2.0 Description of Nuclear Power Plant and Site and Plant Interaction with the Environment

The Duke Energy Corporation's (Duke's) McGuire Nuclear Station, Units 1 and 2 (McGuire) is located on the shore of Lake Norman in North Carolina's Mecklenburg County approximately 27 km (17 mi) north-northwest of Charlotte, North Carolina. The plant consists of two units (Units 1 and 2) that are the subject of this action. Each unit is a pressurized light-water reactor (LWR) with four steam generators producing steam that turns turbines to generate electricity. Lake Norman is used as the sources of cooling and process water for McGuire. The plant and its environs are described in Section 2.1, and the plant's interaction with the environment is presented in Section 2.2.

2.1 Plant and Site Description and Proposed Plant Operation During the Renewal Term

McGuire is located on 234 ha (577 ac) of Duke-owned land in southwestern North Carolina. Figures 2-1 and 2-2 show the site location and features within 80 km and 10 km (50 mi and 6 mi), respectively. The site is surrounded by an exclusion area whose radius measures 0.76 km (0.47 mi) and covers 182.4 ha (450.5 ac) (Duke 2001a).

The McGuire site is bounded to the west by the Catawba River and to the north by Lake Norman. Lake Norman is a 13,156-ha (32,510-ac) lake that was formed by the impoundment of the Catawba River by the Cowan's Ford Dam hydroelectric station (owned and operated by Duke Power). Lake Norman achieved full pond level in 1964. Cowan's Ford Dam is immediately west of the site and on the Catawba River channel.

The region surrounding McGuire is considered to have a high population density based on the definitions applied to case study sites in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999b).[(a)] The area around McGuire is experiencing a rapid change from a rural to a suburban environment (Duke 2001a). Huntersville (population 25,000), North Carolina, is the nearest town (Duke 2001a). The town center is located approximately 10 km (6 mi) to the east of the plant.

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

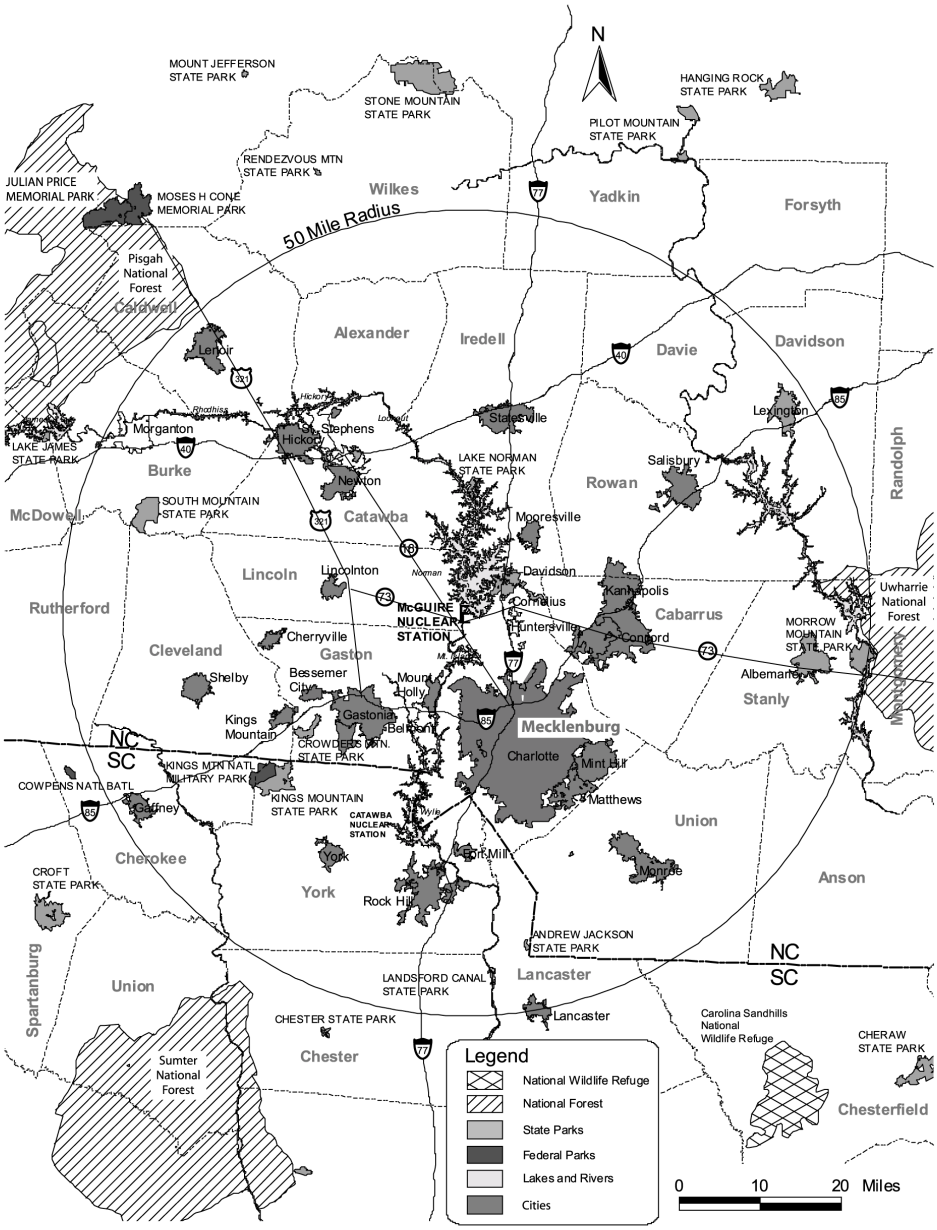

Figure 2-1. Location of McGuire Nuclear Station, Units 1 and 2, 80-km (50-mi) Region

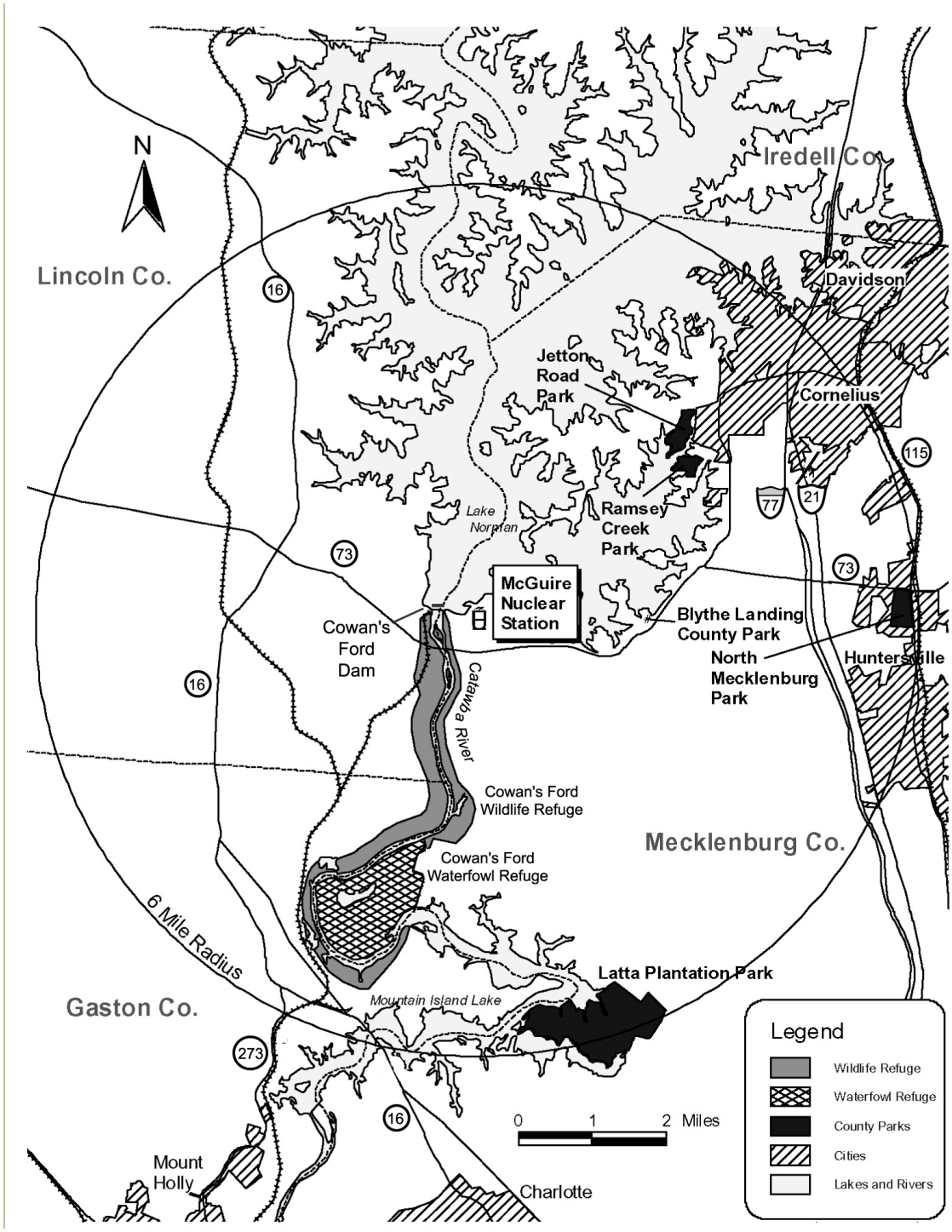

Figure 2-2. Location of McGuire Nuclear Station, Units 1 and 2, 10-km (6-mi) Region

The McGuire site has approximately 1345 full-time workers employed by Duke and site contractors during normal plant operations. Duke refuels each reactor unit at McGuire on an 18- to 24-month schedule, when site employment increases by as many as 1015 workers for temporary duty (30 to 40 days).

