)

The total maximum estimated dose before and after the start of GLE operations is $<1.05 \times 10^{-1}$ millisievert per year (10.5 millirems per year). The maximum dose is dominated by the external dose received from existing sources.

The maximum dose to construction workers of 1.05×10^{-1} millisievert (1.05 millirem) is a very small fraction of background radiation exposure in the United States, which averages approximately 3.11 millisieverts per year (311 millirems per year) (see Section 3.11.1). The estimated maximum annual dose applies to workers in both the preconstruction and construction phases.

Table C-13 Estimated Doses for Liquid Effluent Releases from the Proposed GLE Facility

Exposure location	Exposure Pathway	Dose (mrem/yr)[a] to a Member of Public	Number of People Exposed	Collective Dose (person-mrem/yr)[a]
Confluence with Unnamed Tributary #1 to Northeast Cape Fear River	Fish ingestion	5.26×10^{-5}	1414	7.44×10^{-2}
	Water ingestion during swimming	4.37×10^{-7}	1906	8.33×10^{-4}
	External exposure from swimming	1.03×10^{-8}	1906	1.96×10^{-5}
	External exposure from boating	5.15×10^{-9}	1244	6.41×10^{-6}
	External exposure from shoreline activities	2.01×10^{-5}	1231	2.47×10^{-2}
	Total for a member of public	7.32×10^{-5}	NA[b]	NA[b]
Just South of GE Wilmington Site Boundary	Fish ingestion	5.26×10^{-5}	1414	7.44×10^{-2}
	Water ingestion during swimming	4.37×10^{-7}	1906	8.33×10^{-4}
	External exposure from swimming	1.03×10^{-8}	1906	1.96×10^{-5}
	External exposure from boating	5.15×10^{-9}	1244	6.41×10^{-6}
	External exposure from shoreline activities	2.01×10^{-5}	1231	2.47×10^{-2}
	Total for a member of public	7.32×10^{-5}	NA	NA
NC 133 Bridge	Fish ingestion	5.06×10^{-5}	1414	7.15×10^{-2}
	Water ingestion during swimming	4.21×10^{-7}	1906	8.02×10^{-4}
	External exposure from swimming	9.95×10^{-9}	1906	1.90×10^{-5}
	External exposure from boating	4.98×10^{-9}	1244	6.20×10^{-6}
	External exposure from shoreline activities	1.93×10^{-5}	1231	2.38×10^{-2}
	Total for a member of public	7.03×10^{-5}	NA	NA
	Total population dose	NA	NA	2.72×10^{-1}

[a] To convert millirems to millisieverts, divide by 100.
[b] NA = not applicable.

The total maximum possible dose to construction workers from all pathways is less than the 10 CFR 20.1301(a)(1) limit of 1 millisievert per year (100 millirems per year) for members of the general public, even for estimates combining the most conservative analytical assumptions. This is a negligible dose, representing a lifetime excess cancer risk of less than 5×10^{-6} (less than 5 chances in 1,000,000 of contracting a fatal cancer) when using a risk coefficient of 5×10^{-2} risk/sievert (5×10^{-4} risk/rem) (ICRP, 1991).

A maximum HF concentration of 3.7×10^{-4} micrograms per cubic meter (4.5×10^{-7} parts per million) is estimated at the location of the onsite member of the public (e.g., construction worker). Uranium emissions would result in a maximum uranium concentration of 1.9×10^{-7} micrograms per cubic meter at the location of the onsite construction worker (Table C-11). Both the estimated HF and uranium concentrations at onsite exposure locations are orders of magnitude below safe levels established by the Occupational Safety and Health Administration (2.5 micrograms per cubic meter for HF [3.1 parts per million] and 50 micrograms per cubic meter for uranium, each averaged over eight hours; see Section 3.11.2).

C.4.2 Hypothetical Receptor at the Site Boundary and Nearest Resident

Table C-11 shows the estimated dose to hypothetical receptors residing at the site boundary in each of the 16 directions modeled in CAP88-PC Version 3.0 computer code. It also includes the dose to the nearest resident. The maximum dose to a hypothetical receptor at the Wilmington Site boundary (0.35 kilometers [0.22 miles] in the northeast direction) due to operation of the proposed GLE Facility is estimated to be 1.1×10^{-6} millisievert per year (1.1×10^{-4} millirem per year). The dose to the nearest resident located at 1.35 kilometers (0.84 miles) east-southeast of the proposed GLE Facility is estimated to be 1.4×10^{-7} millisievert per year (1.4×10^{-5} millirem per year). These estimated doses are well below the 10 CFR 20.1301(a)(1) limit of 1 millisievert (100 millirems) per year for members of the public and the 40 CFR Part 61, Subpart H (NESHAPs) airborne dose limit of 0.1 millisievert (10 millirems) per year.

The estimated uranium and HF levels at the site boundary and at the location of the nearest resident given in Table C-11 are lower than onsite levels. HF concentrations at any exposure location, moreover, are far below the most stringent State or Federal ambient air quality standards for the general public (e.g., the State of Washington's standard of 8.7 micrograms per cubic meter (0.011 parts per million); see Section 3.11.2).

C.4.3 Estimated Doses from Liquid Effluent Releases

Table C-13 shows the estimated dose to a member of the public involved in recreational activities at three potential exposure locations, as calculated using the GENII Version 2.06 computer code. The maximum dose is to a member of the public due to operation of the proposed GLE Facility is estimated to be 7.3×10^{-7} millisievert per year (7.3×10^{-5} millirem per year).

The estimated doses for the liquid effluent releases from the proposed GLE Facility are well below the 10 CFR 20.1301(a)(1) limit of 1 millisievert (100 millirems) per year for members of the public. The population dose is estimated to be 2.7×10^{-3} person-millisievert per year (2.7×10^{-1} person-millirem per year).

C.4.4 Operational Worker Doses

The existing nuclear and industrial safety program at the Wilmington Site would be expanded to include operations of the proposed GLE Facility. The program would monitor the occupational workers at the proposed facility for internal exposure from intake of uranium as well as the dose from external exposure to radiation. GLE would also apply an annual administrative limit of 40 millisieverts (4000 millirems), which is below the 10 CFR 20.1201 annual limit of 50 millisieverts (5000 millirems) for radiation workers.

GNF-A has implemented a comprehensive exposure control program at the Wilmington Site to manage occupational radiation exposure and dose. The program maintains exposures "As Low As Reasonably Achievable" (ALARA) through the use of radiation monitoring systems, personnel dosimetry, and mitigation systems to reduce environmental concentrations of uranium. The average total effective dose equivalent (TEDE) to workers from existing GNF-A operations at the Wilmington Site for 2003–2007 varied from 0.5 to 0.75 millisievert (50 to 75 millirems), and the maximum TEDE during the same period varied from 4.7 to 5.6 millisieverts (470 to 560 millirems) (NRC, 2009).

From operations of the proposed GLE Facility, the most significant contributor to occupational radiation exposure would be direct radiation from uranium hexafluoride (UF_6). It is expected that the average occupational doses at the proposed GLE Facility would be similar to occupational doses at existing fuel cycle facilities in the United States. For such facilities, the most substantial sources of direct radiation would likely include full Type 48Y cylinders containing feed material or depleted UF_6 and empty Type 48Y cylinders containing residual material (NRC, 2005). Table C-14 presents occupational doses at fuel cycle facilities within the United States for 2003–2007 (Burrows, 2005; Burrows; 2006; Lewis et al., 2008).

The occupational exposure analysis and the historical exposure data from the United States Enrichment Corporation facilities and the existing GNF-A operations at the Wilmington Site demonstrate that a properly administered radiation protection program at the proposed GLE Facility would maintain radiological occupational impacts below the regulatory limits of 10 CFR 20.1201.

Table C-14 Annual CEDE[a] and TEDE[b] for Fuel Cycle Facilities within the United States for 2003–2007

Year	Number of Monitored Individuals	Workers with Measured TEDE	Collective TEDE (person-rem)[c,d]	Average Measured TEDE (rem)	Workers with Measured DDE	Collective DDE (person-rem)	Average Measured DDE (rem)	Workers with Measured CEDE	Collective CEDE (person-rem)	Average Measured CEDE (rem)
2003	7738	3633	556	0.15	2815	258	0.09	2255	298	0.13
2004	7562	3814	514	0.13	2933	258	0.09	2327	256	0.11
2005	7699	3371	497	0.15	2385	238	0.10	2173	259	0.12
2006	7417	3413	522	0.15	2475	283	0.11	2131	238	0.11
2007	7536	3225	429	0.13	2254	230	0.10	1983	199	0.10

[a] Committed effective dose equivalent = total radiation dose received from ingestion or inhalation of radioactive material.
[b] Total effective dose equivalent = CEDE plus DDE (deep dose equivalent from external radiation).
[c] 1 rem = 1000 mrem.
[d] To convert rems to sieverts, divide by 100.
Sources: Burrows, 2005; Burrows, 2006; Lewis, et al. 2008.

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APPENDIX D
TRANSPORTATION METHODOLOGY, ASSUMPTIONS, AND IMPACTS

APPENDIX D
TRANSPORTATION ANALYSIS METHODOLOGY, ASSUMPTIONS, AND IMPACTS

D.1 Introduction

This appendix provides the detailed methodology, input parameters and assumptions, and results for the transportation risk analysis performed in this draft Environmental Impact Statement (EIS) for the proposed General Electric (GE)-Hitachi Global Laser Enrichment (GLE) Facility near Wilmington, North Carolina. The analysis evaluates transportation of:

- natural uranium hexafluoride (UF_6) (i.e., not enriched) feed to the GLE Facility
- enriched UF_6 product from the GLE Facility to a fuel fabrication facility
- depleted UF_6 to a conversion facility
- return of empty feed cylinders with residual contamination
- low-level radioactive waste (LLRW) for disposal

All domestic shipments are anticipated to occur via heavy haul tractor-trailer combination trucks. A number of these shipments may have multiple origins or destinations. UF_6 feed may be obtained from a U.S. facility (Honeywell International, Metropolis, Illinois), a Canadian source (Cameco, Port Hope, Ontario, Canada) or overseas sources arriving at U.S. seaports (Portsmouth Marine Terminal [PMT], Portsmouth, Virginia; Dundalk Marine Terminal [DMT], Baltimore, Maryland). UF_6 product may be used at the Wilmington Site or sent to other fuel fabrication facilities in Columbia, South Carolina (Westinghouse Electric) and Richland, Washington (AREVA NP). The depleted UF_6 tails could be sent to facilities in either Paducah, Kentucky or Portsmouth, Ohio, both facilities currently under construction for conversion of depleted UF_6 to uranium oxide for disposal. In the case of the low-level radioactive waste (LLRW) generated at the proposed GLE Facility, only one destination would be planned, the Energy*Solutions* disposal facility in Clive, Utah. Single shipment and annual impacts are evaluated for all potential shipment routes. Annual impacts are assumed based on all shipments of one material type over the same route (e.g., all depleted UF_6 tails going to Paducah, Kentucky or all going Portsmouth, Ohio).

D.2 Methodology

D.2.1 Overview

The transportation risk assessment considers human health risks from routine transport (normal, incident-free conditions) of hazardous materials and from potential accidents. In both cases, risks associated with the nature of the cargo itself, or “cargo-related” impacts, and those related to the transportation vehicle (regardless of type of cargo), or “vehicle-related” impacts, are considered.

D.2.1.1 Routine Transportation Risk

The radiological risk associated with routine transportation is cargo-related and results from the potential exposure to low levels of external radiation near a loaded shipment. It is assumed that there are no cargo-related risks posed by incident-free transport of hazardous chemicals. No direct chemical exposure to radioactive material will occur during routine transport because, as discussed in Section D.3.2, these materials will be in packages that are designed and maintained to ensure that they will contain and shield their contents during normal transport. Any leakage or unintended release would be considered under accident risks.

Vehicle-related risks during routine transportation are caused by potential exposure to increased vehicular emissions. These emissions include diesel exhaust, tire and brake particulate emissions, and fugitive dust raised from the roadbed by passing vehicles.

D.2.1.2 Accident Transportation Risk

The cargo-related radiological risk from transportation-related accidents lies in the potential release and dispersal of radioactive material into the environment during an accident and the subsequent exposure of the nearby population through multiple exposure pathways, such as exposure to contaminated soil, inhalation, or the ingestion of contaminated food. Cargo-related hazardous chemical accident impacts to human health during transportation come from immediate inhalation exposure resulting from container failure and chemical release during an accident.

Vehicle-related accident risks refer to the potential for transportation-related accidents that result in fatalities caused by physical trauma unrelated to the cargo.

D.2.2 Routine Risk Assessment Methodology

The RADTRAN 5 computer code (Neuhauser and Kanipe, 2003; Weiner et al., 2006) was used in the routine and accident cargo-related risk assessments to estimate the radiological impacts to collective populations. RADTRAN 5 was developed by Sandia National Laboratories to calculate population risks associated with the transportation of radioactive materials by truck, rail, air, ship, or barge. The code has been used extensively for transportation risk assessments since it was originally issued in the late 1970s as RADTRAN (RADTRAN 1) and has been reviewed and updated periodically. RADTRAN 1 was originally developed to facilitate the calculations presented in NUREG-0170 (NRC, 1977).

D.2.2.1 Collective Population Risk

The radiological risk associated with routine transportation results from the potential exposure to low-level external radiation in the vicinity of loaded shipments. Even under routine transportation, some radiological exposure could occur. Because the radiological consequences (dose) would occur as a direct result of normal operations, the probability of routine consequences is taken to be 1 in the RADTRAN 5 code. Therefore, the dose risk is equivalent to the estimated dose.

For routine transportation, the RADTRAN 5 computer code considers major groups of potentially exposed persons. The RADTRAN 5 calculations of risk for routine highway transportation include exposures of the following population groups:

- *Persons along the Route (Off-Link Population)*. Collective doses were calculated for all persons living or working within 0.8 kilometer (0.5 mile) of each side of a transportation route. The total number of persons within the 1.6-kilometer (1-mile) corridor was calculated separately for each route considered in the assessment.

- *Persons Sharing the Route (On-Link Population)*. Collective doses were calculated for persons in all vehicles sharing the transportation route. This group includes persons traveling in the same or opposite directions as the shipment, as well as persons in vehicles passing the shipment.

- *Persons at Stops*. Collective doses were calculated for people who might be exposed while a shipment was stopped en route. For truck transportation, these stops include those for refueling, food, and rest.

- *Crew Members*. Collective doses were calculated for truck transportation crew members involved in the actual shipment of material. Workers involved in loading or unloading were not considered in the transportation analysis because they are considered to be facility workers.

The doses calculated for the first three population groups were summed to yield the collective dose to the public; the dose calculated for the fourth group represents the collective dose to workers.

The RADTRAN 5 calculations for routine dose generically compute the dose rate as a function of distance from a point source (Neuhauser and Kanipe, 2003). Associated with the calculation of routine doses for each exposed population group are parameters such as the radiation field strength, the source-receptor distance, the duration of exposure, vehicular speed, stopping time, traffic density, and route characteristics (such as population density). The RADTRAN manual contains derivations of the equations used and descriptions of these parameters (Neuhauser and Kanipe, 2003).

D.2.2.2 Maximally Exposed Individual Risk

In addition to the assessment of the routine collective population risk, the risk to a maximally exposed individual (MEI) was estimated. In RADTRAN 5, the MEI is assumed to be located 30 meters (100 feet) from the transport route as the radioactive shipment passes at a speed of 24 kilometers per hour (15 miles per hour).

D.2.2.3 Vehicle-Related Risk

Vehicle-related health risks resulting from routine transportation are associated with the generation of air pollutants by transport vehicles during shipment and would be independent of the radioactive or chemical nature of the shipment. The health endpoint assessed under routine transportation conditions was the excess latent mortality from inhalation of vehicular emissions.

These emissions consist of particulate matter in the form of diesel engine exhaust, tire and brake particulates, and fugitive dust raised from the roadway by the transport vehicle. Risk factors for pollutant inhalation in terms of latent mortality have been used in this analysis. Vehicle-related risks from routine transportation were calculated for each shipment by multiplying the total distance traveled by the appropriate risk factor.

D.2.3 Accident Assessment Methodology

The risk analysis for potential accidents differs fundamentally from the risk analysis for routine transportation because occurrences of accidents are statistical in nature. The accident risk assessment is treated probabilistically. Accident risk is defined as the product of the accident consequence (dose or exposure) and the probability of the accident occurring. In this respect, the analysis estimates the collective accident risk to populations by considering a spectrum of transportation-related accidents. The spectrum of accidents was designed to encompass a range of possible accidents, including low-probability accidents that have high consequences, and high-probability accidents that have low consequences (such as "fender benders"). For radiological risk, the results for collective accident risk can be directly compared with the results for routine collective risk because the latter results implicitly incorporate a probability of occurrence of 1 if the shipment takes place.

D.2.3.1 Radiological Accident Risk Assessment

The RADTRAN 5 calculation of collective accident risk uses models that quantify the range of potential accident severities and the responses of transported packages to accidents. The spectrum of accident severity is divided into several categories, each of which is assigned a conditional probability of occurrence – that is, the probability that if an accident does occur, it will be of a particular severity. Release fractions, defined as the fraction of the material in a package that could be released in an accident, are assigned to each accident severity category on the basis of the physical and chemical form of the material. The model takes into account the mode of transportation and the type of packaging through selection of the appropriate accident probabilities and release fractions, respectively. The accident rates, the definition of accident severity categories, and the release fractions used in this analysis are discussed further in Sections D.3 and D.4.

For accidents involving the release of radioactive material, RADTRAN 5 assumes that the material is dispersed in the environment according to standard Gaussian diffusion models. For the risk assessment, default data for atmospheric dispersion were used, representing an instantaneous ground-level release and a small-diameter source cloud (Neuhauser and Kanipe, 2003). The calculation of the collective population dose following the release and dispersal of radioactive material includes the following exposure pathways:

- external exposure to the passing radioactive cloud

- external exposure to contaminated ground

- internal exposure from inhalation of airborne contaminants

- internal exposure from the ingestion of contaminated food

For the ingestion pathway, the fraction of farmland in each state traversed was used as input to the RADTRAN code. Doses of radiation from external exposure and the ingestion or inhalation of radionuclides were calculated by applying standard dose conversion factors (Eckerman and Ryman, 1993; ICRP, 1996).