The McGuire exclusion area varies in elevation from 198 m to 244 m (650 to 800 ft) (Duke 2001a), and its topography is rolling (NRC 1996). The exclusion area is dominated by Cecil sandy loam and harbors typical piedmont plant communities and cover types, predominantly hardwood-pine forests and marshes and wetlands (Duke 2001a). The majority of land in the area immediately around McGuire is forested, pasture, cropland, or residential developments, each contributing significant proportions to the total land use. The shoreline of Lake Norman is developed with vacation and permanent residences, campgrounds, boat launches, marinas, and golf courses. The 270-ha (668-ac) Cowan's Ford Wildlife Refuge (owned and operated by Mecklenburg County Parks and Recreation Department) and the Cowan's Ford Waterfowl Refuge (managed by the North Carolina Wildlife Resources Commission) are located just south of the McGuire exclusion area along the shores of Mountain Island Lake. These areas, as well as adjacent lands, have been officially designated as Important Bird Areas (IBAs) by the National Audubon Society because of their rich avian diversity (Duke 2001a).

Five parks (Blythe Landing County Park, Jetton Road Park, Latta Plantation Park, North Mecklenburg Park, and Ramsey Park), located in and owned by Mecklenburg County, are within a 10-km (6-mi) radius of the McGuire plant. Five state parks (Andrew Jackson State Park, Crowders Mountain State Park, Lake Norman State Park, Morrow Mountain State Park, and South Mountain State Park), Kings Mountain National Military Park, and the Catawba Indian Reservation are located within 80 km (50 mi) of the McGuire plant (Duke 2001a).

2.1.1 External Appearance and Setting

Because of the large amount of timber adjacent to the site, the nuclear plant is visible from only a few locations on the land. It is readily visible from adjacent locations along the lake shore. The most obvious structures are the transmission lines that are visible from North Carolina Highway 73 (NC-73), which runs along the southern edge of the site.

McGuire Units 1 and 2 each have a separate reactor building, turbine building, and switchyard. The following buildings and features are common to both units: service building, auxiliary building, intake structures (upper level and lower level), discharge structure and discharge canal, standby nuclear service water pond, and independent spent fuel storage installation (ISFSI) (Duke 2001a).

The ISFSI was added to McGuire to expand the storage capacity for spent fuel. The initial loading of spent fuel into the dry storage facility took place in 2001. The storage of spent fuel in the ISFSI is conducted under a general permit issued in accordance with 10 CFR 72.210. The ISFSI is outside the scope of this review.

The McGuire site lies near the center of the Piedmont physiographic province. The Piedmont is characterized by rolling hills and numerous small streams and rivers. It is a northeast-trending zone from Georgia through Virginia that varies in width from about 130 to 190 km (80 to 120 mi) (Duke 2001a). The Fall Line, which divides the Piedmont from the Coastal Plain physiographic province to the southeast, lies 100 km (65 mi) from the site.

The Piedmont province is underlain by five narrow northeast-trending belts of metamorphosed sedimentary rock. The McGuire site is within the Charlotte Belt. These rocks, originally formed during the lower Paleozoic, are now in the form of mica schist and gabbro. Although there are numerous faults in the Piedmont region, there are no identifiable faults or other geological structures that could be expected to localize earthquakes in the immediate vicinity of the McGuire site (NRC 1976).

2.1.2 Reactor Systems

The McGuire site is shown in Figure 2-3. Each unit is a pressurized LWR with four steam generators that produce steam that turns turbines to generate electricity. Each unit, designed and fabricated by the Westinghouse Electric Corporation, is designed to operate at core power levels up to 3411 megawatts thermal (MW[t]), with a corresponding net electrical output of approximately 1129 MW(e) (Duke 2001a).

The nuclear steam supply system for each unit is housed in a separate free-standing steel containment structure within a reinforced concrete shield building. The containment employs the ice condenser pressure-suppression concept. The containment is designed to withstand environmental effects and the internal pressure and temperature accompanying a postulated loss-of-coolant accident or steam-line break. Together with its engineered safety features, the containment structure for each unit is designed to adequately retain fission products that escape from the reactor coolant system.

McGuire is licensed for fuel that is slightly enriched uranium dioxide, up to 4.75 percent by weight uranium-235 (Duke 2001a). McGuire has several different fuel designs that are used for the production of electricity. The Mark-BW design has a maximum fuel assembly burnup of 55,000 megawatt days/metric tons of uranium (MWd/MTU) and a maximum licensed fuel pin

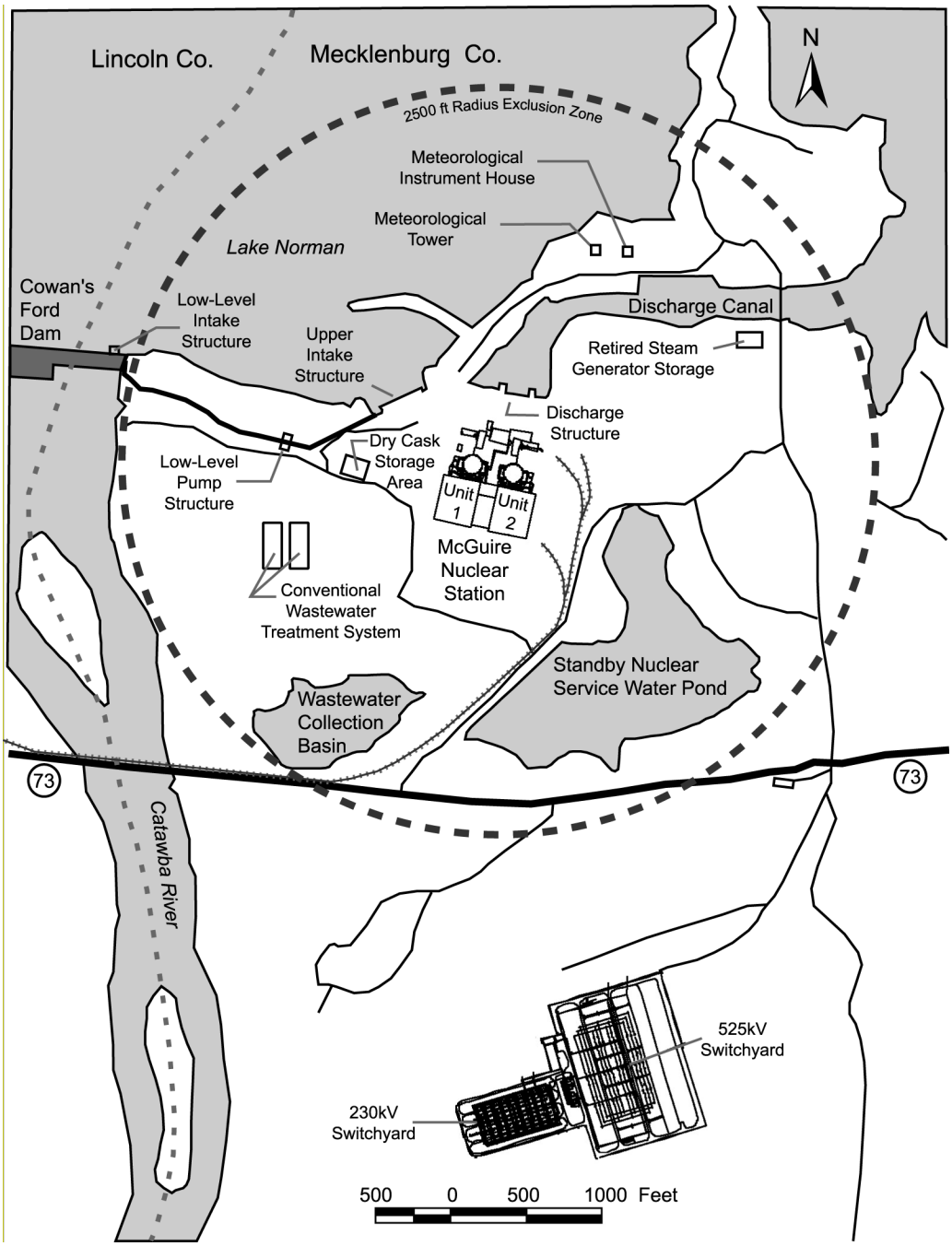

Figure 2-3. McGuire Nuclear Station

burnup of 60,000 MWd/MTU. The Westinghouse Robust Fuel Assembly design does not have a maximum fuel assembly burnup limit; however, this burnup value would be limited by the maximum licensed fuel pin burnup limit of 60,000 MWd/MTU (Duke 2001a).

2.1.3 Cooling and Auxiliary Water Systems

The site currently uses water from Lake Norman for main condenser cooling and process water. Water is withdrawn from the lake at an average daily rate (two-unit operation) of about 111 m^3/s (2530 million gpd), circulated through the two units and discharged back into the lake through the discharge canal. The plant has an upper-level intake and a separate, lower-level intake structure.

For most of the year, cooling and process water is withdrawn from Lake Norman through the upper-level intake structure. The upper-level intake structure is located at the lake surface at the end of the intake channel. It withdraws from the surface water layers of the lake (epilimnion). The water in the intake channel flows through trash bars and through 1-cm (3/8 in.) mesh vertical traveling screens before entering the McGuire plant. Water velocity in the upper intake channel is less than 0.3 m/s (1 ft/s).

During periods of high lake-surface temperature, cooler water (hypolimnion layer) is withdrawn from the lake bottom through the lower-level intake structure. The lower-level intake structure is located west of the upper intake structure and approximately 30 m (100 ft) below the lake surface. Water from the lower intake structure is pumped by a pumping station up to a canal that discharges the cooler water in front of the upper intake structure. The water from the lower intake structure supplements, but cannot completely replace, the surface water flow from the upper intake channel. Thus, water from the lower intake structure drawn primarily during the hot summer months reduces the temperature of the water that is drawn into the plant for cooling. This results in a lower station discharge water temperature. There are no traveling screens on the lower-level intake structure. Water velocity through the lower-level intake structure, when operating, can be as high as 0.43 m/s (1.4 ft/s).

Operation of the rotating vertical traveling screens can be in either an automatic or manual mode. Automatic rotation of the screens is controlled by differential pressure across the screen surface. Manual operation and cleaning of the traveling screens is prescribed weekly. Backwash water and screen debris are discharged into a refuse removal trench, which drains into a debris retention basket.

The increase in temperature of cooling system water discharged back into Lake Norman is related to flow and intake water temperature. During the winter, when the incoming water is the

coolest and the flow is the lowest, the increase in temperature is 13.7°C (24.7°F). During the summer, when the intake temperatures are the warmest and the flow is the highest, the temperature increase is 8.6°C (15.5°F).

Potable water at McGuire is supplied by the Charlotte-Mecklenburg Utilities Department (CMUD) water supply system. Six groundwater wells provide specific low-volume uses (e.g., irrigation, remote restrooms) with a combined maximum pumping rate of 4.3 L/s (68 gpm).

2.1.4 Radioactive Waste Management Systems and Effluent Control Systems

McGuire uses liquid, gaseous, and solid radioactive waste management systems to collect and process the liquid, gaseous, and solid wastes that are the by-products of McGuire operation. These systems process radioactive liquid, gaseous, and solid effluents before they are released to the environment. The waste disposal systems for McGuire meet the design objectives of 10 CFR Part 50, Appendix I (Numerical Guides for Design Objectives and Limiting Conditions for Operations to Meet the Criterion “As Low As Reasonably Achievable” for Radioactive Material in Light-Water Cooled Nuclear Power Reactor Effluents), and control the processing, disposal, and release of radioactive liquid, gaseous, and solid wastes. Radioactive material in the reactor coolant is the source of gaseous, liquid, and solid radioactive wastes in LWRs. Radioactive fission products build up within the fuel as a consequence of the fission process. These fission products are contained in the sealed fuel rods, but small quantities escape from the fuel rods and contaminate the reactor coolant. Neutron activation of the primary coolant system also is responsible for coolant contamination.

Nonfuel solid wastes result from treating and separating radionuclides from gases and liquids and from removing contaminated material from various reactor areas. Solid wastes also consist of reactor components, equipment, and tools removed from service, as well as contaminated protective clothing, paper, rags, and other trash generated from plant design modifications and operations and routine maintenance activities. Solid wastes are shipped to a waste processor for volume reduction before disposal at a licensed burial site (Duke 2001a). Spent resins and filters are stored or packaged for shipment to a licensed offsite processing or disposal facility (Duke 2001a).

Fuel rods that have exhausted a certain percentage of their fuel and are removed from the reactor core for disposal are called spent fuel. Each unit is refueled approximately every 18 to 24 months. Refueling outages are staggered so both units are not in an outage at the same time (Duke 2001a). Spent fuel is stored onsite in one of the two spent fuel pools or in containers in the McGuire ISFSI (Duke 2001a). Each unit has its own spent fuel pool located in the auxiliary building. Spent fuel storage in the McGuire ISFSI was initiated in 2001.

The waste disposal system used for processing liquid, gaseous, and solid wastes is common to Units 1 and 2, with the exception of the reactor coolant drain tanks located in each reactor containment (Duke 2000a).

The offsite dose calculation manual (ODCM) for McGuire (Duke 2001e) describes the methods used for calculating radioactivity concentrations in the environment and the estimated potential offsite doses associated with liquid and gaseous effluents from McGuire. The ODCM also specifies controls for release of liquid and gaseous effluents to ensure compliance with the following:

- The concentration of radioactive liquid effluents released from the site to the unrestricted area will not exceed 10 times the concentration specified in 10 CFR Part 20, Appendix B, Table 2, Column 2, for radionuclides other than dissolved or entrained gases. For dissolved or entrained noble gases, the concentration shall not exceed 7.4 Bq/mL (0.0002 µCi/mL).

- The dose or dose commitment per reactor to a member of the public from any radioactive materials in liquid effluents released to unrestricted areas shall be limited to the design objectives of 10 CFR Part 50, Appendix I; (1) less than or equal to 0.015 mSv [1.5 mrem] to the total body and less than or equal to 0.05 mSv [5 mrem] to any organ during any calendar quarter, and (2) less than or equal to 0.03 mSv [3 mrem] to the total body and less than or equal to 0.1 mSv [10 mrem] to any organ during any calendar year).

- The dose rate due to radioactive materials released in gaseous effluents from the site to areas at and beyond the site boundary shall be limited to (1) less than or equal to 5 mSv/yr (500 mrem/yr) to the total body and less than or equal to 30 mSv (3000 mrem/yr) to the skin due to noble gases and (2) less than or equal to 15 mSv/yr (1500 mrem/yr) to any organ due to iodine-131, iodine-133, tritium, and for all radioactive materials in particulate form with half-lives greater than 8 days per NUREG-1301 (NRC 1991).

- The air dose per reactor to areas at and beyond the site boundary due to noble gases released in gaseous effluents shall be limited to the design objectives of 10 CFR Part 50, Appendix I (i.e., less than or equal to 0.1 mGy (10 mrad) for gamma radiation and less than or equal to 0.2 mGy (20 mrad) for beta radiation during any calendar year).

- The dose to any individual member of the public from the nuclear facility operations will not exceed the maximum limits of 40 CFR Part 190 (i.e., less than 0.25 mSv [25 mrem]) and 10 CFR Part 20 (i.e., less than or equal to 5 mSv [0.5 rem] in a year and less than or equal to 0.02 mSv [2 mrem] in any hour).

2.1.4.1 Liquid Waste Processing Systems and Effluent Controls

All radioactive and potentially radioactive liquids generated in the plant are collected, segregated, and processed. Most reactor- or primary-grade liquids are recycled. Potentially contaminated radioactive liquid wastes in the plant are collected in tanks in the auxiliary building and processed by filtration, demineralization, or evaporation prior to their monitoring and discharge to Lake Norman (Duke 2001a). Liquid wastes from the auxiliary building floor drains, sumps, and equipment drains, as well as from the plant's containment sumps, laboratory drains, and waste evaporator feed tank drainage are collected in the floor drain tank (Duke 2000a). Dependent on the activity of liquid wastes in the floor drain tank, further processing (i.e., filtering, chemical treatment, demineralization) may be required prior to collection in one of two waste monitor tanks (Duke 2000a). Liquid wastes from the laundry hot shower tank also are collected in the waste monitor tanks after filtering (Duke 2000a). From the waste monitor tanks, liquid wastes are sampled and monitored. When they are found to be within the regulated levels, they then are discharged into the condenser cooling water system (i.e., condenser circulating water) that flows into Lake Norman (Duke 2000a). Condensate from the containment ventilation units is collected in the ventilation unit condensate drain tank (Duke 2000a). Liquid wastes from this tank are monitored and discharged into the condenser cooling water system (i.e., condenser circulating water) flowing into Lake Norman similar to the discharge from the waste monitor tanks.