D.2.3.2 Chemical Accident Risk Assessment

The risks from exposure to hazardous chemicals during transportation-related accidents, which includes consideration of the formation of hydrogen fluoride (HF) from the reaction of UF_6 with moisture in the air for this assessment, can be either acute (result in immediate injury or fatality) or latent (result in cancer that would present itself after a latency period of several years). However, none of the chemicals that might be released in any of the transportation accidents involving UF_6 are carcinogenic. As a result, no excess chemically induced latent cancers would be expected from accidental chemical releases.

The acute effects considered were assumed to exhibit a threshold nonlinear relationship with exposure; that is, some low level of exposure can be tolerated without inducing a health effect. To estimate risks, chemical-specific concentrations were developed for potential irreversible adverse effects. All individuals exposed at these levels or higher following an accident were included in the transportation risk estimates.

The primary exposure route of concern with respect to accidental release of hazardous chemicals would be inhalation. Although direct exposure to hazardous chemicals via other pathways such as ingestion or absorption through the skin (dermal absorption) would also be possible, these routes would be expected to result in much lower exposure than the inhalation pathway doses for the uranium compounds. The likelihood of acute effects would be much less for the ingestion and dermal pathways than for inhalation.

The acute health endpoint – potential irreversible adverse effects – was considered for the assessment of cargo-related population impacts from transportation accidents. However, chemical impacts would be negligible; past analyses of depleted UF_6 shipments have shown that the estimates of irreversible adverse effects to be approximately 1 to 3 orders of magnitude lower than the estimates of public latent cancer fatalities from radiological accident exposure (DOE, 2004a; DOE, 2004b; NRC, 2005a). In addition, no more than one percent of cases involving irreversible adverse effects due to exposure to HF or uranium compounds result in fatalities (Policastro, 1997). Thus, no further analysis of chemical hazards posed by transport was conducted for this draft EIS as radiological accident impacts are shown to be SMALL and the relative chemical hazards would be less.

D.2.3.3 Vehicle-Related Accident Risk Assessment

The vehicle-related accident risk refers to the potential for transportation accidents that could result directly in fatalities not related to the nature of the cargo in the shipment. This risk represents fatalities from physical trauma. State-average rates for transportation fatalities are used in the assessment. Vehicle-related accident risks are calculated by multiplying the total distance traveled by the rates for transportation fatalities. In all cases, the vehicle-related accident risks are calculated on the basis of distances for round-trip shipment since the presence or absence of cargo would not be a factor in accident frequency.

D.3 Input Parameters and Assumptions

The principal input parameters and assumptions used in the transportation risk assessment are discussed in this section. Where appropriate, applicable government regulations are referenced. Transportation of hazardous chemical and radioactive materials is governed by U.S. Department of Transportation (DOT), U.S. Nuclear Regulatory Commission (NRC), and U.S. Environmental Protection Agency (EPA) regulations, and by the *Hazardous Materials Transportation Act* (HMTA) (49 U.S.C. 5101 et seq.). These regulations may be found in the U.S. *Code of Federal Regulations* (CFR) at 49 CFR Parts 171–178, 49 CFR Parts 383–397, 10 CFR Part 71, and 40 CFR Parts 262 and 265, respectively. State agencies are also involved in regulating such transport within their borders. All transportation-related activities must be in accordance with applicable regulations of these agencies. However, the DOT and NRC have primary regulatory responsibility for shipment of radioactive materials. Those regulations most pertinent to this risk assessment can be found in 49 CFR Part 173, 49 CFR Part 397, and 10 CFR Part 71.

D.3.1 Route Characteristics

The transportation route selected for a shipment determines the total potentially exposed population and the expected frequency of transportation-related accidents. For truck transportation, the route characteristics most important to the risk assessment include the total shipping distance between each origin and destination and the population density along the route.

D.3.1.1 Route Selection

The DOT routing regulations concerning radioactive materials on public highways are prescribed in 49 CFR 397.101. The objectives of the regulations are to reduce the impacts of transporting radioactive materials, to establish consistent and uniform requirements for route selection, and to identify the role of state and local governments in routing radioactive materials. The regulations attempt to reduce potential hazards by prescribing that populous areas be avoided and that travel times be minimized. In addition, the regulations require that the carrier of radioactive materials ensure that the vehicle is operated on routes that minimize radiological risks, and that accident rates, transit times, population density and activity, time of day, and day of week are considered in determining risk. However, the final determination of the route is left to the discretion of the carrier, such as for shipments of UF_6 (depleted or enriched to five percent uranium-235).

For this analysis, representative shipment routes were identified using the WebTRAGIS (Version 1.5.4) routing model (Johnson and Michelhaugh, 2003) for the truck shipments. The routes were selected to be reasonable and consistent with routing regulations and general practice, but they are considered only representative because the actual routes used would be chosen in the future and are often determined by the shipper. At the time of shipment, route selection would reflect current road conditions, including road repairs and traffic congestion.

The HIGHWAY data network in WebTRAGIS is a computerized road atlas that includes a complete description of the interstate highway system and of all U.S. highways. In addition, most principal state highways and many local and community highways are identified. The code is periodically updated to reflect current road conditions and has been compared with reported mileages and observations of commercial trucking firms.

Routes are calculated within the model by minimizing the total impedance between origin and destination. The impedance is a function of distance and driving time along a particular segment of highway. The population densities along a route are derived from 2000 Census data from the U.S. Census Bureau.

The WebTRAGIS database version used was Highway Data Network 4.0. Summary route information on the truck routes used in the analysis is provided in Table D-1.

D.3.1.2 Population Density

Three population density zones – rural, suburban, and urban – were used for the population risk assessment. The fractions of travel and average population density in each zone were determined with the WebTRAGIS routing model. Rural, suburban, and urban areas are characterized according to the following breakdown: rural population densities range from 0 to 54 persons per square kilometer (0 to 139 persons per square mile); suburban densities range from 55 to 1284 persons per square kilometer (140 to 3326 persons per square mile); and urban covers all population densities greater than 1284 persons per square kilometer (3326 persons per square mile). Use of these three population density zones is based on an aggregation of the 12 population density zones provided in the WebTRAGIS model output. For calculation purposes, information about population density was generated at the state level and used as RADTRAN input for all routes. Route average population densities and other route characteristics are given in Table D-1.

D.3.1.3 Accident and Fatality Rates

For calculating accident risks, vehicle accident involvement and fatality rates are taken from data provided in Saricks and Tompkins (1999). For each transport mode, accident rates are defined generically as the number of accident involvements (or fatalities) in a given year per unit of travel by that mode in the same year. Therefore, the rate is a fractional value – the accident-involvement count is the numerator, and vehicular activity (total traveled distance) is the denominator. Accident rates are derived from multiple-year averages that automatically account for such factors as heavy traffic and adverse weather conditions. For assessment purposes, the total number of expected accidents or fatalities is calculated by multiplying the total shipping distance for a specific route by the appropriate accident or fatality rate.

For truck transportation, the rates presented by Saricks and Tompkins are specifically for heavy combination trucks involved in interstate commerce. Heavy combination trucks are rigs composed of a separable tractor unit containing the engine and one to three freight trailers connected to each other and the tractor. Heavy combination trucks are typically used for shipping radioactive wastes. Truck accident rates are computed for each state on the basis of statistics compiled by the DOT Office of Motor Carriers for 1994 to 1996. Saricks and Tompkins

Table D-1 Summary Route Data

Route	Total distance		Fraction of travel			Average population density [persons/km^2 (persons/mi^2)]					
	[km	(mi)]	Rural	Suburban	Urban	Rural		Suburban		Urban	
UF_6 feed coming from:											
Portsmouth Marine Terminal	463	(288)	70.0	28.2	1.8	16.3	(42.2)	296.4	(767.7)	2157	(5588)
Dundalk Marine Terminal	754	(467)	50.1	42.0	8.0	18.2	(47.2)	369.7	(957.5)	2447	(6338)
Honeywell International	1313	(816)	55.2	42.3	2.5	19.1	(49.4)	332.2	(860.5)	2075	(5373)
Cameco	1397	(868)	52.6	41.7	5.8	18.9	(49.1)	351.1	(909.3)	2383	(6171)
UF_6 product going to:											
Westinghouse Electric	479	(298)	65.0	33.6	1.3	16.6	(43.0)	276.0	(714.8)	2495	(6463)
AREVA NP	4785	(2973)	75.0	23.0	2.0	11.2	(28.9)	325.0	(841.8)	2163	(5603)
Depleted UF_6 tails going to:											
Paducah conversion facility	1316	(818)	55.4	42.2	2.4	19.1	(49.6)	331.9	(859.5)	2087	(5404)
Portsmouth conversion facility	989	(615)	55.3	41.3	3.4	18.3	(47.5)	359.6	(931.4)	2150	(5569)
Empty 48Y cylinder return to:											
Honeywell International	1313	(816)	55.2	42.3	2.5	19.1	(49.4)	332.2	(860.5)	2075	(5373)
LLRW going to:											
EnergySolutions	3947	(2452)	73.0	24.6	2.5	11.4	(29.6)	335.0	(867.7)	2199	(5695)

present accident involvement and fatality counts, estimated kilometers of travel by state, and the corresponding average accident involvement and fatality rates for the three years investigated. Fatalities (including of crew members) are deaths that are attributable to the accident and that occurred within 30 days of the accident.

The truck accident assessment presented in this draft EIS uses accident (fatality) rates for travel on interstate highways. The total accident risk for a case depends on the total distance traveled in various states and does not rely on national average accident statistics. However, for comparative purposes, the national average truck accident rate on interstate highways presented in Saricks and Tompkins is 3.15×10^{-7} accidents per truck-kilometer (5.07×10^{-7} accidents per mile). Note that the accident rates used in this assessment were computed using all interstate shipments, regardless of the cargo.

D.3.2 Packaging

Shipment packaging for radioactive materials must be designed, constructed, and maintained to ensure that it will contain and shield the contents during normal transportation. For more highly radioactive material, the packaging must contain and shield the contents in severe accidents. The type of packaging used is determined by the radioactive hazard associated with the packaged material. The basic types of packaging required by the applicable regulations are designated as Type A, Type B, or industrial packaging (generally for low-specific activity [LSA] material). Table D-2 summarizes the shipment packaging for the shipments considered.

The LLRW and the feed and tails UF_6 shipments would use Type A packaging. This type of packaging must withstand the conditions of normal transportation without the loss or dispersal of the radioactive contents. “Normal” transportation refers to all transportation conditions except those resulting from accidents or sabotage. Approval of Type A packaging is obtained by demonstrating that the packaging can withstand specified testing conditions intended to simulate normal transportation. Type A packaging usually does not require special handling, packaging, or transportation equipment. The UF_6 feed and depleted tails would be shipped in Model 48Y cylinders (USEC, 1999). LLRW would be shipped in 4 × 4 × 4-foot waste boxes. The dimensions of the Model 48Y cylinder are shown in Figure D-1.

The enriched product would be shipped in Model 30B cylinders (USEC, 1999) in Type B overpacks. Figure D-2 displays the dimensions of the 30B cylinder. In addition to meeting all the Type A standards, Type B packaging must also provide a high degree of assurance that the package integrity will be maintained even during severe accidents, with essentially no loss of the radioactive contents or serious impairment of the shielding capability. Type B packaging must satisfy stringent testing criteria (as specified in 10 CFR Part 71) that were developed to simulate conditions of severe hypothetical accidents, including impact, puncture, fire, and immersion in water. The most widely recognized Type B packagings are the massive casks used to transport highly radioactive spent nuclear fuel from nuclear power stations. For shipping the Model 30B cylinders, a UX-30 overpack would be used. The UX-30 has a diameter of 1.10 meters (43.5 inches) and a 2.44 meters (96 inches) length (NRC, 2009).

Table D-2 Radioactive Material Shipment Information

Material	Shipment Configuration	Annual Average Number of Shipments
UF_6 feed	1-48Y cylinder	900
UF_6 product	5-30B cylinders	50
Depleted UF_6 tails	1-48Y cylinder	800
Empty cylinders	2-48Y cylinders with residual heels	50
LLRW	36-4 × 4 × 4-foot waste boxes	36

Sources: GLE, 2008; GLE, 2009.

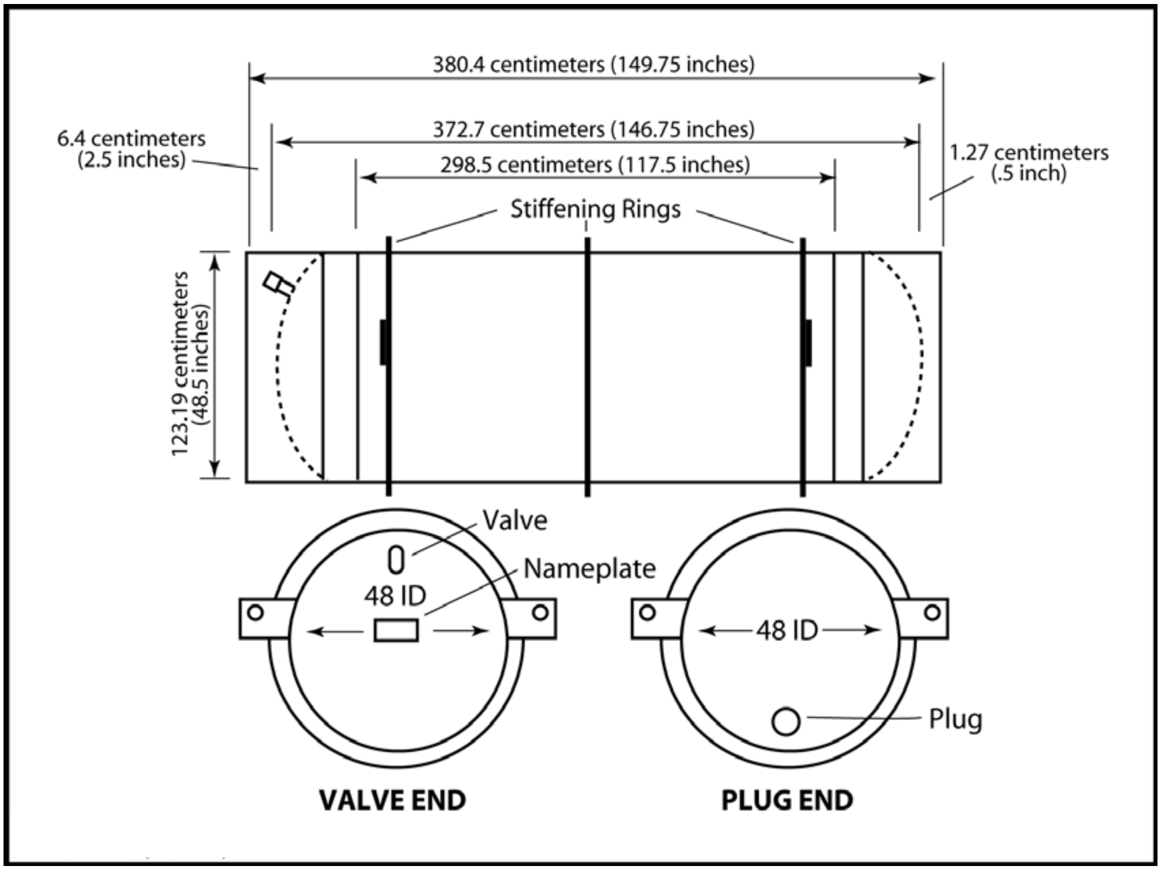

Figure D-1 Schematic of a Type 48Y Cylinder (USEC, 1995)

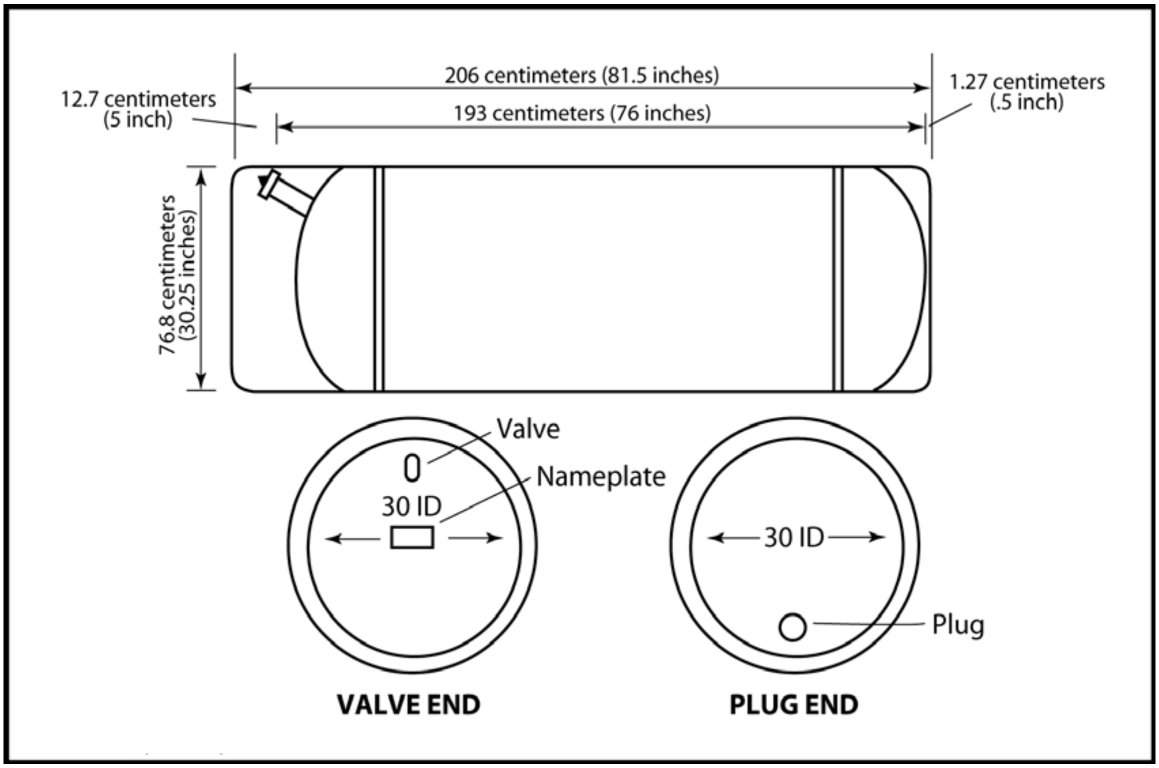

Figure D-2 Schematic of a Type 30B Cylinder (USEC, 1995)

Table D-3 Single-Shipment Radionuclide Inventories (Curies)[a]

Isotopes	UF_6 Feed	Enriched UF_6	Depleted UF_6 (tails)	Empty Cylinders	LLRW
Uranium-234	2.8	22.6	0.509	9.0×10^{-4}	0.027
Uranium-235	0.13	0.830	0.037	1.0×10^{-4}	0.0012
Uranium-238	2.8	2.46	2.835	0.0051	0.027

[a] Source: GLE, 2009.