Liquid wastes from the turbine building sump (typically not contaminated) are monitored and released to the conventional wastewater system and the wastewater collection basin discharge point to the Catawba River downstream of Cowan's Ford Dam (Duke 2001e). If monitoring shows elevated radioactivity levels in the Turbine Building sump, liquid waste is routed into the floor drain tank for processing as described above and eventual discharge to Lake Norman (Duke 2001e).

The ODCM prescribes the alarm/trip setpoints for the liquid effluent radiation monitors; the setpoints are derived from 10 times the effluent concentration limits provided in 10 CFR Part 20, Appendix B, Table 2, Column 2. Liquid effluent radiation monitors are located on the waste monitor tank release line, the containment ventilation unit condensate drain tank release lines, and the turbine building sump release line (Duke 2001e). The alarm/trip setpoint for each liquid effluent monitor is based on the measurements of radioactivity in a batch of liquid to be released or in the continuous liquid discharge (Duke 2001e).

During 2000, there were 246 batch releases of liquid effluents for the two units in a total volume of 1.37E+7 L (3.62E+6 gal) prior to dilution (Duke 2001c). The combined liquid waste volume prior to dilution for batch and continuous releases for 2000 was 3.35E+8 L (8.84E+7 gal) (Duke 2001c). The liquid waste holdup capacity for the plant is approximately 1.48 E+6 L

(390,000 gal) (Duke 2001a). The actual liquid waste generated is reported in the *McGuire Nuclear Station Annual Radioactive Effluent Release Report* (Duke 2001c).

Duke does not anticipate any increase in liquid waste releases during the renewal period.

2.1.4.2 Gaseous Waste Processing Systems and Effluent Controls

The waste gas system is designed to remove fission gases from radioactive contaminated fluids and contain these gases. Fission gases are removed from other systems to the maximum extent possible and contained in the waste gas system. The system is designed so that storage and subsequent decay of these gases can eliminate, to a large extent, the need for regularly scheduled discharge of these radioactive gases from the system into the atmosphere during normal plant operation. There are times, however, when the release of radioactive gas may become necessary. As a result, there are provisions to sample and isolate each of the decay tanks.

The waste gas system, containment and auxiliary building ventilation, and flow from the condenser air ejectors exhaust into the unit vents (Duke 2001e). These four contributors to the unit vent exhaust are discussed below. The unit vents are the primary (major) gaseous release points from the plant (Duke 2001e).

- Waste Gas System. The waste gas system in the auxiliary building (Duke 2000a) is shared between the two reactor units and consists of two waste gas compressors, two catalytic hydrogen recombiners, six gas decay storage tanks for use during normal power generation, and two gas decay storage tanks for use during shutdown and startup operations (Duke 2001e). Letdown flow from the reactor coolant system is processed through the waste gas system, and the resultant gases (hydrogen, nitrogen, and small quantities of the fission products xenon and krypton) are collected in the waste gas decay storage tanks. Gases are allowed to decay in these tanks, then are released at permissible rates and activity to the Unit 1 vent as prescribed by the ODCM (Duke 2001e).

- Containment Ventilation. The containment ventilation includes atmosphere from the containment purge, containment air release and addition, and containment annulus (Duke 2000a). The containment atmosphere will pass through a charcoal adsorber and a high-efficiency particulate air (HEPA) filter prior to being exhausted into either the Unit 1 or Unit 2 vent (Duke 2001e).

- Auxiliary Building Ventilation. Radioactive gases generated within the auxiliary building will be exhausted through the building's ventilation system. Exhausted air is monitored and, upon radiation monitor alarm, the exhaust air is diverted through a charcoal adsorber and a HEPA filter prior to being released to the Unit 1 or Unit 2 vent (Duke 2001e).

- Condenser Air Ejectors. Gases from the condenser air ejectors are monitored continuously and discharged into either the Unit 1 or Unit 2 vent (Duke 2000a).

Secondary (minor) release points include the waste management facility, the waste handling area, and the Unit 2 staging building (Duke 2001e). Exhausts from these three areas are monitored continuously and, upon a high radiation alarm, the supply and exhaust ventilation fans are stopped (Duke 2000a).

Radioactive gaseous wastes from McGuire are released primarily through the Unit 1 and 2 vents. The exhaust streams that flow into the unit vents (i.e., waste gas decay storage tanks, containment ventilation, auxiliary building ventilation, and condenser air ejectors) are monitored for radioactivity. The vents for each unit are continuously monitored for noble gases, radioiodines, and particulate activity (Duke 2000a). The ODCM prescribes alarm/trip setpoints for these effluent monitors and control instrumentation to ensure that the alarm/trip will occur prior to exceeding the limits of 10 CFR Part 20 for gaseous effluents (Duke 2001e).

Duke does not anticipate any increase in gaseous releases during the renewal period.

2.1.4.3 Solid Waste Processing

Solid radioactive wastes from McGuire consist of spent resin, spent (contaminated) filter elements, contaminated oils and sludges, and miscellaneous solid materials (Duke 2000a, Duke 2001a). Spent resin is flushed from plant demineralizers into spent resin storage tanks. The spent resin then is processed by dewatering or solidification and packaged in a cask liner, which is placed in a shielded cask truck (Duke 2000a). Spent filter elements are removed from their housing using filter-handling tools and filter transfer shields. They are transferred to a shielded filter storage bunker in the waste drumming area (Duke 2000a). Contaminated oils and sludges either are pumped to a processing area for solidification or are shipped to an offsite vendor for processing (Duke 2001a). Miscellaneous solid materials include rubber gloves, plastic bags, contaminated clothing, contaminated rags, and contaminated tools (Duke 2001a).

Lower-activity wastes (i.e., miscellaneous solid materials) are processed at an offsite waste processing facility for volume reduction or segregation prior to disposal at a licensed facility

such as Barnwell, South Carolina, or Envirocare of Utah (Duke 2001a). Higher-activity wastes (i.e., spent resins) are typically sent directly to a licensed disposal facility such as Barnwell, South Carolina (Duke 2001a).

Disposal and transportation of solid wastes are performed in accordance with the applicable requirements of 10 CFR Part 61 and 10 CFR Part 71, respectively. There are no releases to the environment from radioactive solid wastes created at McGuire.

In 2000, McGuire Units 1 and 2 made eight shipments of solid waste with a volume of 47 m^3 (1650 ft^3) and a total activity of 0.19 TBq (5 Ci) (Duke 2001c). These shipments are representative of the shipments made in the past several years and are not expected to change appreciably during the license renewal period.

2.1.5 Nonradioactive Waste Systems

Nonradioactive solid wastes from McGuire are disposed of in the onsite landfill or in one of several offsite landfills operated by Mecklenburg County (Duke 2001a). The onsite landfill typically handles the following types of wastes: asbestos, empty containers and drums, insulation (nonasbestos), nonhazardous-spill cleanup, conventional wastewater sludge, alkaline batteries, and oil-contaminated materials. This landfill is permitted by the North Carolina Department of Environmental and Natural Resources (NCDENR), Solid Waste Section (Duke 2001a). General office trash is disposed in one of several offsite landfills operated by Mecklenburg County (Duke 2001a).

Nonradioactive liquid wastes are sampled and treated according to the site National Pollutant Discharge Elimination System (NPDES) permits issued to McGuire by the North Carolina Department of Environmental and Natural Resources (Duke 2001a). These wastes originate from system drainage/leakage, water treatment activities, housekeeping/cleaning wastes, stormwater runoff, and floor and yard drains (Duke 2001a). Sanitary wastes are treated offsite by the CMUD (Duke 2001a).

2.1.6 Plant Operation and Maintenance

Routine maintenance performed on plant systems and components is necessary for safe and reliable operation of a nuclear power plant. Maintenance activities conducted at McGuire include inspection, testing, and surveillance to maintain the current licensing basis of the plant and to ensure compliance with environmental and safety requirements. Certain activities can be performed while the reactor is operating. Others require that the plant be shut down. Long-term outages are scheduled for refueling and for certain types of repairs or maintenance, such as replacement of a major component. Duke refuels each of the McGuire units every 18 to 24 months (Duke 2001a). Each outage is typically scheduled to last approximately 30 to

40 days; the outage schedules are staggered so that both units are not in an outage at the same time (Duke 2001a). One-third of the core is offloaded at each refueling. Approximately 1015 additional workers are onsite during a typical outage (Duke 2001a).

Duke provided an appendix in *Duke Energy Company McGuire Nuclear Station Updated Final Safety Analysis Report* regarding the aging management review to manage the effects of aging on systems, structures, and components in accordance with 10 CFR Part 54 (Duke 2000a). Chapter 3 and Appendix B of the McGuire license renewal application specifies the programs and activities that will manage the effects of aging during the license renewal period (Duke 2001b). Duke expects to conduct the activities related to the management of aging effects during plant operation or normal refueling and other outages but plans no outages specifically for refurbishment activities. Duke has no plans to add additional full-time staff (nonoutage workers) at the plant during the period of the renewed licenses.