D.3.3 Shipment Configurations and Number of Shipments

The anticipated shipment information for the proposed action is summarized in Table D-2. Table D-3 lists the radionuclide inventory for each shipment type. Uranium feed and depleted tails shipments would consist of one Type 48Y cylinder per truck. Each cylinder would contain about 12.4 metric tons (13.7 tons) of natural or depleted UF_6. Enriched UF_6 product would be shipped in Type 30B cylinders in UX-30 overpacks, five cylinders to a truck. Each 30B cylinder would contain approximately 2.3 metric tons (2.5 tons) of product. LLRW would be shipped in 4 × 4 × 4-foot waste boxes, 36 to a truck. The types and amounts of LLRW to be shipped are discussed in Section 4.2.12.2.

D.3.4 Accident Characteristics

Assessment of transportation accident risk takes into account the fraction of material in a package that would be released or spilled to the environment during an accident, commonly referred to as the release fraction. The release fraction is a function of the severity of the accident and the material packaging. For instance, a low-impact accident, such as a "fender-bender," would not be expected to cause any release of material. Conversely, a very severe accident would be expected to release nearly all of the material in a shipment into the environment. The method used to characterize accident severities and the corresponding release fractions for estimating both radioactive and chemical risks are described below.

D.3.4.1 Accident Severity Categories

A method to characterize the potential severity of transportation-related accidents has been described in NUREG-0170, *Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes* (NRC, 1977). The NRC method divides the spectrum of transportation accident severities into eight categories. Other studies have divided the same accident spectrum into six categories (Wilmot, 1981), 20 categories (Fischer et al., 1987), or more (Sprung et al., 2000); however, these latter studies focused primarily on accidents involving shipments of spent nuclear fuel (SNF). In this analysis, the NUREG-0170 scheme was used for all shipments.

The NUREG-0170 scheme for truck transportation accident classification is shown in Figure D-3. Severity is described as a function of the magnitudes of the mechanical forces (impact) and thermal forces (fire) to which a package may be subjected during an accident. Because all accidents can be described in these terms, severity is independent of the specific accident sequence. In other words, any sequence of events that results in an accident in which a package is subjected to forces within a certain range of values is assigned to the accident severity category associated with that range. The scheme for accident severity is designed to take into account all credible transportation-related accidents, including those accidents with low probability but high consequences and those with high probability but low consequences.

Each severity category represents a set of accident scenarios defined by a combination of mechanical and thermal forces. A conditional probability of occurrence C that is, the probability that if an accident occurs, it is of a particular severity C is assigned to each category. The fractional occurrences for accidents by accident severity category and population density zone are shown in Table D-4 and are used for estimating the radioactive risks.

Category I accidents are the least severe but the most frequent; Category VIII accidents are very severe but very infrequent. To determine the expected frequency of an accident of a given severity, the conditional probability in the category is multiplied by the baseline accident rate. Each population density zone has a distinct distribution of accident severities related to differences in average vehicular velocity, traffic density, location (rural, suburban, or urban), and other factors.

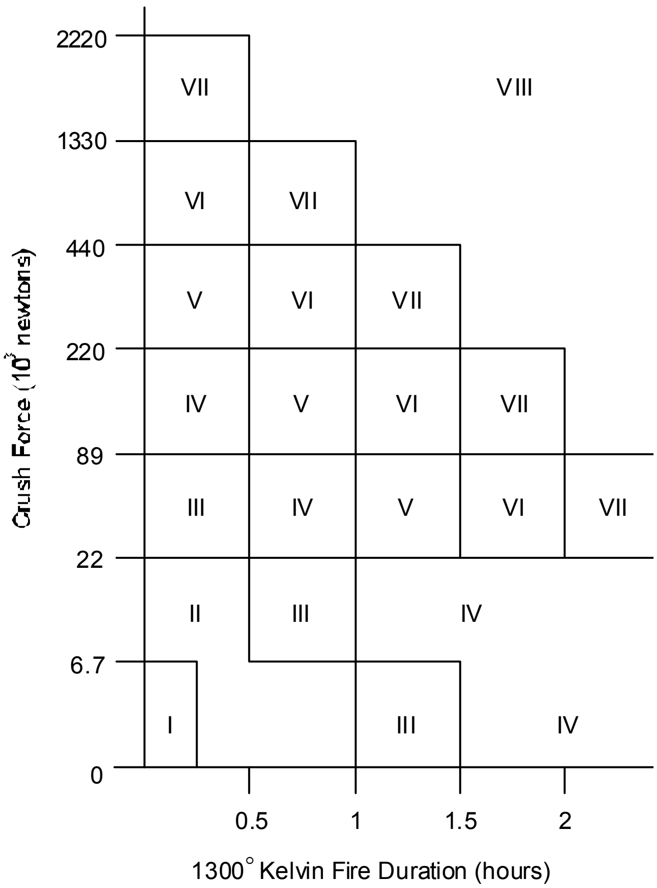

Figure D-3 Scheme for NUREG-0170 Classification by Accident Severity Category for Truck Accidents (NRC, 1977)

D.3.4.2 Package Release Fractions

In NUREG-0170, radiological and chemical consequences are calculated by assigning package release fractions to each accident severity category. The release fraction is defined as the fraction of the material in a package that could be released from the package as the result of an accident of a given severity. Release fractions take into account all mechanisms necessary to create release of material from a damaged package to the environment. Release fractions vary according to the type of package and the physical form of the material.

Representative release fractions for accidents involving all shipments were taken from NUREG-0170 (NRC, 1977). The recommendations in NUREG-0170 are based on best engineering judgments and have been shown to provide conservative estimates of material releases following accidents. The release fractions used are those reported in NUREG-0170 for both Type A and Type B packages. Release fractions for accidents of each severity category are given in Table D-5. As shown in that table, the amount of material released from the package ranges from zero for minor accidents to 100% for the most severe accidents.

Table D-4 Fractional Occurrences for Truck Accidents by Severity Category and Population Density Zone

Severity Category	Fractional Occurrence	Fractional occurrence by population density zone		
		Rural	Suburban	Urban
I	0.55	0.1	0.1	0.8
II	0.36	0.1	0.1	0.8
III	0.07	0.3	0.4	0.3
IV	0.016	0.3	0.4	0.3
V	0.0028	0.5	0.3	0.2
VI	0.0011	0.7	0.2	0.1
VII	8.5×10^{-5}	0.8	0.1	0.1
VIII	1.5×10^{-5}	0.9	0.05	0.05

Source: NRC, 1977.

Also important for the purposes of risk assessment are the fraction of the released material that can be entrained in an aerosol (part of an airborne contaminant plume) and the fraction of the aerosolized material that is also respirable (of a size that can be inhaled into the lungs). These fractions depend on the physical form of the material. Most solid materials are difficult to release in particulate form and are, therefore, relatively nondispersible. Conversely, liquid or gaseous materials are relatively easy to release if the container is breached in an accident.

The aerosolized fraction for the UF_6 shipments was taken to be 0.01, except in the case of higher severity accidents (Categories VI through VIII) involving fire, for which it was taken to be 0.33 (NRC, 2005a). The respirable fraction was taken to be 1 for all accidents. For LLRW, which was assumed to behave as a loose powder, the aerosolized fraction was set to 0.1, with a respirable fraction of 0.05 (Neuhauser and Kanipe, 2003).

Table D-5 Estimated Release Fractions for Type A and Type B packages under Various Accident Severity Categories

Severity Category	Release fraction[a]	
	Type A	Type B
I	0	0
II	0.01	0
III	0.1	0.01
IV	1	0.1
V	1	1
VI	1	1
VII	1	1
VIII	1	1

[a] Values are for total material release fraction (the fraction of material in a package released to the environment during an accident).
Source: NRC, 1977.

D.3.4.3 Atmospheric Conditions During Accidents

Hazardous material released to the atmosphere is transported by the wind. The amount of dispersion, or dilution, of the contaminant material in the air depends on the meteorologic conditions at the time of the accident.

Because predicting the specific location of an offsite transportation-related accident and the exact meteorologic conditions at the time of the accident is impossible, generic atmospheric conditions were selected for the accident risk assessment. Neutral weather conditions were assumed. These conditions were represented by Pasquill atmospheric stability Class D with a wind speed of 4 meters per second (9 miles per hour). Because neutral meteorological conditions are the most frequently occurring atmospheric stability condition in the United States, these conditions are most likely to be present in the event of an accident involving a hazardous material shipment. Observations at National Weather Service surface meteorological stations at more than 300 U.S. locations indicate that on a yearly average, neutral conditions (represented by Pasquill Classes C and D) occur about half (50 percent) the time; stable conditions (Pasquill Classes E and F) occur about one-third (33 percent) of the time; and unstable conditions (Pasquill Classes A and B) occur about one-sixth (17 percent) of the time (Doty et al., 1976). The neutral category predominates in all seasons, but it is most prevalent (nearly 60 percent of the observations) during winter.

D.3.5 Radiological Risk Assessment Input Parameters and Assumptions

The dose (and, correspondingly, the risk) to populations during routine transportation of radioactive materials is directly proportional to the assumed external dose rate from the shipment. The actual dose rate from the shipment is a complex function of the composition and configuration of shielding and containment materials used in the packaging, the geometry of the loaded shipment, and the characteristics of the radioactive material itself.

Table D-6 lists the external dose rates used for this analysis that were adapted from Table D-7 of NUREG-1790, *Environmental Impact Statement for the Proposed National Enrichment Facility in Lea County, New Mexico* (NRC, 2005b) and used in this transportation analysis. The dose rates are presented in terms of the transport index (TI), which is the dose rate at 1 meter (3 feet) from the lateral sides of the transport vehicle. The regulatory limit established in 49 CFR 173.441 and 10 CFR 71.47 to protect the public is 0.1 millisievert per hour (10 millirem per hour) at 2 meters (6 feet) from the outer lateral sides of the transport vehicle.

Note that in Table D-6, the external radiation levels for an empty cylinder are approximately double those for a full cylinder. This occurs for two reasons. First, after UF_6 is vaporized and removed from a cylinder, the radioactive uranium daughter products that build up due to the radioactive decay of uranium collect at the bottom and form what is known as a "heel." The nature of the radiation emitted from the uranium daughter products results in a greater release of gamma radiation than occurs from just uranium. Second, uranium is also a good shield material for gamma radiation. When the cylinder is full of UF_6, the uranium daughters are distributed throughout the cylinder and emitted radiation must pass through a significant amount of uranium (and thus, can be stopped or absorbed by the uranium). It is only gamma radiation from the uranium daughters near to the inner surface of the cylinder that can penetrate the cylinder and contribute to a nearby person's radiation exposure. Because the empty cylinder no longer has the high shielding capability of the UF_6 versus the remaining vapor, and the heel concentrates the more highly radioactive uranium daughters right next to the inner cylinder surface, the radiation levels of the empty UF_6 cylinder are higher than those for a full UF_6 cylinder.

Table D-6 External Dose Rates and Package Sizes Used in RADTRAN

Material	Vehicle Size (m)	Crew View (m)	Shipment External Dose Rate at 1 m (mrem/hr)[a]
UF_6 feed	3.73	1.23	0.29
UF_6 product	12	0.76	0.95
Depleted UF_6 tails	3.73	1.23	0.28
Empty cylinders[b]	8	1.23	2.0
LLRW	14	2.44	0.15

[a] Sources: GLE, 2008; GLE, 2009; NRC, 2005b.
[b] Contains residual material. See text for discussion.

Table D-7 General RADTRAN Input Parameters[a]

Parameter	Truck
Number of crew members	2
Distance from source to crew (m)	3.1
Average vehicular speed (km/h)[b]	
Rural	88.49
Suburban	88.49
Urban	88.49
Number of people per vehicle sharing route	2
Population density along routes (persons/km^2)[c]	Route-specific
One-way traffic count (vehicles/h)[d]	
Rural	530
Suburban	760
Urban	2400
Stop time (h/km)[e]	0.0014
Population density at stops (persons/km^2)[f]	
1 to 10 m from vehicle	30,000
10 to 800 m from vehicle	340

[a] Accident conditional probabilities are listed by severity category in Table D-4; accident release fractions are given in Table D-5.
[b] Fraction of rural and suburban travel on freeways was set to 1 in RADTRAN. Thus, the rural speed was used for both urban and suburban zones.
[c] Route-specific population densities are listed in Table D-1.
[d] DOE, 2002.
[e] Hostick et al., 1992. Equivalent to 30 minutes for every 4 hours of driving at 88.49 km/hr (55 mph).

In addition to the specific parameters discussed previously, values for a number of general parameters must be specified within the RADTRAN code to calculate radiological risks. These general parameters define basic characteristics of the shipment and traffic and are specific to the mode of transportation. The RADTRAN user manual (Neuhauser and Kanipe, 2003) contains derivations and descriptions of these parameters. The general RADTRAN input parameters used in the radiological transportation risk assessment are summarized in Table D-7.

D.3.6 Routine Nonradiological Vehicle Emission Risks

Vehicle-related risks during incident-free transportation include incremental risks caused by potential exposure to airborne particulate matter from fugitive dust and vehicular exhaust emissions. The health endpoint assessed under routine transport conditions is the excess (additional) latent mortality caused by inhalation of vehicular emissions. These emissions occur primarily in the form of diesel exhaust and fugitive dust (resuspended particulates from the roadway). Strong epidemiological evidence exists suggesting that increases in ambient air concentrations of PM_{10} (particulate matter with a mean aerodynamic diameter less than or equal to 10 microns) lead to increases in mortality (EPA, 1996a; EPA, 1996b). Currently, it is assumed that no threshold exists and that the dose-response functions for most health effects associated with PM_{10} exposure, including premature mortality, are linear over the concentration ranges investigated (EPA, 1996a). Over both the short and long terms, fatalities (mortality) may result from life-shortening respiratory or cardiovascular diseases (EPA, 1996a; Ostro and Chestnut, 1998). The long-term fatalities also are assumed to include those from cancer.

The increased ambient air particulate concentrations caused by the transport vehicle, due to fugitive dust and diesel exhaust emissions, were related to premature latent fatalities in the form of risk factors for transportation risk assessments (Biwer and Butler, 1999). Thus, a value of 8.36×10^{-10} latent fatalities per kilometer for truck transport was used in this assessment. This value is for heavy combination trucks (truck class VIIIB) and for areas with an assumed population density of one person per square kilometer (2.6 persons per square mile). One-way shipment risks are obtained by multiplying the appropriate risk factor by the average population density along the route and the route distance. The risks reported for routine vehicle risks in this analysis are for round-trip travel of the transport vehicle.

The vehicle risks reported here are estimates based on the best available data. However, as is true for the radiological risks, there is a large and not readily quantifiable degree of uncertainty in the vehicle emission risk factors. For example, large uncertainties exist as to the extent of increased mortality with an incremental rise in particulate air concentrations and as to whether there are threshold air concentrations that are applicable. Also, estimates of the particulate air concentrations caused by transport vehicles are dependent on location, road conditions, vehicle conditions, and weather.

As discussed by Biwer and Butler (1999), there are large uncertainties in the human health risk factors used to develop the emission risks. In addition, because of the conservatism of the assumptions made to reconcile results with those presented by EPA (EPA, 1993), latent fatality risks estimated with the above risk factor may be considered to be near an upper bound. Use of this risk factor for truck class VIIIB will give estimated fatalities comparable to those from accident fatalities in some cases. In addition, the question as to what exactly constitutes a fatality as a direct consequence of increased PM_{10} levels from vehicle emissions has not been answered definitively, but long-term fatalities have been associated with increased levels of PM_{10} (Biwer and Butler, 1999).

D.4 Transportation Impacts

Single shipment transportation impacts are presented in Table 4-12 of Section 4.2.10.2. Total collective population transportation impacts are presented in Table 4-13.

D.5 References

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APPENDIX E
AIR QUALITY ANALYSIS

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AIR QUALITY ANALYSIS

This appendix discusses detailed information on assumptions, emission factors, and emission calculations for criteria air pollutants. Detailed information on assumptions, parameter selection, and air dispersion modeling is also presented. For the air quality analysis, the lifespan of the GLE project is considered in four phases:

- Access road construction and land clearing (does not include other elements of preconstruction, such as ancillary building construction)

- Building construction (including ancillary building construction that occurs as part of preconstruction)[1]

- Start-up and final construction (includes concurrent indoor construction with staged testing and start-up of process units as completed)

- Facility operation

The analyses in this appendix are based on the assumption that a licensing decision would be made in late 2011, construction (if authorized) would start shortly after a licensing decision was made, and license termination would occur in 2051. Subsequently, the Commission's *Notice of Hearing and Commission Order* (75 FR 1819) specified that a licensing decision be made within 30 months of the Order (i.e., June 2012). Thus, the NRC staff currently expects that a licensing decision will be made in mid-2012, NRC-licensed construction will begin in mid-2012 (although the building construction phase, which includes ancillary building construction, may begin before NRC-licensed construction starts), and that termination of the 40-year license, if granted, will occur in 2052. The NRC staff expects that the dates for start-up and final construction (2013–2017) and full facility operations (2017) will remain unchanged. The NRC staff expects that any resulting changes in the licensing and construction schedule would cause slight changes to the air quality analysis but would not affect the resulting conclusions. Any necessary changes will be reflected in the final EIS.