2.1.7 Power Transmission System

Two switchyards connect the McGuire plant transmission lines to the transmission system: a 230-kV switchyard for Unit 1 and a 525-kV switchyard for Unit 2. The switchyards are located south of Highway NC-73 (see Figure 2-4). Power from Unit 1 is transmitted to the 230-kV switchyard over two separate three-phase 230-kV transmission lines with an average length of 1.2 km (4000 ft) (Figure 2-4). Power from Unit 2 is transmitted to the 525-kV switching station over two separate three-phase 525-kV transmission lines with an average length of 1 km (3300 ft) (Figure 2-4). The 230- and 525-kV lines are designed to meet the heavy loading condition as defined in the National Electrical Safety Code, 7th Edition (Duke 2001). The 230-kV switching station is tied into the Duke 230-kV network by seven double-circuit overhead lines. The 525-kV switching station is east of the 230-kV switching station and is tied into the Duke 525-kV network by four single-circuit overhead lines.

The right-of-way for the 525-kV lines is 151.5 m (500 ft) wide. The right-of-way for the 230-kV lines is 60.6 m (200 ft) wide (Gaddy 2001). Duke has a well-established set of management practices for right-of-way maintenance. These best management practices include vegetation management; erosion and sediment control; soil stabilization; stream and wetland protection; and protection of sensitive areas and sensitive species. Vegetation management consists of mowing and herbicide application (Gaddy 2001). Arsenal and Accord with Garlon 4A or Krenite are used for stump treatments and basal applications. Each of these products has been evaluated for safety and environmental concerns. In particular, Arsenal and Accord are approved for use in wetland areas. Following initial treatment with Arsenal and Accord, rights-of-way are maintained thereafter on an approximate 3-year rotation. Subsequent herbicide applications are limited primarily to trees that could grow into transmission lines (Duke 2001a).

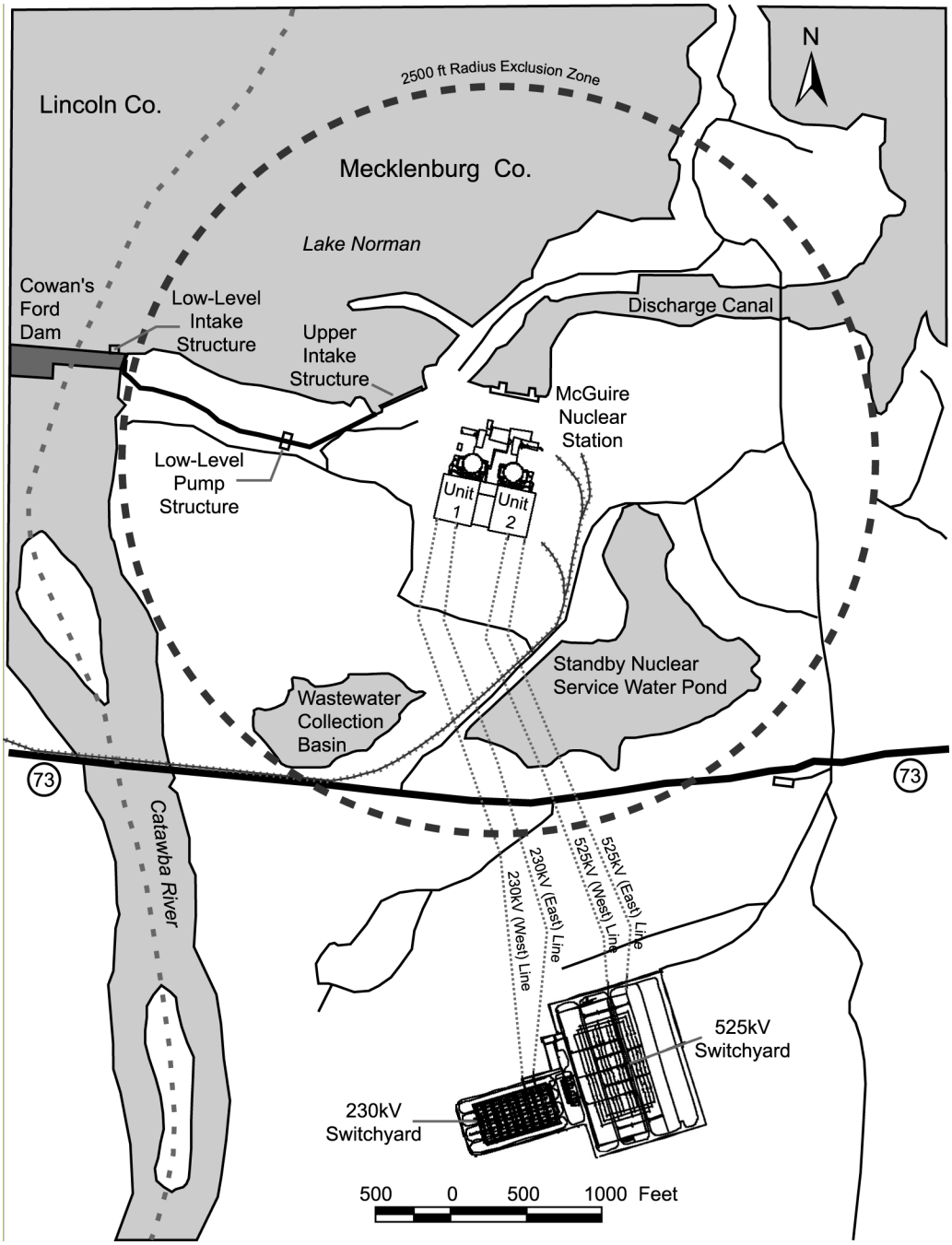

Figure 2-4. Transmission Lines Attributable to McGuire Nuclear Station

Duke maintains a working relationship with the North Carolina Department of Environment and Natural Resources (NCDENR) Natural Heritage Program and the U.S. Fish and Wildlife Service (FWS). Duke communicates with these agencies about pertinent natural heritage data such as Federal- and State-listed species, special habitats, and new findings. Information from the North Carolina Natural Heritage Program database is used to establish new and review existing vegetation management programs for the rights-of-way (Duke 2001a).

The transmission line connecting McGuire to the Oconee Nuclear Station was evaluated previously in the Supplemental Generic Environmental Impact Statement for license renewal of the Oconee Nuclear Station (NRC 1999a).

2.2 Plant Interaction with the Environment

Sections 2.2.1 through 2.2.8 provide general descriptions of the environment as background information. They also provide detailed descriptions where needed to support the analysis of potential environmental impacts of refurbishment and operation during the renewal term, as discussed in Chapters 3 and 4. Section 2.2.9 describes the historic and archaeological resources in the area, and Section 2.2.10 describes possible impacts on other Federal project activities.

2.2.1 Land Use

Although the McGuire site is not within the town limits of Huntersville North Carolina (the nearest incorporated town), the site is subject to the extraterritorial zoning jurisdiction of Huntersville. Exercise of extraterritorial jurisdiction is authorized by Section 160A-360 of the General Statutes of North Carolina. The McGuire site is located in a special-purpose zoning district. Power generation plants are a permitted use in special-purpose districts (Town of Huntersville 2001).

2.2.2 Water Use

Lake Norman, North Carolina's largest reservoir, was created by constructing the Cowan's Ford Dam on the Catawba River. Lake Norman is part of the Catawba-Wateree Project, which consists of 11 reservoirs operated for hydroelectric power generation on the Catawba River and licensed by the Federal Energy Regulatory Commission.

In addition to supplying the cooling water for the McGuire plant, Lake Norman also supplies water for Duke Power's coal-fired Marshall Steam Station on the western shore of the lake, approximately 26 km (16 mi) upstream from McGuire. Lake Norman also is a source of

municipal drinking water for several cities in the region. Lake Norman supports extensive recreational use by fishermen, boaters, skiers, and swimmers.

Construction of the Cowan's Ford Dam and impoundment of the Lake Norman reservoir to serve a variety of purposes, including providing cooling water for McGuire, have considerably altered the regional water resources environment. Lake Norman represents the critical landscape feature to lakeside development and regional recreation.

McGuire employs a once-through cooling system. The average daily withdrawal from Lake Norman for the cooling water and other service water systems is 9580 million L/d (2530 million gpd). The average daily discharge to Lake Norman from McGuire also is approximately 9580 million L/d (2530 million gpd). Approximately 4090 m^3/d (1.08 million gpd) from the conventional wastewater treatment system and from the wastewater collection basin are discharged to the Catawba River.

Potable water at McGuire is supplied by the CMUD water supply system. McGuire has six groundwater wells with a combined maximum pumping rate of 4.3 L/s (68 gpm).

2.2.3 Water Quality

Lake Norman provides water of sufficiently high quality to serve a variety of needs, including propagation of fish and wildlife and contact recreation. The NCDENR Division of Water Quality found Lake Norman fully supportive of all uses (NCDENR 1999).

Pursuant to the Federal Water Pollution Control Act of 1977, also known as the Clean Water Act, the water quality of the plant effluents is regulated through the NPDES. The Division of Water Quality within the NCDENR is delegated to issue NPDES permits. The current permit (NC0024392) was issued February 28, 2000, and is due to expire February 28, 2005. Any new regulations promulgated by the U.S. Environmental Protection Agency (EPA) or the State of North Carolina would be reflected in future permits.

2.2.4 Air Quality

The McGuire site is located in the Piedmont of the Carolinas, a transitional region between the Blue Ridge Mountains to the west and the Coastal Plain to the east. The region has a moderate climate with cool winters and warm summers. Climatological records for Charlotte, North Carolina (NCDC 2001), are generally representative of the McGuire site. Normal daily maximum temperatures for Charlotte range from about 9°C (49°F) in January to a high of

about 32°C (89°F) in July. Normal minimum temperatures range from about -1°C (30°F) in January to about 21°C (70°F) in July. The average precipitation of about 109 cm (43.1 in.) per year is rather evenly distributed through the year. Normal monthly precipitation ranges from 7 to 11 cm (2.7 to 4.4 in.).

The wind energy resource in the Piedmont of the Carolinas is limited. The annual average wind power in the region is rated 1 on a scale of 1 through 7 (Elliott et al. 1986). Wind turbines are economical in wind power classes 4 through 7 (average wind speeds of 5.6 to 9.4 m/s (12.5 to 21.1 mph) (DOE 2001). The average wind power of exposed coastal areas of North Carolina is rated 3, and the wind power rating for mountain summits and ridges to the west generally varies from 3 to 6.

Thunderstorms can occur in any month and occur on an average of more than 3 days per month from April through August. Hurricanes that strike the Carolina coast may produce heavy rains but seldom cause high winds at the site (NCDC 2001). Statistics for the 30 years from 1954 through 1983 (Ramsdell and Andrews 1986) indicate that the probability of a tornado striking the site is expected to be about 2×10^{-4} per year.

The McGuire site is located within the Metropolitan Charlotte Interstate Air Quality Control Region. This region is designated as in attainment or unclassified for criteria pollutants in 40 CFR 81.334 except for the EPA's reinstated 1-hr ozone standard. Mecklenburg County is a maintenance area for the 1-hr ozone. The State of North Carolina and Mecklenburg County have adopted EPA's proposed 8-hr ozone standard. This standard was exceeded on 32 days in 1999 (Mecklenburg County Department of Environmental Protection [MCDEP] 2000). Monitoring data for Mecklenburg County also indicate that the annual average concentration of fine particles (PM2.5) for 1999 exceeded the PM2.5 standard adopted by EPA in 1997. Six areas in North and South Carolina are designated in 40 CFR 81.422 and 40 CFR 81.426 as mandatory Class I Federal areas in which visibility is an important value. All of these Class I areas are more than 80 km (50 mi) from the site.

Diesel generators and other activities and facilities associated with McGuire emit various pollutants. Emissions from these sources are regulated under Air Quality Permit to Construct/Operate 00-019–269 issued by the MCDEP on February 23, 2000.

2.2.5 Aquatic Resources

Aquatic resources in the vicinity of the McGuire site are associated with the southernmost portion of Lake Norman, North Carolina's largest man-made reservoir. In addition to serving McGuire, Lake Norman also provides water to Duke Power's Marshall Steam Station and the Cowan's Ford Dam hydroelectric station. The lake also is a source of drinking water for several

cities in the region. Boaters, fishermen, swimmers, and water skiers use the lake for recreation. Centers for tourism and conservation in the vicinity include Lake Norman State Park and three county parks on the shores of the lake. The Cowan's Ford Wildlife Refuge (owned and operated by Mecklenburg County Parks and Recreation Department) and the Cowan's Ford Waterfowl Refuge (managed by North Carolina Wildlife Resources Commission) are located along the shores of Mountain Island Lake, south of the McGuire site and immediately downstream of the Cowan's Ford Dam.

Lake Norman's major tributaries include the Catawba River, Lyle Creek, and Buffalo Shoals Creek. The lake itself covers 13,150 ha (32,500 ac) and averages 10 m (33 ft) deep, with a maximum 36.6-m (120-ft) depth.

Pelagic fish species are primarily forage fish, including threadfin shad (*Dorosoma petenense*), gizzard shad (*D. cepedianum*), and alewife (*Alosa aestivalis*). Game fish include black crappie (*Pomoxis nigromaculatus*) and white crappie (*P. annularis*), largemouth bass (*Micropterus salmoides*), white perch (*Morone americana*), white bass (*M. chrysops*), striped bass (*M. saxatilis*), and some spotted bass (*Micropterus punctulatus*). The primary fish caught in the nearshore littoral zone include sunfish (*Lepomis* spp.), carp (*Cyprinus carpio*), and catfish, including the blue catfish (*Ictalurus furcatus*), snail bullhead (*Ameiurus brunneus*), white catfish (*I. catus*), and flat bullhead (*I. platycephalus*). The blue catfish, white perch, threadfin shad, white bass, spotted bass, and alewife are introduced species, some of which may impact native species populations. In addition, striped bass are not indigenous to Lake Norman and do not reproduce naturally. Instead, they are stocked on an annual basis to provide a resource for sport fishermen.

In addition to finfish, numerous aquatic invertebrate species are found in the vicinity of McGuire. These include diverse phytoplankton, zooplankton, and benthic macroinvertebrates. In 1999, 135 species of phytoplankton were collected, the dominant types being cryptophytes and diatoms (Duke 2001a). Zooplankton communities in Lake Norman also are diverse and tend to fluctuate seasonally and spatially. Since 1987, Duke researchers have observed 108 zooplankton taxa (Duke 2001a). Most recently (1999), immature copepods dominated the zooplankton standing crop during most of the year, while rotifers and cladocerans had the highest densities in February and August, respectively. Information from 1977 through 1984 indicates that benthos at sublittoral locations was dominated by chironomids, chaoborids, *Corbicula sp., Hexagenia spp.,* and oligochaetes (Duke Power Company 1985). Since 1989, benthic macroinvertebrate studies have been limited to determining seasonal densities of *Corbicula sp.* in front of the McGuire intake structures. Recent studies indicate that the potential for biofouling from these organisms is moderate to high, but population numbers in front of the intake structures vary widely from year to year (Hall and Wilda 2000, 2001; Duke 2001a). Adult clams, capable of reproduction, generally comprise 10 percent or less of the samples (Duke 2001a).

The McGuire site lies entirely in Mecklenburg County. However, Lincoln County, immediately to the west of the site, also could harbor species that would be affected by plant refurbishment or continued operation. A search through the FWS database and the North Carolina National Heritage Program for Federally and State-listed species indicated that two fish—Carolina darter (*Ethostoma collis collis*) and highfin carpsucker (*Carpoides velifer*)— and three mussel species—Carolina heelsplitter (*Lasmigona decorata*), dwarf threetooth (*Triodopsis fulciden*), and Carolina creekshell (*Villosa vaughnaniana*)—could inhabit the region around McGuire (Table 2-1). In addition, a summer 2000 biological assessment of species associated with McGuire and related power transmission lines (Gaddy 2001) indicated that three other important species, including two mussels—the Carolina elktoe (*Alasmidonta robusta*) and Eastern creekshell (*V. delumbis*)—and one fish—the Santee chub (*Cyprinella zanema*)—could also inhabit the region around McGuire (Table 2-1).

Gaddy (2001) inventoried the site environs, excluding the industrial areas in the center of the site, using aerial photographs supplemented by field work. Gaddy also walked the four power line rights-of-way in their entirety. Areas that appeared to be reasonable habitat for Federally and State-listed species were inventoried intensively in the summer and the early autumn. Despite an extensive survey program conducted by the State and licensee, no Federal-or State-listed species or critical habitat for such species was found within the McGuire site exclusion area (see Figure 2-4) or along related power transmission rights-of-way (Gaddy 2001).

Of the species mentioned, only the Carolina heelsplitter is listed as endangered. The other species are considered species of concern or “significantly rare.” The Carolina heelsplitter was known historically in the Catawba River system in Mecklenburg County. However, recent collection records indicate the Carolina heelsplitter has been eliminated from all but one of the streams where it was originally known to exist. In North Carolina, the only remnant populations appear to exist in Union County, far to the southeast of the site (Fridell 2001). All of the streams supporting this species are free-flowing and natural (EPA 2002) and no longer occur in the vicinity of the plant. The last known occurrence in Mecklenburg County was more than 20 years in the past (Fridell 2001).