E.1 Emissions Estimation Associated with Construction and Operation of the Proposed GLE Facility

For convenience in emission inventories and air quality modeling, road construction is assumed to begin in April 2011, followed by land clearing for the remainder of 2011, and building construction, including ancillary building construction, which is part of preconstruction, for all of 2012. Table E-1 presents general assumptions for estimating air emissions associated with construction and operation of the proposed General Electric (GE)-Hitachi Global Laser Enrichment LLC (GLE) Facility. Tables E-2 through E-5 discuss input parameters and activity-specific assumptions used for estimating air emissions at the proposed GLE Facility.

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[1] For the purposes of estimating emission inventories and air quality modeling, the construction of ancillary structures, which is part of preconstruction, is grouped into building construction.

Tables E-6 through E-13 present average daily and annual emissions based on emission factors and activity levels (e.g., area disturbed, total vehicle miles traveled).

During access road construction and land clearing as well as building construction, air emissions would include fugitive dust from soil disturbances caused by heavy equipment and by truck traffic on unpaved roads, and engine exhaust emissions from off-road construction equipment and motor vehicles, such as commuting, visiting, support, and delivery traffic in and around the proposed GLE Facility. These activities would generate air emissions of criteria pollutants (sulfur dioxide [SO_2], nitrogen oxides [NO_x], carbon monoxide [CO], particulate matter equal to or smaller than 10 micrometers [PM_{10}] and particulate matter equal to or smaller than 2.5 micrometers [$PM_{2.5}$]), volatile organic compounds (VOCs), greenhouse gases (GHGs) (e.g., carbon dioxide [CO_2]), and a small amount of hazardous air pollutants (HAPs) (e.g., benzene). VOCs are organic compounds that easily volatize or evaporate and can break down through photochemical reactions, contributing to air pollution, especially the generation of tropospheric ozone (O_3). GHGs are gases that absorb outgoing infrared radiation emitted by the earth's surface and trap heat in the atmosphere. HAPS are a group of 188 chemicals identified in the *1990 Clean Air Act Amendments*, exposure to which can cause or contribute to cancer, birth defects, genetic damage, and other adverse health effects. Small quantities of additional VOC and HAP emissions would be released from the refueling and onsite maintenance of the off-road construction equipment, and from painting and other construction-finishing activities.

Fugitive Dust: No detailed information on the time schedule, heavy equipment usage, and activity levels is available at this time. General area-wide emission factors based on the area and duration of disturbances were used. As shown in Tables E-2 and E-3, it is assumed that an uncontrolled emission factor of 0.94 metric tons per hectare-month (0.42 tons per acre-month) was applied to large-scale earthmoving activities, such as road construction and site preparation, while that of 0.25 metric tons per hectare-month (0.11 tons per acre-month) was applied to construction activities, such as erection of building structures and equipment installation (MRI, 1996). It is also assumed that 10 percent of PM_{10} emissions of fugitive dust is $PM_{2.5}$ (Countess Environmental, 2006). For this analysis, an emission control efficiency of 74 percent is assumed during the early construction phase.

Off-Road Construction Equipment: Composite emission factor for off-road construction equipment was estimated based on assumed mix of heavy equipment types and pieces of heavy equipment, load factor, and equipment-specific emission factors (EPA, 2004a,b).

Onroad Motor Vehicles: Commuting, visitor, support, and delivery traffic, ranging from small passenger cars to heavy-duty tractor trailers, would travel within and to and from the Wilmington Site. Emission factors by vehicle classification are estimated using the EPA's MOBILE6.2 mobile source emission factor model (EPA, 2003).

The GLE Facility operation generates a small amount of criteria pollutants and HAP emissions because of no combustion being involved. During facility operation, primary emission sources include minimal PM emissions from the GLE Facility building stack, PM emissions as drift from mechanical-draft cooling towers, auxiliary diesel generator units operating on an intermittent basis, onsite transfer vehicles (OSTVs) for moving cylinders to and from the cylinder pads, and heavy-duty trucks transferring product cylinders to the onsite Fuel Manufacturing Operations

(FMO) facility. During the facility operation phase, commuting, visiting, support, and local delivery traffic in and around the proposed GLE Facility are also emission sources. To support facility operation, regional deliveries would be anticipated: UF_6 feedstock coming to the GLE Facility and UF_6 product, depleted UF_6 tails, empty 48Y cylinders, and low-level radioactive waste (LLRW) going out from the proposed GLE Facility. But these emissions would have minimal impacts on the surrounding area of the proposed GLE Facility because they are released along the long roadways. Although criteria pollutants and VOCs from regional deliveries are not included, greenhouse gas emissions (such as CO_2) are included in the analysis. Overall, non-particulate matter (PM) emissions are comparable to but PM emissions are far lower than those for access road construction and land clearing as well as building construction.

E.2 Air Quality Modeling Analysis

Air dispersion modeling was performed to estimate ambient air concentration increments at the site boundary and offsite receptors as a result of air emissions during access road construction and land clearing as well as building construction at the proposed GLE Facility. Air quality modeling was performed for criteria air pollutants including SO_2, NO_2, CO, and PM (PM_{10} and $PM_{2.5}$). Air quality modeling for ozone and lead was not performed. Ozone is of a regional concern and is formed by highly complex and nonlinear reactions that involve VOC and nitrogen oxide (NO_x) precursors. Air dispersion modeling for ozone requires intensive meteorological and emissions data processing and computing resources. However, emissions from construction and operation at the proposed GLE Facility would not be high enough to influence regional ozone levels, and thus, no ozone modeling is warranted. Air quality modeling for lead (Pb) was not performed because its emissions and associated ambient impacts would be minimal due to the phasing out of leaded gasoline in the 1970s. The following sections include brief descriptions of the air dispersion model, meteorological data processing, receptor data, and modeling assumptions.

E.2.1 Selection of Air Dispersion Model

For this modeling analysis, the latest version of the AMS/EPA Regulatory MODel (AERMOD) modeling system (version 09292) (EPA, 2009) was used, which is the U.S. Environmental Protection Agency's (EPA's) preferred or recommended model for a wide range of regulatory applications. AERMOD is a refined, steady-state plume model that incorporates air dispersion based on state-of-the-art planetary boundary layer turbulence structure and scaling concepts, and building wake effects and plume downwash for point sources. It includes treatment of both surface and elevated sources (including multiple point, area, and volume sources), and both simple and complex terrain, and can be applied to rural and urban areas. The model uses hourly sequential preprocessed meteorological data to estimate not only airborne concentrations, but also dry and wet deposition fluxes for both particulate and gaseous emissions of nonreactive pollutants for averaging times, ranging from one hour to the period (one year or multiple years).

AERMOD is a modeling system that contains three major separate components:

- AERMET – meteorological data preprocessor that incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts;

- AERMAP – terrain data preprocessor that incorporates complex terrain using digital elevation data; and

- AERMOD – air dispersion model that estimates airborne concentrations and dry/wet deposition fluxes.

In addition, supporting programs for the AERMOD modeling system include:

- AERSURFACE – surface characteristics preprocessor that estimates surface characteristics including surface roughness length, albedo, and Bowen ratio for input to the AERMET;

- BPIPPRIME – a tool that calculates building parameters to account for building downwash effects of point source(s) for input to the AERMOD; and

- AERSCREEN – a screening model for AERMOD that produces estimates of regulatory design concentrations without the need for meteorological data and is designed to produce more conservative results than AERMOD. EPA is currently working on a beta version of the code.

E.2.2 Determination of Surface Characteristics

For use in the computation of the fluxes and stability of the atmosphere, meteorological data preprocessor AERMET needs surface characteristics parameters, including surface roughness length, albedo, and the Bowen ratio. The surface roughness length is a measure of irregularities at the surface, including vegetation, topography, and structures, which influence the near-surface wind stress. Surface roughness length plays the most crucial role in determining the magnitude of mechanical turbulence and the stability of the boundary layer. The typical values range from 0.001 meter (0.003 feet) over calm water surfaces and 1 meter (3.3 feet) or more over a forest or urban area. Albedo is the fraction of the amount of radiation reflected from the surface to the amount of radiation incident on the surface. Typical values range from 0.1 for thick deciduous forests to 0.9 for fresh snow. The Bowen ratio, indicator of surface moisture, is the ratio of sensible heat flux to the latent heat flux. The Bowen ratio is used to determine the planetary boundary layer parameters for convective conditions. The typical values range from 0.1 over water to 10 over desert at midday.

Surface characteristics should represent the meteorological data at the application site. However, such data may not be available and data from a nearby representative *measurement* site must be used. In particular, the Wilmington/Hanover County Airport is exposed to open areas, while the proposed GLE Facility is surrounded by wooded area. Although the Wilmington Airport is only about 8 kilometers (5 miles) from the proposed GLE Facility, its meteorological parameters and surface characteristics are not representative of those for the proposed GLE Facility. In this case, the AERMOD Implementation Guide (EPA, 2009) recommends finding another nearby measurement site representative of both meteorological parameters and surface characteristics of the site of interest. Failing that, it is likely that site-specific meteorological data will be required.

The AERSURFACE tool has been developed to aid users in obtaining realistic and reproducible surface characteristic values, which is, in turn, input to the meteorological data preprocessor AERMET. AERSURFACE requires land cover data from the U.S. Geological Survey (USGS) National Land Cover Data 1992 archives (NLCD92) (USGS, 2009). These data are used to determine the land cover types around the user-defined location.

The Horticultural Crops Research Station (CAST) in Castle Hayne operated by the State Climate Office of North Carolina (SCONC), which is located less than 3 kilometers (2 miles) directly east of the proposed GLE Facility, was selected for the AERSURFACE analysis. The elevation and terrain features (mostly flat) surrounding the CAST station are comparable to those of the proposed GLE Facility. Surface characteristics for the CAST station are representative of those for the proposed GLE Facility, once trees are removed for construction. Accordingly, the CAST station is considered adequately representative of the proposed GLE Facility and was used as the source of onsite meteorological data for this assessment.

Seasonal surface characteristics were determined for each of twelve 30-degree sectors. A default domain defined by 10 kilometers by 10 kilometers (6 miles by 6 miles) centered on the measurement site is used for determination of albedo and Bowen ratio. A radius of 1 kilometer (0.6 mile) from the measurement site was used to determine the surface roughness values per recommendation in EPA's AERMOD Implementation Guide (EPA, 2009). To determine the Bowen ratio, surface moisture conditions around the site are needed to characterize the area relative to climate normals. Surface moisture conditions for Bowen ratio were determined by year, based on the 30-year (1971–2000) annual precipitation record at the Wilmington Airport (NCDC, 2009a; NCDC 2009b). If annual precipitation for the year of interest is within the lower-30th percentile or the upper-30th percentile of the 30-year record, dry or wet conditions, respectively, are assigned. Otherwise, average conditions were assigned. For this analysis, wet conditions were selected for 2005 and 2006, dry conditions for 2007, and average conditions for 2008. Additional user inputs to affect surface characteristic values include whether the site is an airport or an arid region, and the amount of continuous snow cover through most of the winter.

E.2.3 Meteorological Data Processing

The meteorological data preprocessor (AERMET) requires three types of data: National Weather Service (NWS) hourly surface observations; NWS twice-daily upper air soundings; and data collected from an onsite measurement tool such as an instrumented tower, if available. No onsite meteorological data are available, so hourly surface and twice-daily upper sounding data from the nearest CAST station and NWS stations were used for the analysis. As discussed, the CAST station represents onsite data for this assessment. Meteorological data at the CAST station have been collected at 10-meter (33-foot) height, which include wind speed and direction, ambient temperature, standard deviation of horizontal wind direction (missing from the second half of 2006 to 2008), and solar radiation. Site-specific surface characteristics influence plume dispersion in the boundary layer, associated parameters for which are typically derived using the surface measurement data from a nearby airport. Hourly surface meteorological data at the Wilmington Airport, which is located about 8 kilometers (5 miles) southeast of the proposed GLE Facility, are used to supplement the missing onsite data and to estimate boundary layer parameters (NCDC, 2009c). Twice-daily upper sounding data from Charleston, S.C.,[2] which is located about 249 kilometers (155 miles) southwest of the GLE Facility, are used for estimating the heights of convective boundary layer (NOAA, 2009). Using the AERMET preprocessor, the most recent four years of meteorological data (2005 to 2008)[3] were processed for input to the AERMOD model. Table E-14 presents detailed information on surface, upper air, and onsite meteorological stations, data file formats, anemometer heights, and distance and direction from the proposed GLE Facility.

Figure E-1 presents a wind rose at 10-meter (33-foot) level of CAST station on 2005–2008 wind data (Frazier, 2009). The average annual wind speed is about 2.1 meters per second (4.7 miles per hour) and relatively higher calm winds are recorded about one-fourth of the time. The prevailing wind directions are from the southwest and northeast (about 8.7 percent of the time each), and secondarily from west–southwest (8.2 percent). Wind speed tends to be relatively higher in spring and lower in summer. The reverse is true for calm winds. In general, southwesterly winds prevail in spring and summer, while northerly winds prevail in fall and winter. The southwesterly winds are strongly influenced by general synoptic-scale[4] wind patterns of the Bermuda High. In contrast, northerly winds reflect the influences of penetrating polar air masses and changes in global circulation (Robinson, 2005). Compared to wind directions at the Wilmington Airport (see Figure 3-5), prevailing wind directions at the CAST station are a little different, but general wind patterns are similar. Average wind speed at the CAST station is about two-thirds of that at the Wilmington Airport, even though the two stations are only 6 kilometers (4 miles) apart. This can be explained by differences in surface roughness, because the CAST site is surrounded by tall trees, but the Airport is surrounded by open areas.

E.2.4 Terrain Data Processing

Areas are relatively flat within a 50-kilometer (31-mile) radius from the proposed GLE Facility, with approximately 20-meter (66-foot) variances in elevation, and no significant topographic features. For the modeling analysis, it is assumed that the terrain is flat, and thus, no AERMAP processing has been performed.

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[2] An upper air station at Morehead City, North Carolina is about 113 kilometers (70 miles) northeast of the proposed GLE Facility, closer than Charleston, South Carolina. However, the former is located in the barrier island and thus, is more affected by the marine boundary layer of Atlantic Ocean than Charleston and the proposed GLE Facility, which are more than 16 kilometers (10 miles) from the Atlantic Ocean. Accordingly, the Charleston was chosen for the analysis, considering the similarity of distance and orientation to the Atlantic Ocean.

[3] Per EPA's Modeling Guidance (40 CFR Part 51 Appendix W), most-recent consecutive five years of meteorological data representative of the site of interest should be used when estimating concentrations with an air quality model. However, four years of data (2005–2008) were used for this analysis. A problem in wind direction measurements was found at the Horticultural Crops Research Station in 2004 and wind sensor was replaced in January, 2005. Wind roses for 2001–2004 at the station indicated that wind patterns are totally off from the general patterns in the area and thus, wind data during this period are not useable.

[4] The scale of high- or low-pressure systems in the lower atmosphere seen on weather maps, in which the typical horizontal dimension is on the order of 1000 kilometers (621 miles) or more.

E.2.5 Receptor Location Data

For the analysis, a modeling domain of 50-kilometer (31-mile) radius centered on the proposed GLE Facility was developed. In doing so, two sets of receptor networks were developed: (1) fenceline receptors and (2) regularly spaced polar receptor grids. For the analysis, discrete receptors at Wilmington Site boundaries are set densely (few tens meters) at northern boundaries, where maximum concentration are anticipated, and sparsely (few hundred meters) at other site boundaries. Regularly spaced polar receptor grids were placed at 31 rings outward ranging from 50 meters (164 feet) to 50 kilometers (31 miles) along sixteen 22.5-degree radials. A total of 557 receptors consists of 61 fenceline receptors and 496 regularly spaced polar receptor grids. Although air quality impact analysis was performed at site boundaries and beyond, irrespective of human residence, modeling calculations for onsite receptors were made to provide maximum onsite concentrations for worker health hazards and to analyze concentration contour patterns.

E.2.6 Modeling Assumptions

The following assumptions are for air quality modeling and modeling result interpretations:

- Construction activities would occur seven days per week (359 days per year) for nine hours per day, from 7 a.m. to 4 p.m, while operation activities would occur seven days per week (365 days per year) for 24 hours per day.

- Dry and wet deposition mechanisms are uncertain and are not included in EPA's regulatory option, and thus, it is not recommended to use them for typical applications except in special cases (e.g., deposition impacts on vegetation). Accordingly, no dry and wet depositions for construction-related PM modeling were assumed (i.e., all PMs are airborne as a conservatism).

- During site preparation and construction phases, fugitive dust emissions resulting from soil disturbances by heavy construction equipment or vehicles are typically released at the top of the wheel/tire, with initial dispersion corresponding to the volume size of the equipment or truck. Engine exhaust emissions from heavy construction equipment or vehicles are released at some height along with plume rise induced by momentum and buoyancy. However, for this analysis, it is conservatively assumed that emissions are released at the ground level without vertical dimension.

- For purposes of modeling demonstrations of compliance with the National Ambient Air Quality Standards (NAAQS), the following modeled concentrations were used for comparison with the NAAQS as recommended by EPA. The highest of the second-highest modeled concentrations over four years were presented for 3-hour and 24-hour SO_2, and 1-hour and 8-hour CO. The highest of the annual averages over four years were presented for annual average for SO_2 and NO_2. For PM_{10}, high-5th-high over four years (2005–2008) was presented. For $PM_{2.5}$, the highest of the four-year average of the high-8th-high concentration at each receptor was presented. The highest of four-year averaged annual means across the receptors for $PM_{2.5}$ were presented.

- Air dispersion modeling results, which are concentration increments over the background, and total concentrations are presented. To obtain total concentrations for comparison with applicable air quality standards, these modeled concentration increments were added to measured background concentrations representative of the Wilmington Site (Buckler, 2009). Detailed discussion regarding modeling results can be found in Section 4.2.4 of this draft EIS.

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Table E-1 General Assumptions for Estimating Air Emissions Associated with Construction and Operation of the Proposed GLE Facility

Phase	Activity	Schedule Assumed in Analysis[a]	Current Schedule	Workdays per year	Work Schedule	Area Disturbed (acres)	Average Daily Workers Onsite	Average Daily Trips[b,c]
Early Construction								
Road Construction	Onsite access road construction	April 2011[d]	April 2011[d]	30	7 days/week 7 a.m.–4 p.m.	8.65[f]	95	200
Land Clearing	Preparation of site for erection of buildings and structures	May-Dec 2011[d]	May–Dec 2011[d]	240[e]		148.7		
Building Construction	Erection of main GLE Facility building and ancillary buildings and structures	2012–2013	Mid-2012 through 2013	360[g]	7 days/week 7 a.m.–4 p.m.	117.4	680	1428
Start-up and Final Construction	Concurrent indoor construction activities with staged testing and start-up of process units as completed	2013–2017	2013–2017	365[h]	7 days/week 24 hours/day	NA[i]	743	1559
Operation	Full capacity fuel enrichment operations	2018–2050	2018–2051	365[h]	7 days/week 24 hours/day	NA	350	735

[a] As discussed in the introduction of this Appendix, the Air Quality analysis was based on a slightly different schedule than currently is expected. These scheduling differences are expected to cause slight changes in the air quality analysis, but are not expected to change any of the impacts conclusions. The updated schedule will be reflected in the Final EIS.

[b] Each trip is a one-way trip, including onsite road from the proposed GLE Facility to the entrance on Castle Hayne Road (2.64 km [1.64 mi]) and offsite roads (16.1 km [10 mi] for automobiles and 161 km [100 mi] for heavy-duty trucks).

[c] Average daily traffic consists of gasoline engine automobiles of 90 percent and heavy-duty diesel trucks of 10 percent.

[d] As discussed in Section 2.1.5, the schedule for preconstruction activities, including road construction and land clearing, is uncertain. The change in the anticipated licensing date discussed in the introduction to Appendix E is not expected to affect the schedule for preconstruction activities.

[e] No work schedule on five holidays (Memorial Day, Independence Day, Labor Day, Thanksgiving Day, and Christmas Day).

[f] Total length of the onsite access road to the proposed GLE Facility (2.64 km [1.64 mi]) consists of existing paved road (0.72 km [0.45 mi]) and unpaved road (1.91 km [1.19 mi]). Road construction would occur on unpaved road segment only with an assumed 18.3-meter (60-foot) width.

[g] No work schedule on six holidays (New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, and Christmas Day).

[h] 366 for leap years.

[i] NA = not applicable.

Table E-2 Input Parameters Used for Estimating Air Emissions at the Proposed GLE Facility: Road Construction Followed by Land Clearing

Air Emission Source	Parameter	Parameter Value	Reference and/or Note
Fugitive dust emissions from soil disturbances at construction sites	PM_{10} uncontrolled emission factor	0.42 ton/acre/month	MRI, 1996
	$PM_{2.5}$ to PM_{10} ratio	0.1	Countess Environmental, 2006 (Section 3.3.1)
	Dust control efficiency	74 percent	Countess Environmental, 2006 (Section 3.6); 2.1-hour watering interval
Fugitive dust emissions from vehicular travel on unpaved onsite access road	Unpaved road segment	1.19 miles	See note d in Table E-1
	Surface silt content	18.9 percent	Weighted-average site-specific data for soils on onsite road segment; 0.77 mile of road for Murville fine sand soil (0.6% silt) and 0.42 mile of road for Pantego loam soil (44% silt)
	Average vehicle weight	9700 lb (4.85 ton)	Weighted average based on assumed 90% daily trips for automobiles with 3000 lb and 10% daily traffic for heavy-duty diesel trucks with 70,000 lb
	Average vehicle speed	15 miles per hour	Assumed as part of onsite fugitive dust control mitigation measures
	PM_{10} uncontrolled emission factor	2.81 lb/VMT	EPA, 1995 (Section 13.2.2, 11/06)
	$PM_{2.5}$ uncontrolled emission factor	0.28 lb/VMT	EPA, 1995 (Section 13.2.2, 11/06)
	Dust control efficiency	55 percent	Countess Environmental, 2006 (Section 6.5); watering twice per day

Table E-2 Input Parameters Used for Estimating Air Emissions at the Proposed GLE Facility: Road Construction Followed by Land Clearing (Cont.)

Air Emission Source	Parameter	Parameter Value			Reference and/or Note
Engine exhaust emissions from offroad diesel-powered heavy construction equipment	Average equipment mix	**Equipment**			Assumed mix of heavy construction equipment Load factor from EPA, 2004a
		Type (Number)	**Engine Horsepower (hp)**	**Load Factor**	
		Bulldozer (4)	175	0.59	
		Loader (4)	175	0.59	
		Grader (2)	175	0.59	
		Compactor/Roller (2)	120	0.59	
		Excavator (1)	175	0.59	
		Water truck (1)	175	0.59	
		Paver (1)	120	0.59	
	Site-specific composite emission factors	**Pollutant**	**lb/hr**		EPA, 2004b Weighted averages based on emission factor for each equipment, number of each equipment, and load factor
		PM_{10}	1.48		
		$PM_{2.5}$	1.44		
		NO_x	8.16		
		SO_2	0.02		
		VOC	0.62		
		CO	4.75		

Table E-2 Input Parameters Used for Estimating Air Emissions at the Proposed GLE Facility: Road Construction Followed by Land Clearing (Cont.)

Air Emission Source	Parameter	Parameter Value		Reference and/or Note
Engine exhaust emissions from automobile and truck traffic	$PM_{2.5}$ to PM_{10} ratio	0.97		EPA, 2004b
	Automobile emission factors	**Pollutant**	**g/mi**	EPA, 2003
		PM_{10}	0.025	Estimated using MOBILE6.2 with: Calendar year: 2011 Minimum/maximum temperature: 2.1°C/13.5°C (35.8°F/56.3°F) (January) Fuel RVP: 9.0 (maximum RVP allowed in attainment areas in North Carolina) Used default values for other input parameters and assumptions
		$PM_{2.5}$	0.024	
		NO_x	0.549	
		SO_2	0.007	
		VOC	0.656	
		CO	13.080	
	Truck emission factors	**Pollutant**	**g/mi**	
		PM_{10}	0.136	Use light-duty gasoline vehicle (LDGV) emission factor for automobiles and heavy-duty diesel vehicle (HDDV) for trucks
		$PM_{2.5}$	0.132	
		NO_x	6.360	
		SO_2	0.013	
		VOC	0.381	
		CO	1.627	

Table E-3 Input Parameters Used for Estimating Air Emissions at the Proposed GLE Facility: Building Construction

Air Emission Source	Parameter	Parameter Value			Reference and/or Note
Fugitive dust emissions from soil disturbances at construction sites	PM_{10} uncontrolled emission factor	0.11 ton/acre/month			MRI, 1996
	$PM_{2.5}$ to PM_{10} ratio	0.1			Countess Environmental, 2006 (Section 3.3.1)
Engine exhaust emissions from offroad diesel-powered heavy construction equipment	Average equipment mix	Equipment			Assumed mix of heavy construction equipment Load factor from EPA, 2004a
		Type (Number)	Engine Horsepower (hp)	Load Factor	
		Crane (2)	175	0.43	
		Tractor/backhoe (4)	100	0.21	
		Forklift (4)	75	0.59	
		Aerial lift (4)	75	0.21	
		Air compressor (4)	75	0.43	
	Site-specific composite emission factors	Pollutant	lb/hr		EPA, 2004b Weighted averages based on emission factor for each equipment, number of each equipment, and load factor
		PM_{10}	0.75		
		$PM_{2.5}$	0.73		
		NO_x	4.01		
		SO_2	0.01		
		VOC	0.29		
		CO	4.47		

Table E-3 Input Parameters Used for Estimating Air Emissions at the Proposed GLE Facility: Building Construction (Cont.)

Air Emission Source	Parameter	Parameter Value		Reference and/or Note
Engine exhaust emissions from automobile and truck traffic	$PM_{2.5}$ to PM_{10} ratio	0.97		EPA, 2004b
	Automobile emission factors	**Pollutant**	**g/mi**	EPA, 2003
		PM_{10}	0.025	Estimated using MOBILE6.2 with: Calendar year: 2012 Minimum/maximum temperature: 2.1°C/13.5°C (35.8°F/56.3°F) (January) Fuel RVP: 9.0 (maximum RVP allowed In attainment areas in North Carolina) Used default values for other input parameters and assumptions
		$PM_{2.5}$	0.024	
		NO_x	0.498	
		SO_2	0.007	
		VOC	0.597	
		CO	12.590	
	Truck emission factors	**Pollutant**	**g/mi**	
		PM_{10}	0.136	Use light-duty gasoline vehicle (LDGV) emission factor for automobiles and heavy-duty diesel vehicle (HDDV) for trucks
		$PM_{2.5}$	0.132	
		NO_x	5.481	
		SO_2	0.013	
		VOC	0.352	
		CO	1.418	

Table E-4 Input Parameters Used for Estimating Air Emissions at the Proposed GLE Facility: Start-up and Final Construction

Air Emission Source	Parameter	Parameter Value	Reference and/or Note
Fugitive dust emissions from soil disturbances	Assumed no emissions because activities would occur mostly inside buildings		GLE Preliminary design information as of November 2009
Drift PM emissions from mechanical-draft cooling towers	See parameter and parameter data for the operation phase in the below		Production will be incrementally ramped up to full production over the 5-year period of the start-up (final construction) phase. Conservatively, assumed the same parameter values for the operation phase.
Engine exhaust emissions from auxiliary diesel generator units			
Engine exhaust emissions from onsite transfer vehicles (OSTVs) used for moving UF_6 cylinders to and from cylinder pads			
Engine exhaust emissions from heavy-duty truck used for transfer of product cylinders to onsite Fuel Manufacturing Operations (FMO) facility			

Table E-4 Input Parameters Used for Estimating Air Emissions at the Proposed GLE Facility: Start-up and Final Construction (Cont.)

Air Emission Source	Parameter	Parameter Value		Reference and/or Note
Engine exhaust emissions from automobile and truck traffic	$PM_{2.5}$ to PM_{10} ratio	0.97		EPA, 2004b
	Automobile emission factors	**Pollutant**	**g/mi**	EPA, 2003
		PM_{10}	0.025	Estimated using MOBILE6.2 with: Calendar year: 2015 Minimum/maximum temperature: 2.1°C/13.5°C (35.8°F/56.3°F) (January) Fuel RVP: 9.0 (maximum RVP allowed in attainment areas in North Carolina) Used default values for other input parameters and assumptions
		$PM_{2.5}$	0.024	
		NO_x	0.379	
		SO_2	0.007	
		VOC	0.475	
		CO	11.640	
	Truck emission factors	**Pollutant**	**g/mi**	Use light-duty gasoline vehicle (LDGV) emission factor for automobiles and heavy-duty diesel vehicle (HDDV) for trucks.
		PM_{10}	0.136	
		$PM_{2.5}$	0.132	
		NO_x	3.507	
		SO_2	0.013	
		VOC	0.304	
		CO	0.840	

Table E-5 Input Parameters Used for Estimating Air Emissions at the Proposed GLE Facility: Operations

Air Emission Source	Parameter	Parameter Value		Reference and/or Note
Drift PM emissions from mechanical-draft cooling towers	Number of cooling towers	2		GLE Preliminary design information as of November 2009
	Number of cells per cooling tower	8		
	Water flow rate per cell	22,500 gal/hr		
	Total dissolved solids (TDS) concentration	858 ppm		Based on cooling towers operating at the existing manufacturing facilities at the Wilmington Site
	Total liquid drift factor	1.7 lb/1000 gal		EPA, 1995 (induced draft cooling tower, Section 13.4, 1/95)
	PM_{10} emission factor per cell	0.0015 lb/1000 gal		Calculated
	$PM_{2.5}$ to PM_{10} ratio	1		Assumed based on typical drift particle size distribution for cooling towers
Engine exhaust emissions from auxiliary diesel generator units	Number of units	2		GLE Preliminary design information as of November 2009
	Engine rating	382 hp		
	Diesel fuel sulfur content	0.2 percent		Based on NCDAQ air permit conditions for the existing emergency diesel generators at the Wilmington Site
	Annual operation	240 hours per year per unit		
	Emission factors	**Pollutant**	**lb/hr**	NCDENR, 2000
		PM_{10}	0.27	Assume VOC is the non-methane total organic compound (NMTOC) rate provided in the NCDAQ spreadsheet
		$PM_{2.5}$	0.27	
		NO_x	5.0	
		SO_2	0.62	
		VOC	0.25	
		CO	2.1	

Table E-5 Input Parameters Used for Estimating Air Emissions at the Proposed GLE Facility: Operations (Cont.)

Air Emission Source	Parameter	Parameter Value		Reference and/or Note
Engine exhaust emissions from onsite transfer vehicles (OSTVs) used for moving UF_6 cylinders to and from cylinder pads	Number of OSTVs	2		GLE Preliminary design information as of November 2009
	Engine rating	75 hp		Assume based on engineering judgment.
	Operating hours per day	3		GLE Preliminary design information as of November 2009
	Emission factors	**Pollutant**	**g/hp-hr**	EPA, 2004b
		PM_{10}	0.6496	
		$PM_{2.5}$	0.6301	
		NO_x	3.1450	
		SO_2	0.0049	
		VOC	0.1980	
		CO	4.1657	
Engine exhaust emissions from heavy-duty diesel truck used for transfer of product cylinders to onsite Fuel Manufacturing Operations (FMO) facility	Number of vehicles	1		GLE Preliminary design information as of November 2009
	Operating interval	1 round trip per week		
	Distance traveled	2 miles		One-way distance between the proposed GLE Facility and FMO facility
	Emission Factors	See below		

Table E-5 Input Parameters Used for Estimating Air Emissions at the Proposed GLE Facility: Operations (Cont.)

Air Emission Source	Parameter	Parameter Value		Reference and/or Note
Engine exhaust emissions from automobile and truck traffic	$PM_{2.5}$ to PM_{10} ratio	0.97		EPA, 2004b
	Automobile emission factors	**Pollutant**	**g/mi**	EPA, 2003
		PM_{10}	0.025	Estimated using MOBILE6.2 with: Calendar year: 2018 Minimum/maximum temperature: 2.1°C/13.5°C (35.8°F/56.3°F) (January) Fuel RVP: 9.0 (maximum RVP allowed in attainment areas in North Carolina) Used default values for other input parameters and assumptions
		$PM_{2.5}$	0.024	
		NO_x	0.300	
		SO_2	0.007	
		VOC	0.403	
		CO	11.060	
	Truck emission factors	**Pollutant**	**g/mi**	Use light-duty gasoline vehicle (LDGV) emission factor for automobiles and heavy-duty diesel vehicle (HDDV) for trucks.
		PM_{10}	0.136	
		$PM_{2.5}$	0.132	
		NO_x	2.272	
		SO_2	0.013	
		VOC	0.279	
		CO	0.585	

Table E-6 Estimated Average Daily Criteria Air Pollutant and VOC Emissions at the Proposed GLE Facility During Road Construction and Land Clearing

Average Daily Onsite Air Emissions Associated with Onsite Access Road Construction Activities

Air Emission Source	Average Daily Emissions (lb/day)					
	PM_{10}	$PM_{2.5}$	NO_x	SO_2	VOC	CO
Fugitive dust emissions from onsite access road construction	63.0	6.30	NA[a]	NA	NA	NA
Engine exhaust emissions from offroad diesel-powered heavy construction equipment	13.4	13.0	73.5	0.14	5.55	42.8
Engine exhaust emissions from onsite gasoline engine automobile traffic	0.02	0.02	0.36	0.004	0.43	8.48
Engine exhaust emissions from onsite diesel engine truck traffic	0.01	0.01	0.46	0.001	0.03	0.12
TOTAL	76.4	19.3	74.3	0.14	6.00	51.4

Average Daily Onsite Air Emissions Associated with Land Clearing

Air Emission Source	Average Daily Emissions (lb/day)					
	PM_{10}	$PM_{2.5}$	NO_x	SO_2	VOC	CO
Fugitive dust emissions from site preparation	1082.5	108.3	NA	NA	NA	NA
Fugitive dust emissions from construction vehicle traffic on unpaved onsite access road	300.0	30.0	NA	NA	NA	NA
Engine exhaust emissions from offroad diesel-powered heavy construction equipment	13.4	13.0	73.5	0.14	5.55	42.8
Engine exhaust emissions from onsite gasoline engine automobile traffic	0.02	0.02	0.36	0.004	0.43	8.48
Engine exhaust emissions from onsite diesel engine truck traffic	0.01	0.01	0.46	0.001	0.03	0.12
TOTAL	1395.9	151.2	74.3	0.14	6.00	51.4

[a] NA = not applicable.

Table E-6 Estimated Average Daily Criteria Air Pollutant and VOC Emissions at the Proposed GLE Facility During Road Construction and Land Clearing (Cont.)