Menhinick (1991) lists the highfin carpsucker from Lake Norman considerably north of the study area and lists only historic records of the Santee chub in Lake Norman but north of the study area (Gaddy 2001).

Table 2-1. Federal and State of North Carolina Listed Aquatic Species Potentially Occurring in Lincoln and Mecklenburg Counties

Scientific Name	Common Name	Federal Status[(a)]	State Status[(a)]	County
Ethostoma collis collis	Carolina darter	FSC	–	Mecklenburg
Carpoides velifer	highfin carpsucker	–	SC	Mecklenburg
Cyprinella zanema	Santee chub	–	SR	Mecklenburg or Lincoln
Lasmigona decorata	Carolina heelsplitter	E	E	Mecklenburg
Triodopsis fulciden	dwarf threetooth	–	SC	Lincoln
Villosa vaughnaniana	Carolina creekshell	FSC	SC	Mecklenburg
Villosa delumbis	Eastern creekshell	–	SR	Mecklenburg or Lincoln
Alasmidonta robusta	Carolina elktoe	–	EX	Mecklenburg or Lincoln

(a) E = endangered; EX = extirpated (no longer found in the area); FSC = Federal species of concern; SC = State species of concern but not protected under State regulations; SR = significantly rare but not protected under State regulation; – = no listing.

The three freshwater mussel species – dwarf threetooth, Eastern creekshell, and Carolina creekshell—are not reported from the Lake Norman South quadrangle, according to the North Carolina Natural Heritage Program database <http://www.ncsparks.net/nhp/search.html>.

2.2.6 Terrestrial Resources

Forest is the primary land cover near the McGuire site, with pasture, cropland, and residential development each contributing substantially to total land use. Noteworthy natural habitats outside the McGuire site include the 270-ha (668-ac) Cowan's Ford Wildlife Refuge (Figure 2-2) (owned and operated by Mecklenburg County Parks and Recreation Department) and the Cowan's Ford Waterfowl Refuge (Figure 2-2) (managed by the North Carolina Wildlife Resources Commission) to the south along the shores of Mountain Island Lake. These areas, as well as adjacent lands, are occupied by bottomland hardwood forests and other habitats that support nearly 200 species of birds, 54 of which are neotropical migrants. Because of this rich avian diversity, the lands from Cowan's Ford to Mountain Island Lake have been officially designated as IBAs by the National Audubon Society. In addition, wildlife such as wild turkey *(Meleagris gallopavo*), numerous raptor species, whitetail deer *(Odocoileus virginianus*), and red fox *(Vulpes vulpes*) use these IBAs and the properties around the McGuire site to move freely along the Catawba River corridor (Duke 2001a).

The McGuire exclusion area is a circle with a 760-m (2500-ft) radius (Figure 2-5) that covers 182 ha (450 ac). Two man-made water bodies, the standby nuclear service water pond (13.3 ha [32.9 ac]) and the wastewater collection basin (4.13 ha [10.2 ac]), are located within the exclusion area (Figure 2-5). The exclusion area includes portions of Lake Norman and the McGuire discharge canal. Approximately 58.7 ha (145 ac) of the exclusion area are composed of generation and maintenance facilities, parking lots, roads, storage yards, and mowed grass. The remaining 41.3 ha (102 ac) consist of forest communities (Duke 2001a). In addition, 4.5 km (2.8 mi) of transmission line right-of-way connects the exclusion area to the McGuire switching station via nonforested terrestrial habitat.

The exclusion area harbors typical Piedmont plant communities (Duke 2001a) and land cover types. As shown in Figure 2-5, seven plant communities or cover types have been identified at the McGuire site: marsh; marsh/wetland mixed hardwood/open water; mixed hardwood-pine; pine; wetland mixed hardwood; wetland mixed hardwood/marsh; and open water (Gaddy 2001). Cecil sandy loam dominates the site, with some Monacan clay loam found along the Catawba River. The more rare and more alkaline Mecklenburg and Iredell soils, which often support prairie plant species, are absent from the site (Duke 2001a; Gaddy 2001).

Marshes are nonforested and found along the margin of the floodplain of the Catawba River. Dominant marsh species include black willow (*Salix nigra*), tag alder (*Alnus serrulata*), a mallow (*Hibiscus* sp.), false nettle (*Boehmeria cylindrica*), fringed sedge (*Carex crinita*), cattail (*Typha latifolia*), rice cut-grass (*Leersia oryzoides*), and the exotic Asiatic dayflower (*Analeima keisak*) (Gaddy 2001).

Marsh/wetland mixed hardwood/open water describes a small wetland altered by beavers (*Castor canadensis*) found along the eastern edge of the exclusion area boundary. Common needlerush (*Juncus effusus*), sedges (*Carex* spp.), and false nettle occur in the backwaters of a small pond on the site. Black willow, tag alder, and sycamore (*Platanus occidentalis*) are found in the wetland mixed hardwood community upstream from the pond (Gaddy 2001).

The mixed hardwood-pine community is the most widespread forest type on the McGuire site. Dominant species include white oak (*Quercus alba*), red oak (*Q. rubra*), tulip poplar (*Liriodendron tulipifera*), post oak (*Q. stellata*), hickories (*Carya* spp.), shortleaf pine (*Pinus echinata*), and Virginia pine (*P. virginiana*). Gaddy (2001) identified a portion of this forest community as a “significant natural area.” This area supports a well-developed mixed hardwood forest with scattered mature trees (some greater than 2 ft in diameter). Tulip poplar, white oak, red oak, white ash (*Fraxinus americana*), and hickories dominate the canopy of this area, while dogwood (*Cornus florida*), sourwood (*Oxydendrum arboreum*), strawberry bush (*Calycanthus floridus*), and big-leaved storax (*Styrax grandifolia*) are found in the shrub layer of the understory.

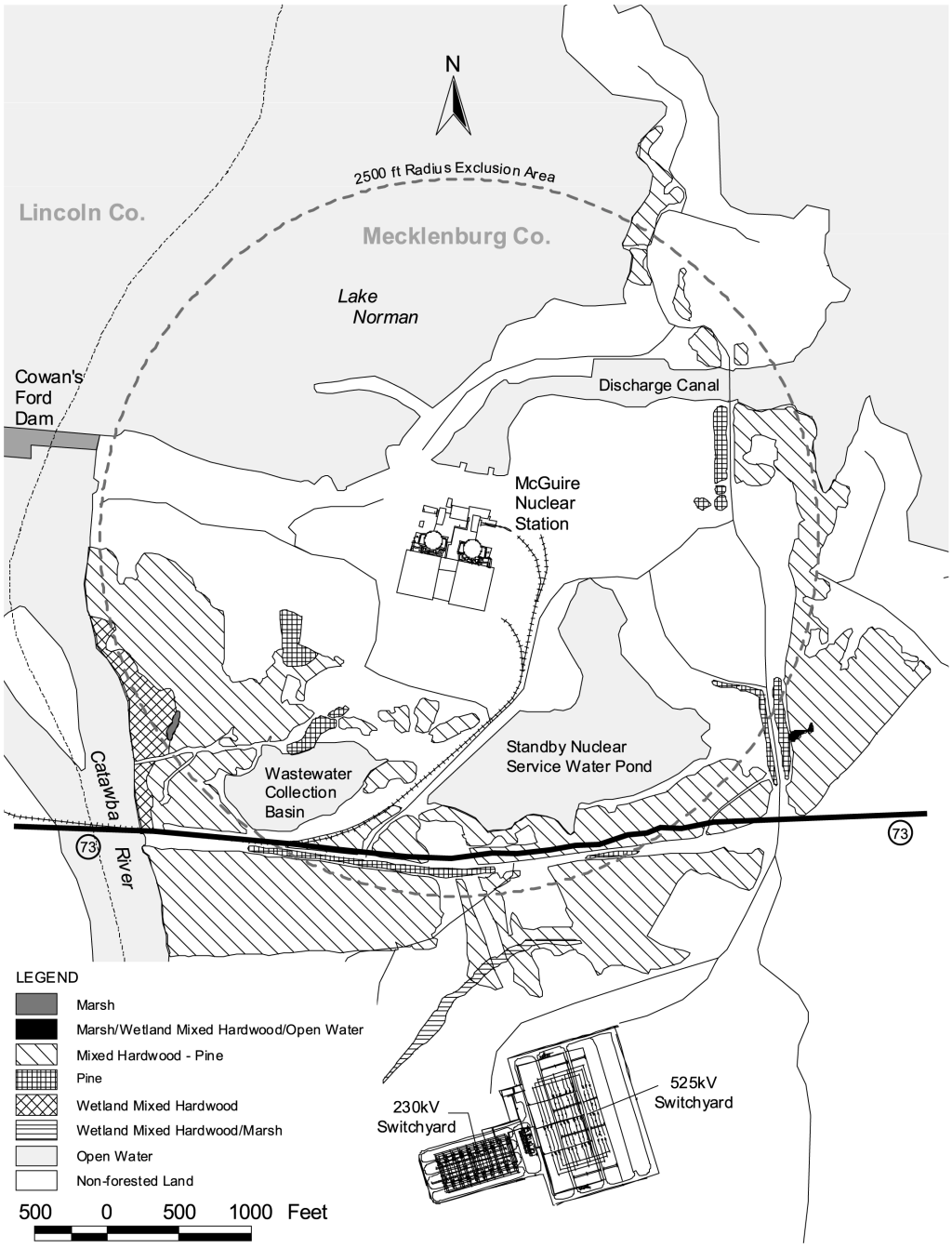

Figure 2-5. McGuire Site Vegetation Types

The pine community is early successional and is dominated by loblolly pine (*P. taeda*) with a low-density groundcover. Most of these stands occur in disturbed areas and along forest edges and appear to have been planted (Gaddy 2001).