Average Daily Offsite Air Emissions from Vehicle Traffic Traveling on Roadways to and from the Proposed GLE Facility Associated with Road Construction and Land Clearing						
	Average Daily Emissions (lb/day)					
Air Emission Source	PM_{10}	$PM_{2.5}$	NO_x	SO_2	VOC	CO
Gasoline engine automobile traffic	0.10	0.10	2.17	0.03	2.59	51.7
Diesel engine truck traffic	0.60	0.58	27.9	0.06	1.67	7.15
TOTAL	0.70	0.68	30.1	0.08	4.27	58.9

Table E-7 Estimated Average Annual Criteria Air Pollutant and VOC Emissions at the Proposed GLE Facility During Road Construction and Land Clearing

Average Annual Onsite Air Emissions Associated with Road Construction and Land Clearing

Air Emission Source	Average Annual Emissions (ton/yr)					
	PM_{10}	$PM_{2.5}$	NO_x	SO_2	VOC	CO
Fugitive dust emissions from onsite access road construction	0.95	0.09	NA[a]	NA	NA	NA
Fugitive dust emissions from site preparation	129.9	13.0	NA	NA	NA	NA
Fugitive dust emissions from construction vehicle traffic on unpaved onsite access road	36.0	3.60	NA	NA	NA	NA
Engine exhaust emissions from offroad diesel-powered heavy construction equipment for access road construction	0.20	0.19	1.10	0.002	0.08	0.64
Engine exhaust emissions from offroad diesel-powered heavy construction equipment for site preparation	1.60	1.55	8.82	0.02	0.67	5.13
Engine exhaust emissions from onsite gasoline engine automobile traffic	0.002	0.002	0.05	0.001	0.06	1.15
Engine exhaust emissions from onsite diesel engine truck traffic	0.001	0.001	0.06	0.0001	0.004	0.02
TOTAL	168.7	18.4	10.0	0.02	0.81	6.94

Average Annual Offsite Air Emissions from Vehicle Traffic Traveling on Roadways to and from the Proposed GLE Facility Associated with Road Construction and Land Clearing

Air Emission Source	Average Annual Emissions (ton/yr)					
	PM_{10}	$PM_{2.5}$	NO_x	SO_2	VOC	CO
Gasoline engine automobile traffic	0.01	0.01	0.29	0.004	0.35	6.98
Diesel engine truck traffic	0.08	0.08	3.77	0.01	0.23	0.97
TOTAL	0.09	0.09	4.07	0.01	0.58	7.95

[a] NA = not applicable.

Table E-8 Estimated Average Daily Criteria Air Pollutant and VOC Emissions at the Proposed GLE Facility During Building Construction

Average Daily Onsite Air Emissions Associated with Building Construction Activities

Air Emission Source	Average Daily Emissions (lb/day)					
	PM_{10}	$PM_{2.5}$	NO_x	SO_2	VOC	CO
Fugitive dust emissions from proposed GLE Facility building construction activities	860.9	86.1	NA[a]	NA	NA	NA
Engine exhaust emissions from offroad construction equipment used for building construction	6.77	6.56	36.1	0.06	2.61	40.2
Engine exhaust emissions from onsite gasoline engine automobile traffic	0.12	0.11	2.31	0.03	2.77	58.4
Engine exhaust emissions from onsite diesel engine truck traffic	0.07	0.07	2.83	0.01	0.18	0.73
TOTAL	867.9	92.8	41.2	0.10	5.56	99.4

Average Daily Offsite Air Emissions from Vehicle Traffic Traveling on Roadways to and from the Proposed GLE Facility Associated with Building Construction Activities

Air Emission Source	Average Daily Emissions (lb/day)					
	PM_{10}	$PM_{2.5}$	NO_x	SO_2	VOC	CO
Gasoline engine automobile traffic	0.71	0.69	14.1	0.19	16.9	356.4
Diesel engine truck traffic	4.28	4.15	172.4	0.41	11.1	44.6
TOTAL	4.99	4.84	186.5	0.60	28.0	401.0

[a] NA = not applicable.

Table E-9 Estimated Average Annual Criteria Air Pollutant and VOC Emissions at the Proposed GLE Facility During Building Construction

Average Daily Onsite Air Emissions Associated with Building Construction Activities						
	Average Annual Emissions (ton/yr)					
Air Emission Source	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_2**	**VOC**	**CO**
Fugitive dust emissions from proposed GLE Facility building construction activities	154.5	15.5	NA[a]	NA	NA	NA
Engine exhaust emissions from offroad construction equipment used for building construction	1.21	1.18	6.48	0.01	0.47	7.22
Engine exhaust emissions from onsite gasoline engine automobile traffic	0.02	0.02	0.42	0.01	0.50	10.5
Engine exhaust emissions from onsite diesel engine truck traffic	0.01	0.01	0.51	0.001	0.03	0.13
TOTAL	155.8	16.7	7.40	0.02	1.00	17.8

Average Daily Offsite Air Emissions from Vehicle Traffic Traveling on Roadways to and from the Proposed GLE Facility Associated with Building Construction Activities						
	Average Annual Emissions (ton/yr)					
Air Emission Source	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_2**	**VOC**	**CO**
Gasoline engine automobile traffic	0.13	0.12	2.53	0.03	3.03	64.0
Diesel engine truck traffic	0.77	0.75	30.9	0.07	1.99	8.01
TOTAL	0.90	0.87	33.5	0.11	5.02	72.0

[a] NA = not applicable.

Table E-10 Estimated Average Daily Criteria Air Pollutant and VOC Emissions at the Proposed GLE Facility During Start-up and Final Construction

Average Daily Onsite Air Emissions Associated with Start-up and Final Construction Activities

Air Emission Source	Average Daily Emissions (lb/day)					
	PM_{10}	**$PM_{2.5}$**	**NO_x**	**SO_2**	**VOC**	**CO**
Stationary source emissions from main GLE Facility operations building stack vent	~0	~0	0	0	0	0
Stationary source emissions from mechanical-draft cooling towers	12.6	12.6	NA[a]	NA	NA	NA
Stationary source emissions from auxiliary diesel generator unit exhaust stacks	0.54	0.54	10.0	1.24	0.50	4.20
Engine exhaust emissions from onsite transfer vehicles (OSTVs) used for transfer of cylinders to and from the outdoor cylinder storage pads	0.64	0.62	3.12	0.00	0.20	4.13
Engine exhaust emissions from diesel engine truck used to transfer product cylinders to onsite Fuel Manufacturing Operations (FMO) facility	0.001	0.001	0.03	0.0001	0.003	0.007
Engine exhaust emissions from onsite gasoline engine automobile traffic	0.13	0.12	1.92	0.03	2.41	59.0
Engine exhaust emissions from onsite diesel engine truck traffic	0.08	0.07	1.98	0.01	0.17	0.47
TOTAL	14.0	14.0	17.0	1.29	3.28	67.8

Average Daily Offsite Air Emissions from Vehicle Traffic Traveling on Roadways to and from the Proposed GLE Facility Associated with Start-up and Final Construction Activities

Air Emission Source	Average Daily Emissions (lb/day)					
	PM_{10}	**$PM_{2.5}$**	**NO_x**	**SO_2**	**VOC**	**CO**
Gasoline engine automobile traffic	0.77	0.75	11.7	0.21	14.7	359.8
Diesel engine truck traffic	4.67	4.53	120.5	0.45	10.4	28.9
TOTAL	5.45	5.28	132.2	0.66	25.1	388.7

[a] NA = not applicable.

Table E-11 Estimated Average Annual Criteria Air Pollutant and VOC Emissions at the Proposed GLE Facility During Start-up and Final Construction

Average Annual Onsite Air Emissions Associated with Start-up and Final Construction Activities

Air Emission Source	Average Annual Emissions (ton/yr)					
	PM_{10}	$PM_{2.5}$	NO_x	SO_2	VOC	CO
Stationary source emissions from main GLE Facility operations building stack vent	~0	~0	0	0	0	0
Stationary source emissions from mechanical-draft cooling towers	2.3	2.3	NA[a]	NA	NA	NA
Stationary source emissions from auxiliary diesel generator unit exhaust stacks	0.06	0.06	1.20	0.15	0.06	0.50
Engine exhaust emissions from onsite transfer vehicles (OSTVs) used for transfer of cylinders to and from the outdoor cylinder storage pads	0.12	0.11	0.57	0.001	0.04	0.75
Engine exhaust emissions from diesel engine truck used to transfer product cylinders to onsite Fuel Manufacturing Operations (FMO) facility	~0	~0	~0	~0	~0	~0
Engine exhaust emissions from onsite gasoline engine automobile traffic	0.02	0.02	0.35	0.01	0.44	10.8
Engine exhaust emissions from onsite diesel engine truck traffic	0.01	0.01	0.36	0.001	0.03	0.09
TOTAL	2.52	2.51	2.48	0.16	0.57	12.1

Average Daily Offsite Air Emissions from Vehicle Traffic Traveling on Roadways to and from the Proposed GLE Facility Associated with Start-up and Final Construction Activities

Air Emission Source	Average Annual Emissions (ton/yr)					
	PM_{10}	$PM_{2.5}$	NO_x	SO_2	VOC	CO
Gasoline engine automobile traffic	0.14	0.14	2.14	0.04	2.68	65.7
Diesel engine truck traffic	0.85	0.83	22.0	0.08	1.91	5.27
TOTAL	0.99	0.96	24.1	0.12	4.59	70.9

[a] NA = not applicable.

Table E-12 Estimated Average Daily Criteria Air Pollutant and VOC Emissions at the Proposed GLE Facility During Operations

Average Daily Onsite Air Emissions Associated with Operations

Air Emission Source	Average Daily Emissions (lb/day)					
	PM_{10}	$PM_{2.5}$	NO_x	SO_2	VOC	CO
Stationary source emissions from main GLE Facility operations building stack vent	~0	~0	0	0	0	0
Stationary source emissions from mechanical-draft cooling towers	12.6	12.6	NA[a]	NA	NA	NA
Stationary source emissions from auxiliary diesel generator unit exhaust stacks	0.54	0.54	10.0	1.24	0.50	4.20
Engine exhaust emissions from onsite transfer vehicles (OSTVs) used for transfer of cylinders to and from the outdoor cylinder storage pads	0.64	0.62	3.12	0.00	0.20	4.13
Engine exhaust emissions from diesel engine truck used to transfer product cylinders to onsite Fuel Manufacturing Operations (FMO) facility	0.001	0.001	0.03	0.0001	0.003	0.007
Engine exhaust emissions from onsite gasoline engine automobile traffic	0.06	0.06	0.72	0.02	0.96	26.4
Engine exhaust emissions from onsite diesel engine truck traffic	0.04	0.04	0.60	0.003	0.07	0.16
TOTAL	13.9	13.9	14.5	1.26	1.74	34.9

Average Daily Offsite Air Emissions from Vehicle Traffic Traveling on Roadways to and from the Proposed GLE Facility Associated with Operations

Air Emission Source	Average Daily Emissions (lb/day)					
	PM_{10}	$PM_{2.5}$	NO_x	SO_2	VOC	CO
Gasoline engine automobile traffic	0.36	0.35	4.37	0.10	5.87	161.1
Diesel engine truck traffic	2.20	2.14	36.8	0.21	4.52	9.47
TOTAL	2.57	2.49	41.2	0.31	10.4	170.6

[a] NA = not applicable.

Table E-13 Estimated Average Annual Criteria Air Pollutant and VOC Emissions at the Proposed GLE Facility During Operations

Average Daily Onsite Air Emissions Associated with Operations

Air Emission Source	Average Annual Emissions (ton/yr)					
	PM_{10}	$PM_{2.5}$	NO_x	SO_2	VOC	CO
Stationary source emissions from main GLE Facility operations building stack vent	~0	~0	0	0	0	0
Stationary source emissions from mechanical-draft cooling towers	2.30	2.30	NA[a]	NA	NA	NA
Stationary source emissions from auxiliary diesel generator unit exhaust stacks	0.06	0.06	1.20	0.15	0.06	0.50
Engine exhaust emissions from onsite transfer vehicles (OSTVs) used for transfer of cylinders to and from the outdoor cylinder storage pads	0.12	0.11	0.57	0.001	0.04	0.75
Engine exhaust emissions from diesel engine truck used to transfer product cylinders to onsite Fuel Manufacturing Operations (FMO) facility	~0	~0	~0	~0	~0	~0
Engine exhaust emissions from onsite gasoline engine automobile	0.01	0.01	0.13	0.00	0.18	4.82
Engine exhaust emissions from onsite diesel engine truck traffic	0.01	0.01	0.11	0.001	0.01	0.03
TOTAL	2.50	2.50	2.01	0.15	0.29	6.11

Average Daily Offsite Air Emissions from Vehicle Traffic Traveling on Roadways to and from the Proposed GLE Facility Associated with Operations

Air Emission Source	Average Annual Emissions (ton/yr)					
	PM_{10}	$PM_{2.5}$	NO_x	SO_2	VOC	CO
Gasoline engine automobile traffic	0.07	0.06	0.80	0.02	1.07	29.4
Diesel engine truck traffic	0.40	0.39	6.71	0.04	0.82	1.73
TOTAL	0.47	0.45	7.51	0.06	1.90	31.1

[a] NA = not applicable.

Table E-14 Meteorological Data Information Used for AERMET

Station Name	Station ID	Location (lat/long)	Elevation (meters)	File Format	Anemometer Height (meters)	Distance & Direction from the Proposed GLE Facility[a]	Notes
Surface Wilmington/ Hanover County Airport	ILM USAF: 723013 WBAN: 13748	34.267N 77.900W	9	ISD (DS3505)	10	5 miles southeast	NA[b]
Upper Air Charleston, SC	CHS WBAN: 13880 WMO: 72208	32.90N 80.03W	15	FSL	NA	155 miles southwest	NA
Onsite Horticultural Crops Research Station	CAST	34.321N 77.916W	13	NA	10	2 miles east	Wind sensor threshold = 1.0 meter per second

[a] Longitude, latitude, and elevation for the center of the proposed GLE Facility are: 34.335N, 77.947W, and 7 meters.

[b] NA = not applicable.

Sources: Frazier, 2009; NCDC, 2009c; NOAA, 2009.

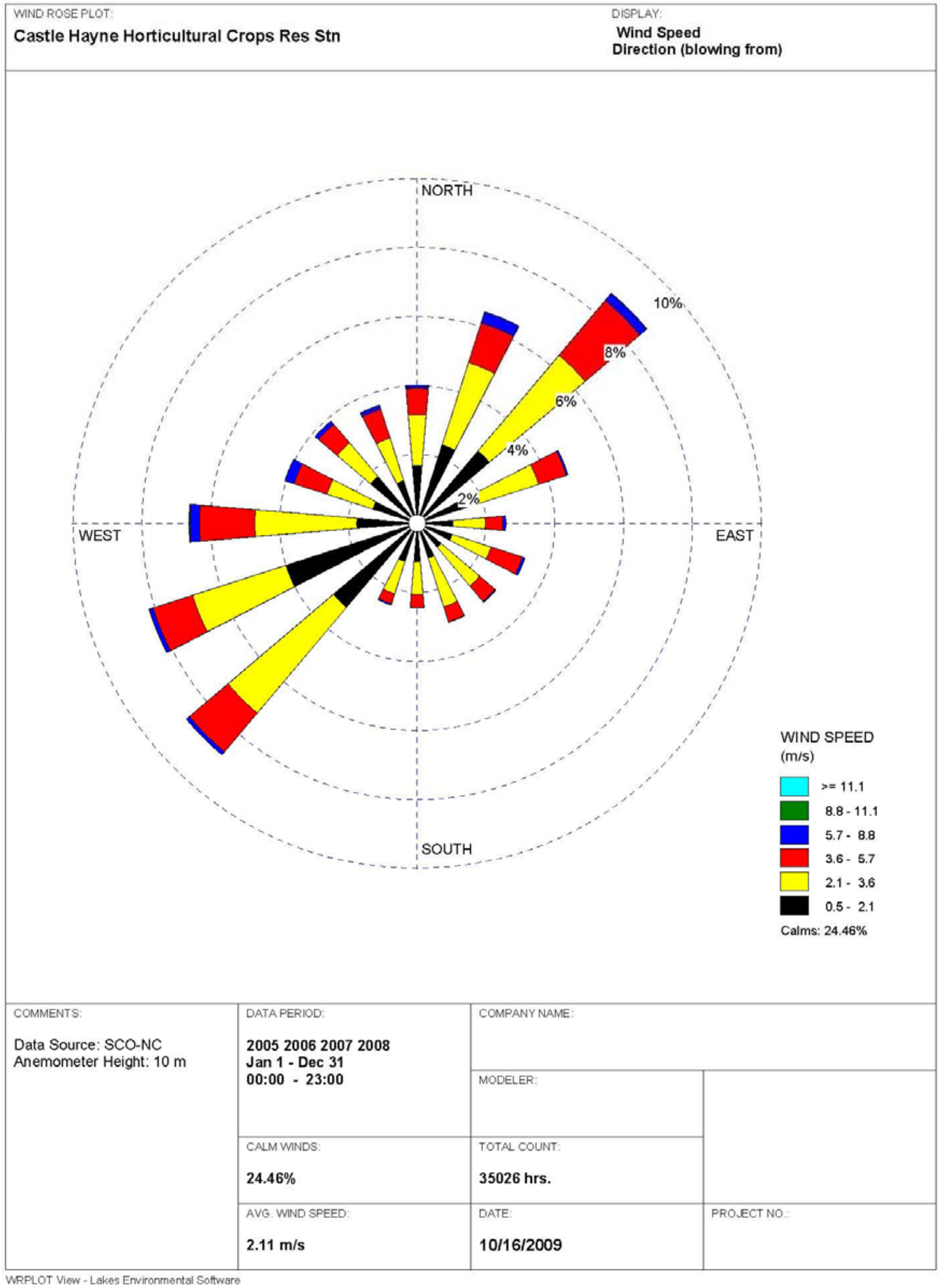

Figure E-1 Wind Rose (10-meter [33-foot] Level) for the Horticultural Crops Research Station (CAST) in Castle Hayne, North Carolina, 2005–2008 (Frazier, 2009)

APPENDIX F
SOCIOECONOMIC ANALYSIS METHODS

APPENDIX F
SOCIOECONOMIC ANALYSIS METHODS

This appendix describes the methods used to estimate the socioeconomic impacts of preconstruction and construction, operations, and decommissioning of the proposed General Electric (GE)-Hitachi Global Laser Enrichment LLC (GLE) Facility. Impacts are evaluated for the area in which the majority of the proposed GLE Facility permanent employees are expected to live and spend their wages and salaries. This area, referred to as the region of influence (ROI) in this appendix, includes New Hanover County, Brunswick County, and Pender County. The ROI corresponds to the Wilmington Metropolitan Statistical Area (MSA), which is expected to be the primary source of labor for each phase of the proposed GLE Facility (GLE, 2008)..

The socioeconomic analysis was divided into four main areas of impact: (1) site employment data during preconstruction and construction, start-up, operations, and decommissioning were used to estimate direct and indirect economic impacts; (2) the impact on direct State and local tax revenues was considered; (3) the number of in-migrating workers required to fill onsite job positions during each project phase, and associated family members, was estimated based on information gathered from local economic development agencies; and (4) the resulting housing and local community service employment impacts were estimated.

F.1 Economic and Fiscal Impacts

Employment and income impacts include both direct and indirect employment and income associated with the various phases of GLE Facility development. Direct employment and income are created by onsite employment at the facility, while indirect employment and income are created in the ROI as workers directly employed by the proposed GLE Facility spend their wages and salaries, and as jobs are created with the purchase of materials, equipment, and services and other non-payroll expenditures. Direct employment and income created during each phase of the proposed action are estimated based on anticipated labor inputs and salaries for the various engineering and construction activities associated with each phase. The indirect impact of the proposed GLE Facility on regional employment and income is based on the use of regional economic multipliers. Multipliers capture the indirect (offsite) effects of onsite activities associated with construction and operation of an activity or event.

Multipliers were taken from the Impact Analysis for Planning (IMPLAN) input-output model. These multipliers take into account the flow of commodities to industries from producers and institutional consumers in the various sectors in the economy of the ROI. Input-output accounts also show consumption activities by workers, owners of capital, and imports from outside the region. The IMPLAN model contains 528 sectors representing industries in agriculture, mining, construction, manufacturing, wholesale and retail trade, utilities, finance, insurance and real estate, and consumer and business services. The model also includes information for each sector on employee compensation, proprietary and property income, personal consumption expenditures, Federal, State, and local expenditures, inventory and capital formation, imports, and exports.

Estimates of the indirect impacts used Type Social Accounting Matrix (SAM) IMPLAN multipliers, which measure the total (direct plus indirect) impact of direct facility employment on ROI output, income, and employment. Type II multipliers associated with each major expenditure category (for example, separator equipment, process building and offices, laser equipment, utilities, spare parts, construction payroll) were taken from the IMPLAN model and multiplied by the relevant direct employment number, with the resulting total impacts in each category aggregated to produce the overall impact of each phase of the proposed facility.

State income tax revenue impacts are estimated by applying State income tax rates to construction and operations earnings related to the proposed GLE Facility. State and local sales tax revenues are estimated by applying appropriate State and local sales tax rates to after-tax income generated by construction and operations employees, spent within the ROI.

F.2 Impacts on Population

With preconstruction, construction, and operation of the proposed GLE Facility, a number of workers, families, and children would migrate into the ROI, either temporarily or permanently. The capacity of regional labor markets to produce sufficient numbers of workers in the appropriate occupations required for facility construction and operation is closely related to the occupational profile of the ROI and occupational unemployment rates. Although the ROI corresponds to the Wilmington MSA, which is expected to be the primary source of labor for the proposed GLE Facility, some labor in-migration of workers, families, and children into the ROI, either temporarily or permanently, is expected during each phase of the proposed GLE Facility. The capacity of regional labor markets to produce sufficient numbers of workers in the appropriate occupations required for facility construction and operation is closely related to the occupational profile of the ROI and occupational unemployment rates. The number of in-migrating workers was based on interviews with local economic development officials, and was based on estimates of available labor in each direct labor category. With some uncertainty in labor availability estimates, the analysis used a range for in-migration during each phase of the proposed project. Sixty-five percent of in-migrating workers were assumed to be accompanied by their families, which would consist of an additional adult and one school-age child (GLE, 2008), based on the national average household size. The national average household size is used to calculate the number of additional family members that would accompany direct and indirect in-migrating workers.

F.3 Impacts on Local Housing Markets

The in-migration of workers has the potential to substantially affect the housing market in the ROI. The analysis considered these impacts by estimating the increase in demand for rental housing units in the peak year of construction and for owner-occupied units in the first year of operation, resulting from the in-migration of both direct and indirect workers to the ROI. The impacts on housing were described in terms of the number of rental units required in the peak year of construction, and the number of owner-occupied units required in the first year of operation. The relative impact on existing housing in the ROI was estimated by calculating the impact of GLE-related housing demand on the forecasted number of vacant rental housing units in the peak year of construction, and the forecasted number of vacant owner-occupied units in the first year of operations. Forecasts are based on data provided by the U.S. Census Bureau.

F.4 Impacts on Community Services

The impacts of GLE Facility in-migration on community service employment are estimated for the core ROI counties in which the majority of new workers would locate. Using the estimates of the number of in-migrating workers and families, the analysis calculates the number of new sworn police officers, firefighters, and general government employees required to maintain the existing levels of service for each community service. Calculations were based on the existing number of employees per 1000 population for each community service. The analysis of the impact on educational employment estimated the number of teachers in each school district required to maintain existing teacher-student ratios across all student age groups. Information on existing employment and levels of service was collected from the individual jurisdictions providing each service.

Reference

(GLE, 2008) GE-Hitachi Global Laser Enrichment LLC. “Environmental Report for the GLE Commercial Facility, Revision 0.” December. ADAMS Accession No. ML090910573.

APPENDIX G
ENVIRONMENTAL JUSTICE DATA

APPENDIX G
ENVIRONMENTAL JUSTICE DATA

This appendix contains a brief description of methods and definitions, and provides the data used in the assessment of the potential for disproportionately high and adverse human health or environmental effects on minority and/or low-income populations resulting from the preconstruction and construction, operation, and decommissioning of the proposed General Electric (GE)-Hitachi Global Laser Enrichment LLC (GLE) Facility.

The assessment method consists of three parts: (1) the geographic distribution of low-income and minority populations in the affected area is described using data from the 2000 U.S. Census; (2) based on data provided on the health and environmental impacts of the proposed facility presented in Sections 4.2.1 through 4.2.18, an assessment is made as to whether the impacts of facility construction and operation would produce impacts that are high and adverse; and (3) if impacts are high and adverse, a determination is made as to whether these impacts disproportionately affect minority and low-income populations.

The Council on Environmental Quality (CEQ) provides definitions of disproportionality in *Environmental Justice: Guidance Under the National Environmental Policy Act* (CEQ, 1997).

Disproportionately High and Adverse Human Health Effects. Adverse health effects are measured in risks and rates that could result in latent cancer fatalities, as well as other fatal or nonfatal adverse impacts on human health. Adverse health effects may include bodily impairment, infirmity, illness, or death. Disproportionately high and adverse human health effects occur when the risk or rate of exposure to an environmental hazard for a minority or low-income population is significant (as defined by NEPA [*National Environmental Policy Act*]) and appreciably exceeds the risk or exposure rate for the general population or for another appropriate comparison group (CEQ, 1997).

Disproportionately High and Adverse Environmental Effects. A disproportionately high environmental impact that is significant (as defined by NEPA) refers to an impact or risk of an impact on the natural or physical environment in a low-income or minority community that appreciably exceeds the environmental impact on the larger community. Such effects may include ecological, cultural, human health, economic, or social impacts. An adverse environmental impact is an impact that is determined to be both harmful and significant (as defined by NEPA). In assessing cultural and aesthetic environmental impacts, impacts that uniquely affect geographically dislocated or dispersed minority or low-income populations or American Indian tribes are considered (CEQ, 1997).

Construction and operation of the proposed GLE Facility could impact environmental justice if any adverse health and environmental impacts resulting from either phase of development are significantly high, and if these impacts would disproportionately affect minority and low-income populations. If the analysis determines that health and environmental impacts are not significant, there can be no disproportionate impacts to minority and low-income populations. In the event impacts are significant, disproportionality would be determined by comparing the proximity of any high and adverse impacts to the location of low-income and minority populations.

Tables G-1 through G-4 present detailed Census data for the environmental justice analysis at the State, county, and Census block group level for 2000 (USCB, 2009). Minority and low-income populations are defined in Sections 3.14.1 and 3.14.2. ArcView® geographic information system software was used to determine minority and low-income characteristics by block group. Minority and low-income data are shown for all block groups that lay partially or completely within 6.4 kilometers (4 miles) of the proposed GLE Facility site. Census block groups exceeding minority or low-income criteria are shown in bold.

Table G-1 State and County Minority Population Totals

Location	Total Population	Minority Population	Percent Minority
North Carolina	8,049,313	2,623,620	32.6
Brunswick County	73,143	14,903	20.4
New Hanover County	160,307	35,485	22.1
Pender County	41,082	12,696	30.9

Source: USCB, 2009.

Table G-2 Census Block Group Minority Population Totals

Location	County	Total Population	Minority Population	Percent Minority
Census Tract 020100, Census Block Group 1	**Brunswick**	**2030**	**926**	**45.6**
Census Tract 011500, Census Block Group 1	New Hanover	2172	404	18.6
Census Tract 011500, Census Block Group 2	New Hanover	1699	182	10.7
Census Tract 011500, Census Block Group 3	New Hanover	495	47	9.5
Census Tract 011500, Census Block Group 4	New Hanover	974	98	10.1
Census Tract 011500, Census Block Group 5	**New Hanover**	**1985**	**1219**	**61.4**
Census Tract 011603, Census Block Group 1	New Hanover	1076	389	36.2
Census Tract 011603, Census Block Group 2	New Hanover	3286	616	18.7
Census Tract 011603, Census Block Group 3	New Hanover	1429	547	38.3
Census Tract 011604, Census Block Group 1	New Hanover	134	39	29.1
Census Tract 011604, Census Block Group 2	New Hanover	2475	340	13.7
Census Tract 980500, Census Block Group 4	Pender	1949	683	35.0
Census Tract 980600, Census Block Group 1	**Pender**	**800**	**404**	**50.5**
Census Tract 980600, Census Block Group 2	Pender	4981	1235	24.8
Census Tract 980600, Census Block Group 3	Pender	1271	431	33.9

Source: USCB, 2009.

Table G-3 State and County Low-Income Population Totals

Location	Total Population	Low-Income Population	Percent Low-Income
North Carolina	8,049,313	958,667	12.3
Brunswick County	73,143	9095	12.6
New Hanover County	160,307	20,445	13.1
Pender County	41,082	5429	13.6

Source: USCB, 2009.

Table G-4 Census Block Group Low-Income Population Totals

Location	County	Total Population	Low-Income Population	Percent Low-Income
Census Tract 020100, Census Block Group 1	Brunswick	1952	283	14.5
Census Tract 011500, Census Block Group 1	New Hanover	2168	146	6.7
Census Tract 011500, Census Block Group 2	New Hanover	1665	139	8.3
Census Tract 011500, Census Block Group 3	New Hanover	494	8	1.6
Census Tract 011500, Census Block Group 4	New Hanover	957	79	8.3
Census Tract 011500, Census Block Group 5	New Hanover	2016	324	16.1
Census Tract 011603, Census Block Group 1	New Hanover	1054	76	7.2
Census Tract 011603, Census Block Group 2	New Hanover	3285	258	7.9
Census Tract 011603, Census Block Group 3	New Hanover	1012	171	16.9
Census Tract 011604, Census Block Group 1	New Hanover	155	29	18.7
Census Tract 011604, Census Block Group 2	New Hanover	2411	258	10.7
Census Tract 980500, Census Block Group 4	Pender	1932	231	12.0
Census Tract 980600, Census Block Group 1	**Pender**	**826**	**302**	**36.6**
Census Tract 980600, Census Block Group 2	Pender	4958	789	15.9
Census Tract 980600, Census Block Group 3	Pender	1232	108	8.8

Source: USCB, 2009.

G.1 References

(CEQ, 1997) Council on Environmental Quality. *Environmental Justice: Guidance Under the National Environmental Policy Act*. December 10. <http://ceq.hss.doe.gov/nepa/regs/ej/justice.pdf> (Accessed January 26, 2010).

(USCB, 2009) U.S. Census Bureau. "American Fact Finder." <http://factfinder.census.gov> (Accessed September 18, 2009).

APPENDIX H
PROPRIETARY AND SECURITY-RELATED INFORMATION

The text in this appendix is being withheld under 10 CFR 2.390.

APPENDIX I
GLOSSARY

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GLOSSARY

Air pollutant: Any substance in the air which could, if in high enough concentration, harm humans, other animals, vegetation, or material. Pollutants may include almost any natural or artificial composition of matter capable of being airborne.

Air quality: A measure of the quantity of pollutants, measured individually, in the air. These levels are often compared to regulatory standards.

ALARA: Acronym for "As Low As (is) Reasonably Achievable." An approach to keep radiation exposures (both to the workforce and the public) and releases of radioactive material to the environment at levels that are as low as social, technical, economic, practical, and public policy considerations allow. ALARA is not a dose limit; it is a practice whose objective is the attainment of dose levels as far below applicable limits as possible.

Alluvium: Loose gravel, sand, silt, or clay deposited by streams or running water.

Alpha particle: A positively charged particle ejected spontaneously from the nuclei of some radioactive elements. It is identical to a helium nucleus that has a mass number of 4 and an electrostatic charge of +2. It has low penetrating power and a short range (a few centimeters in air).

Ambient Air Quality Standards: Standards established on a State or Federal level, that define the limits for airborne concentrations of designated "criteria" pollutants (sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, particulate matter [PM_{10} and $PM_{2.5}$], and lead), to protect public health with an adequate margin of safety (primary standards) and to protect public welfare, including plant and animal life, visibility, and materials (secondary standards).

Aquifer: A permeable body of rock capable of yielding quantities of groundwater to wells and springs.

Archaeology: The science devoted to the study of historic or prehistoric peoples and their cultures by analysis of their artifacts, inscriptions, monuments, and other such remains.

Area of potential effects: The geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The area of potential effects is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking (see 36 CFR 800.16).

Assay: The qualitative or quantitative analysis of a substance, often used to determine the proportion of isotopes in radioactive materials.

Attainment area: A region that meets the U.S. Environmental Protection Agency National Ambient Air Quality Standards (NAAQS) for a criteria pollutant under the *Clean Air Act*.

Background radiation: Radiation from cosmic sources, naturally occurring radioactive materials, including radon (except as a decay product of source or special nuclear material), and global fallout as it exists in the environment from the testing of nuclear explosive devices. It does not include radiation from source, byproduct, or special nuclear materials regulated by the Nuclear Regulatory Commission. The typically quoted average individual exposure from background radiation is 3.6 millisieverts per year (360 millirems per year).

Becquerel (Bq): A unit used to measure radioactivity. One Becquerel is that quantity of a radioactive material that will have one transformation in one second. There are 3.7×10^{10} Bq in one curie (Ci).

Best Management Practices (BMPs): Structural, nonstructural, and managerial techniques recognized to be the most effective and practical means to reduce surface water and groundwater contamination while still allowing the productive use of resources.

Beta particle: A charged particle emitted from a nucleus during radioactive decay, with a mass equal to 1/1837 that of a proton. A negatively charged beta particle is identical to an electron. A positively charged beta particle is called a positron. Beta particles may be stopped by thin sheets of metal or plastic.

Bound: To estimate or describe a lower or upper limit on a potential environmental or health consequence when uncertainty exists.

Buffer area: A designated area of land that is designed to permanently remain vegetated in an undisturbed and natural condition in order to protect an adjacent aquatic or wetland site from upland impacts and to provide habitat for wildlife.

Byproduct material: The tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content. See also, Source Material.

Carbon monoxide (CO): An odorless, colorless, poisonous gas produced by incomplete burning of carbon in fuels.

Census tract: An area usually containing between 2500 and 8000 persons that is used for organizing and monitoring census data. The geographic dimensions of Census tracts vary widely, depending on population density. Census tracts do not cross county borders.

Climatology: The science devoted to the study of the conditions of the natural environment (rainfall, daylight, temperature, humidity, air movement) prevailing in specific regions of the earth.

Contamination: Undesired radioactive material that is deposited on the surface of, or inside structures, areas, objects, or people.

Cooling water: Water circulated through a nuclear reactor or processing plant to remove heat.

Cost-benefit analysis: A formal quantitative procedure comparing costs and benefits of a proposed project or act under a set of preestablished rules.

Criteria pollutants: Common air pollutants for which National Ambient Air Quality Standards have been established by the U.S. Environmental Protection Agency under Title I of the *Clean Air Act* (42 U.S.C. 7401 et seq.). Criteria pollutants include sulfur dioxide, nitrogen oxides, carbon monoxide, ozone, particulate matter (PM_{10} and $PM_{2.5}$), and lead. Standards for these pollutants were developed on the basis of scientific knowledge about their health effects.

Critical habitat: Specific areas within the geographical range of an endangered species that is formally designated by the U.S. Fish and Wildlife Service under the *Endangered Species Act* (16 U.S.C. 1531 et seq.) as essential for conservation.

Cumulative impacts: Potential impacts when the proposed action is added to other past, present, and reasonable foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

Curie (Ci): The basic unit used to describe the intensity of radioactivity in a sample of material. The curie is equal to 37 billion (3.7×10^{10}) disintegrations per second, which is approximately the activity of 1 gram (0.035 ounces) of radium. A curie is also a quantity of any radionuclide that decays at a rate of 37 billion disintegrations per second.

Day-Night Average Sound Level (DNL or L_{dn}): DNL is a noise metric combining the levels and durations of noise events and the number of events over an extended time period. It is a cumulative average computed over a set of 24-hour periods to represent total noise exposure. DNL also accounts for more intrusive night time noise, adding a 10 decibel penalty for sounds after 10:00 p.m. and before 7:00 a.m.

Decibel (dB): A standard unit for measuring sound-pressure levels based on a reference sound pressure of 0.0002 dyne per square centimeter. This is the smallest sound a human can hear. In general, a sound doubles in loudness with every increase of about 10 decibels.

Decibel, A-weighted (dBA): A number representing the sound level which is frequency-weighted according to a prescribed frequency response established by the American National Standards Institute and accounts for the response of the human ear.

Decommissioning: The process of closing down a facility followed by reducing residual radioactivity to a level that permits the release of the property for unrestricted use (see 10 CFR 20.1003).

Decontamination: The reduction or removal of contaminating radioactive material from a structure, area, object, or person. Decontamination may be accomplished by (1) treating the surface to remove or decrease the contamination, (2) letting the material stand so that the radioactivity is decreased as a result of natural radioactive decay, or (3) covering the contamination to shield or attenuate the radiation emitted (see 10 CFR 20.1003 and 20.1402).

Depleted uranium: Uranium having a percentage of uranium-235 smaller than the 0.7 percent found in natural uranium. It is obtained from spent (used) fuel elements or as byproduct tails, or residues, from uranium isotope separation.

Depleted uranium hexafluoride (depleted UF_6): Uranium hexafluoride from which most of the uranium-235 isotope has been removed.

Direct jobs: The number of workers required at a site to implement an alternative.

Dose: The absorbed dose, given in rads (or in the International Systems of Units [SI], grays), that represents the energy absorbed from the radiation in a gram of any material. Furthermore, the biological dose or dose equivalent, given in rem or sieverts, is a measure of the biological damage to living tissue from radiation exposure.

Dosimetry: The theory and application of the principles and techniques involved in the measurement and recording of radiation doses. Its practical aspect is concerned with the use of various types of radiation instruments with which measurements are made (i.e., film badge, thermoluminescent dosimeter, and Geiger counter).

Ecological resources: Terrestrial, wetland, and aquatic resources that could be affected, with particular attention to species protected by the Federal government and State-listed species and habitats of special concern.

Ecoregion: An area having a general similarity in ecosystems and characterized by the spatial patterning and composition of biotic and abiotic features, including vegetation, wildlife, geology, physiography (patterns of terrain or land forms), climate, soils, land use, and hydrology, such that within an ecoregion, there is a similarity in the type, quality, and quantity of environmental resources present.

Effluent: A gas or fluid discharged into the environment, treated or untreated. Most frequently, the term applies to wastes discharged to surface waters.

Emissions: Substances that are discharged into the air.

Endangered species: Any species (plant or animal) that is in danger of extinction throughout all or a significant part of its range. Requirements for determining whether a species is endangered are found in the *Endangered Species Act* (16 U.S.C. 1531 et seq.).

Erosion: The wearing away of the land surface by wind, water, ice, or other geologic agents. Erosion occurs naturally from weather or runoff but is often intensified by human land use practices.

Exposure: Being exposed to ionizing radiation or to radioactive material.

Exposure pathways: A route or sequence of processes by which a radioactive or hazardous material may move through the environment to humans or other organisms. Each exposure pathway includes a source or release from a source, an exposure point, and an exposure route.

Fissile: A radionuclide that is capable of undergoing fission after capturing low-energy thermal (slow) neutrons. The three primary fissile materials are uranium-233, uranium-235, and plutonium-239.

Floodplain: Low-lying areas adjacent to rivers and streams that are subject to natural inundations typically associated with precipitation.

Fuel cycle: The series of steps involved in supplying fuel for nuclear power reactors. It can include mining, milling, isotopic enrichment, fabrication of fuel elements, use in a reactor, chemical reprocessing to recover the fissionable material remaining in the spent fuel, reenrichment of the fuel material, refabrication into new fuel elements, and waste disposal.

Fugitive Dust: Any solid particulate matter (PM) that becomes airborne, other than that emitted from an exhaust stack, directly or indirectly as a result of the activities of man. Fugitive dust may include emissions from haul roads, wind erosion of exposed soil surfaces, and other activities in which soil is either removed or redistributed.

Geology and soils: Those earth resources that may be described in terms of landforms, geology, and soil conditions.

Gray (Gy): The international system (SI) unit of absorbed dose. One gray is equal to an absorbed dose of 1 Joule/kilogram (one gray equals 100 rads) (see 10 CFR 20.1004).

Greenhouse gases (GHGs): Gases that absorb outgoing infrared radiation emitted by the earth's surface and trap heat in the atmosphere.

Groundwater: Water, both fresh and saline, that is stored below the earth's surface in pores, cracks, and crevices below the water table.

Hazardous Air Pollutants (HAPs): A group of 188 chemicals identified in the *1990 Clean Air Act Amendments* (42 U.S.C. 7401 et seq.).

Hazardous waste: As defined in the *Resource Conservation and Recovery Act* (42 U.S.C. 6901 et seq.), is "a solid waste, or combination of solid wastes, which, because of its quantity, concentration, or physical, chemical, or infectious characteristics, may (A) cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness, or (B) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed."

Hectare (ha): Metric unit of surface or land, equivalent to 10,000 square meters or 2.471 acres.

Heels: In the uranium enrichment process, heels refers to the residual solid uranium hexafluoride left after the feed rate declines to a predetermined level.

Highly enriched uranium (HEU): Uranium enriched in the isotope uranium-235 to 20 percent or above.

Holding ponds: Engineered depressions in the land that contain storm-water runoff until it can slowly seep back into the ground or evaporate.

Hydrogen fluoride (HF): Chemical compound formed from the conversion of uranium hexafluoride (UF_6) to uranyl fluoride (UO_2F_2) upon contact of UF_6 emissions with water vapor in air.

Hydrology: The science devoted to the study of the occurrence, circulation, distribution, and properties of the waters of the earth and its atmosphere.

Impacts: An assessment of the meaning of changes in all attributes being studied for a given resource, usually measured using a qualitative and nominally subjective technique.

Indirect jobs: Jobs generated or lost in related industries within a regional economic area as a result of a change in direct employment.

Ingestion: To take in by mouth. Material that is ingested enters the digestive system.

Inhalation: To take in by breathing. Material that is inhaled enters the lungs.

Isotope: Any two or more forms of an element having identical or very closely related chemical properties and the same atomic number but different atomic weights or mass numbers.

Land Use: The way land is developed and used in terms of the kinds of human-related activities that occur (e.g., agriculture, residential areas, industrial areas).

Lead (Pb): A naturally occurring heavy metal element formerly added to gasoline and paint for improved performance characteristics. Lead can be inhaled and ingested in food, water, soil, or dust.

Low-enriched uranium (LEU): Uranium enriched in the isotope uranium-235, greater than 0.7 percent but less than 20 percent of the total mass. Naturally occurring uranium contains about 0.7 percent uranium-235, almost all the rest is uranium-238.

Low-level mixed waste: Low-level radioactive waste that also contains hazardous chemical components regulated under the *Resource Conservation and Recovery Act* (42 U.S.C. 6901 et seq.).

Low-level radioactive waste (LLRW): As defined in the *Low-Level Radioactive Waste Policy Act, as amended* (42 U.S.C. 2021 et seq.), low-level radioactive waste means radioactive material that is “not high-level radioactive waste, spent nuclear fuel, or byproduct material” as byproduct material is defined in the *Atomic Energy Act* (42 U.S.C. 2011 et seq.)

Maximally exposed individual (MEI): A hypothetical person who – because of proximity, activities, or living habits – could receive the highest possible dose of radiation or of a hazardous chemical from a given event or process.

Mercury (Hg): A naturally-occurring heavy metal element found in air, water, and soil. Mercury is listed as a hazardous air pollutant (HAP).

Meteorology: The science dealing with the atmosphere and its phenomena, especially as they relate to weather.

Microcurie (μCi): One millionth of a curie. That amount of radioactive material that disintegrates (decays) at the rate of 37 thousand atoms per second.

Mitigation: A series of actions implemented to ensure that projected impacts will result in no net loss of habitat value or wildlife populations. The purpose of mitigative actions is to avoid, minimize, rectify, or compensate for any adverse environmental impact.

Millirem (mrem): One thousandth of a rem (0.001 rem).

Millisievert (mSv): One thousandth of a sievert (0.001 Sv); equivalent to 100 millirem.

Mixing height: The height above the earth's surface through which relatively strong vertical mixing of the atmosphere occurs.

Nitrogen dioxide (NO_2): A brownish, highly reactive gas that is present in all urban atmospheres. The major mechanism for the formation of nitrogen dioxide in the atmosphere is the oxidation of the primary air pollutant nitric oxide.

Nitrogen oxides (NO_x): Nitrogen oxides form when fuel is burned at high temperatures.

Nonattainment Areas: An area that has been designated by the Environmental Protection Agency, or the appropriate state air quality agency, as exceeding one or more national or State Ambient Air Quality Standards.

Normal operations: Conditions during which facilities and processes operate as expected or designed. In general, normal operations include the occurrence of some infrequent events that, although not considered routine, are not classified as accidents.

Ozone (O_3): A photochemical (formed in chemical reactions between volatile organic compounds and nitrogen oxides in the presence of sunlight) oxidant.

Outfall: The place where effluent is discharged into receiving waters.

Particulate matter (PM): Materials such as dust, dirt, soot, smoke, and liquid droplets that are emitted into the air by sources such as factories, power plants, cars, construction activity, fires, and natural windblown dust. Commonly expressed as PM_{10} or $PM_{2.5}$, signifying particles with aerodynamic diameter of less than 10 micrometers and 2.5 micrometers, respectively.

Personnel monitoring: The use of portable survey meters to determine the amount of radioactive contamination on individuals; or, the use of dosimetry to determine an individual's occupational radiation dose.

Point source: A source of effluents that is small enough in dimension that it can be treated as if it were a point. A point source can be either a continuous source or a source that emits effluents only in puffs for a short time.

Pollutant: Any material entering the environment that has undesired effects.

Pollution: The addition of an undesirable agent to the environment in excess of the rate at which natural processes can degrade, assimilate, or disperse it.

Pollution prevention: The use of any process, practice, or product that reduces or eliminates the generation and release of pollutants, hazardous substances, contaminants, and wastes, including those that protect natural resources through conservation or more efficient utilization.

Prime farmland: Land with the best combination of physical and chemical characteristics for economically producing high yields of food, feed, forage, fiber, and oilseed crops with minimum inputs of fuel, fertilizer, pesticides, and labor. Prime farmland includes cropland, pastureland, rangeland, and forestland.

Rad: The traditional (English) unit for radiation absorbed dose, which is the amount of energy from any type of ionizing radiation (e.g., alpha, beta, gamma, neutrons, etc.) deposited in any medium (e.g., water, tissue, air). A dose of one rad means the absorption of 100 ergs (a small but measurable amount of energy) per gram of absorbing tissue (100 rad = 1 gray).

Radiation (ionizing radiation): Alpha particles, beta particles, gamma rays, x-rays, neutrons, high-speed electrons, high-speed protons, and other particles capable of producing ions. Radiation, as used in 10 CFR Part 20, does not include non-ionizing radiation, such as radio- or microwaves, or visible, infrared, or ultraviolet light (see 10 CFR 20.1003).

Radiation standards: Exposure standards, permissible concentrations, rules for safe handling, regulations for transportation, regulations for industrial control of radiation, and control of radioactive material by legislative means.

Radioactivity: The spontaneous decay or disintegration of unstable atomic nuclei, accompanied by the emission of radiation. Eventually the unstable nuclei reach a stable state.

Radionuclide: An atom that exhibits radioactive properties. Radionuclides can be man-made or naturally occurring, can have a long life, and can have potentially mutagenic or carcinogenic effects on the human body.

Region of influence (ROI): The geographic region based on the area in which workers are expected to live and spend most of their salaries, and in which a significant portion of site purchase and nonpayroll expenditures from the construction, manufacturing, operation, and decommissioning phases are expected to occur. In this draft EIS, this region corresponds to the Wilmington Metropolitan Statistical Area (MSA), a three-county area comprising Brunswick, New Hanover, and Pender Counties. These three counties cover an area that extends up to approximately 80 kilometers (50 miles) from the Wilmington Site.

Rem: The acronym for roentgen equivalent man, is the traditional (English) unit that measures the effects of ionizing radiation on humans. The dose equivalent in rems is equal to the absorbed dose in rads multiplied by the quality factor of the type of radiation (see 10 CFR 20.1004).

Remediation: Action taken to permanently remedy a release, or threatened release, of a hazardous or radioactive substance to the environment, instead of or in addition to removal.

Restricted area: Any area to which access is controlled for the protection of individuals from exposure to radiation and radioactive materials.

Roentgen: A traditional (English) unit of exposure to ionizing radiation. It is the amount of gamma or x-rays required to produce ions resulting in a charge of 0.000258 coulombs/kilogram of air under standard conditions.

Runoff: The portion of rainfall that is not absorbed by soil, evaporated, or transpired by plants, but finds its way into streams directly or as overland surface flows.

Sanitary/industrial waste: Nonhazardous, nonradioactive liquid and solid waste generated by normal housekeeping activities.

Sediment: Eroded soil particles that are deposited downhill or downstream by surface runoff.

Separative Work Unit (SWU): A separative work unit (SWU) is a unit of measurement used in the nuclear industry, pertaining to the process of enriching uranium for use as fuel for nuclear power plants. It describes the effort needed to separate uranium-235 and uranium-238 atoms in natural uranium to create a final product that is richer in uranium-235 atoms.

Shielding: Any material or obstruction that absorbs radiation and thus tends to protect personnel or materials from the effects of ionizing radiation.

Sievert (Sv): The metric unit of radiation dose used to express a quantity called equivalent dose. This relates the absorbed dose in human tissue to the effective biological damage of the radiation by taking into account the kind of radiation received, the total amount absorbed by the body, and the tissues involved. Not all radiation has the same biological effect, even for the same amount of absorbed dose. One sievert is equivalent to 100 rem.

Site characterization: An onsite investigation at a known or suspected contaminated waste or release site to determine the extent and type(s) of contamination.

Source material: Uranium or thorium ores containing 0.05 percent uranium or thorium regulated under the *Atomic Energy Act* (42 U.S.C. 2011 et seq.). In general, this includes all materials containing radioactive isotopes in concentrations greater than natural and the byproduct (tailings) from the formation of these concentrated materials.

Special nuclear material: Plutonium, uranium-233, or uranium enriched in the isotopes uranium-233 or uranium-235.

Subsidence: The process of sinking or settling of a land surface due to natural or artificial causes.

Sulfur dioxide (SO_2): A gas emitted largely from stationary sources such as coal and oil combustion, steel and paper mills, and refineries.

Surface water: Water located on the surface of the Earth in water bodies such as lakes, rivers, streams, ponds, wetlands, and the ocean.

Tails: In the uranium enrichment process, tails refers to gas with a reduced concentration of the uranium-235 isotope.

Toxic air pollutants (TAPs): Toxic air pollutants from created sources. Many chemicals on a State TAPs list may overlap those on the Federal HAPs list, but the State list may include additional substances.

Threatened species: Plant and wildlife species that are likely to become endangered in the foreseeable future.

Total effective dose equivalent (TEDE): The sum of deep-dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

Uranium: A radioactive element with the atomic number 92 and, as found in natural ores, an atomic weight of approximately 238. The two principal natural isotopes are uranium-235 (0.7 percent of natural uranium) and uranium-238 (99.3 percent of natural uranium). Naturally occurring uranium also includes a minute amount of uranium-234.

Uranium enrichment: The process of increasing the percentage of the naturally occurring and fissile uranium-235 isotope and decreasing the percentage of uranium-238.

Uranium Hexafluoride (UF_6): The chemical form of uranium used during the uranium enrichment process consisting of one atom of uranium and six atoms of fluorine.

Visual Resource Management (VRM): A process devised by the Bureau of Land Management to assess the aesthetic quality of a landscape and to design proposed activities in a way that would minimize their visual impact on that landscape. The process consists of a rating of site visual quality followed by a measurement of the degree of contrast between the proposed development activities and the existing landscape.

Visual and scenic resources: Natural or developed landscapes that provide information for an individual to develop their perceptions of the area. The size, type, gradient, scale, and continuity of landforms, structures, land use patterns, and vegetation are all contributing factors to an area's visual character and how it is perceived.

Volatile Organic Compounds (VOCs): Organic compounds that easily evaporate and can break down through photochemical reactions.

Waste management: The planning, coordination, and direction of functions related to generation, handling, treatment, storage, transportation, and disposal of waste. It also includes associated pollution prevention and surveillance and maintenance activities.

Waste minimization: An action that economically avoids or reduces the generation of waste by source reduction and recycling; or reduces the toxicity of hazardous waste, improving energy usage.

Water resources: This term includes both freshwater and marine systems, wetlands, floodplains, and groundwater.

Well field: Area containing one or more wells that produce usable amounts of water.

Wetlands: Land or areas exhibiting the following characteristics: hydric soil conditions; saturated or inundated soil during some part of the year and plant species tolerant of such conditions; also, areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, under normal circumstances, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

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(See instructions on the reverse)

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11. ABSTRACT *(200 words or less)*

General Electric (GE)-Hitachi Global Laser Enrichment LLC (GLE) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) for a license to construct, operate, and decommission the GLE Global Laser Enrichment Facility, a proposed laser-based uranium enrichment facility to be located in the North-Central Sector of the existing GE property near Wilmington, North Carolina. The proposed GLE Facility, if licensed, would enrich uranium for use in nuclear fuel for commercial power reactors. Feed material would be comprised of non-enriched uranium hexafluoride (UF6). GLE would employ a laser-based enrichment process to enrich uranium up to 8 percent uranium-235 by weight with an initial planned maximum target production of 6 million separative work units (SWUs) per year. The proposed GLE facility would be licensed in accordance with the provisions of the Atomic Energy Act. Specifically, an NRC license under Title 10, "Energy," of the U.S. Code of Federal Regulations (10 CFR) Parts 30, 40, and 70 would be required to authorize GLE to possess and use special nuclear material, source material, and byproduct material at the proposed GLE site.

This environmental impact statement (EIS) was prepared in compliance with the National Environmental Policy Act and the NRC regulations for implementing the Act (10 CFR Part 51). This draft EIS evaluates the potential environmental impacts of the proposed action and its reasonable alternatives.

12. KEY WORDS/DESCRIPTORS *(List words or phrases that will assist researchers in locating the report.)*

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