The wetland mixed hardwood community is found in the floodplain of the Catawba River along the western edge of the exclusion area. Dominant overstory species include sweet gum (*Liquidambar styraciflua*), red maple (*Acer rubrum*), American elm (*Ulmus americana*), river birch (*Betula nigra*), and sycamore. Box elder (*A. negundo*) is the understory dominant. The forest floor is occupied by sedges, Japanese honeysuckle (*Lonicera japonica*), and Vietnam grass (*Microstegium vimineum*) (Gaddy 2001).

The wetland mixed hardwood/marsh community occurs just south of the exclusion area where transmission lines pass over a small tributary of the Catawba River. Sycamore, black willow, tag alder, and sweet gum grow in the forested portions of the wetland, with Vietnam grass and cutgrass (*Leersia* sp.) in the understory. False nettle, common needlerush (*Scirpus polyphyllus*), and groundnut (*Apios americana*) grow in marshy openings (Gaddy 2001).

The forested portion of the exclusion area, as well as the transmission line rights-of-way, do not provide significant terrestrial habitat because of the small acreage involved. However, McGuire site contains man-made wildlife food plots, including strip plots in the rights-of-way, that attract whitetail deer and other wildlife, including songbirds, a variety of mice and voles, raptors, gray fox (*Urocyon cinereoargenteus*), raccoon (*Procyon lotor*), and opossum (*Didelphis virginiana*).

Food plots include sorghum, sunflowers, rye, clover, and wheat that are mowed selectively to further enhance wildlife habitat value (Duke 2001a).

Notable wildlife species common to the McGuire site include whitetail deer, wild turkey, Canada geese (*Branta canadensis*), great blue heron (*Ardea herodias*), muskrat (*Ondatra zibethicus*), and osprey (*Pandion haliaetus*). Whitetail deer numbers have increased since McGuire has been operating. This is attributable largely to forest fragmentation, which provides for more open area and an increase in the foraging area for the deer. Fifteen wild turkeys were released on the McGuire site in 1996, and this population is apparently increasing. Wild turkeys are commonly observed frequenting the food plots, rights-of-way, and bottomland hardwood areas. Canada geese numbers around McGuire also are increasing. These, and to a lesser extent other waterfowl and birds, routinely travel between the McGuire site and Cowan's Ford Waterfowl Refuge on Mountain Island Lake. Year-round access to reliable food sources in agricultural settings, yards, golf courses, and other open spaces explains why many of these are nonmigratory. A great blue heron rookery exists on Davidson Creek Island in Lake Norman approximately 4.5 km (3 mi) north of McGuire. This rookery consists of approximately 30 nests and is protected under the North Carolina Wildlife Resources Commission Colonial Waterbird

Nesting Area Program. Island access is prohibited from April 1 to August 31. Muskrats, osprey, and various salamanders, aquatic snakes, and turtles have commonly been observed in marshy lowland areas and near open water (Duke 2001a).

Duke has a progressive wildlife enhancement program for which it received WAIT (Wildlife and Industry Together) certification from the North Carolina Wildlife Federation in 2001. This program is implemented both in the relatively unused portions of the plant site and offsite on nearby properties. It includes establishment and maintenance of food plots in the exclusion area and the rights-of-way; introduction of wild turkeys in cooperation with the Wild Turkey Federation; establishment of an osprey hatching site near Cowan's Ford Dam in cooperation with the Carolina Raptor Center; deeding Davidson Creek Island to the North Carolina Wildlife Resources Commission for management under the Colonial Waterbird Nesting Area Program; and establishment of bluebird houses.

Eight Federally listed and 10 State-listed threatened or endangered species, candidate species, or species of special concern are known to occur or may potentially occur in Mecklenburg County (Table 2-2) (Cole 2001; NCDENR 2001). Bald eagles (*Haliaeetus leucocephalus*) are known to nest at Lake Wylie (downstream of McGuire) and Lake James (upstream of McGuire) and are known from the Catawba River area (Cole 2001). The eagles are observed occasionally along Lake Norman (Cole 2001; Duke 2001a; Gaddy 2001), but sightings are rare and there are no known nest sites within 100 km (60 mi) of the McGuire site. Except for the bald eagle, no Federally or State-listed species are known to occur within the McGuire exclusion area or associated transmission line rights-of-way (Duke 2001a; Gaddy 2001). However, Schweinitz's sunflower (*Helianthus schweinitzi*) and Georgia aster (*Aster georgianus*) are known to occur on adjacent property (Cole 2001). No areas designated by the FWS as critical habitat for threatened/endangered species are known to exist within the McGuire exclusion area or associated transmission line rights-of-way (Duke 2001a; Gaddy 2001).

2.2.7 Radiological Impacts

Duke has conducted a radiological environmental monitoring program (REMP) around the McGuire site since 1977 (Duke 2001d). The radiological impacts to workers, the public, and the environment have been routinely monitored, documented, and compared to the appropriate standards. The REMP has four key objectives:

- Provide assurance that McGuire's contribution of radioactivity to the environment is and remains within applicable limits (Duke 2000a)

- Detect and identify changes in environmental levels as a result of station operations (Duke 2001d)

Table 2-2. Federal and State of North Carolina-Listed Terrestrial Species Potentially Occurring in Mecklenburg County.

Scientific Name	Common Name	Federal Status[(a)]	State Status[(a)]
BIRDS			
Haliaeetus leucocephalus	bald eagle	T	E
Lanius ludovicianus ludovicianus	loggerhead shrike		SC
MAMMALS			
Condylura cristata	star-nosed mole - coastal plain population		SC
PLANTS			
Aster georgianus	Georgia aster	C	T
Delphinium exaltatum	tall larkspur	FSC	E
Echinacea laevigata	smooth coneflower	E	E
Helianthus schweinitzii	Schweinitz's sunflower	E	E
Isoetes virginica	Virginia quillwort	FSC	C
Lotus helleri	Carolina birdfoot-trefoil	FSC	C
Rhus michauxii	Michaux's sumac	E	E

(a) E = endangered; T = threatened; FSC = Federal species of (special) concern; C = candidate for Federal or State listing; SC = State species of special concern, but not protected under State regulations.

- Provide representative measurements of radiation and radioactive materials in the exposure pathways for the radionuclides that have the highest potential for radiation exposures of members of the public.

- Supplement the radiological effluent monitoring program by verifying that the measurable concentrations of radioactive materials and levels of radiation are not higher than expected on the basis of the effluent measurements and the modeling of the environmental exposure pathways (Duke 2001d).

Radiological releases are summarized in the annual reports—*McGuire Nuclear Station Units 1 and 2—Annual Radiological Environmental Operating Report* (Duke 2001d) and *McGuire Nuclear Station Annual Radioactive Effluent Release Report* (Duke 2000b, 2001c). The limits for all radiological releases are specified in the McGuire ODCM (Duke 2001e), and these limits

are designed to meet Federal standards and requirements. The REMP includes monitoring of the air, direct radiation, surface water, drinking water, shoreline sediment, milk, fish, broadleaf vegetation, and food products.

Review of historical data on releases and the resultant dose calculations revealed that the doses to maximally exposed individuals in the vicinity of the McGuire site were a small fraction of the limits specified in the EPA's environmental radiation standards 40 CFR Part 190 as required by 10 CFR 20.1301(d). For 2000 (the most recent year for which data were available), dose estimates were calculated based on actual liquid and gaseous effluent release data (Duke 2001c) and on measured concentrations of radionuclides from the REMP (Duke 2001d). Dose estimates based on effluent data were performed using the plant effluent release data, onsite meteorological data, and appropriate pathways identified in the ODCM.

A breakdown of maximum dose to an individual located at the McGuire site boundary from effluent-based releases and environmental-based releases for the year 2000 is as follows:

- Total body dose from liquid effluent-based estimates was 0.001 mSv (0.102 mrem) compared to 0.00056 mSv (0.056 mrem) from environmental-based estimates. These estimates were between 1 and 2 percent of the 0.06-mSv (6-mrem) dose limit.[(a)] The maximum total organ dose for the liquid effluent-based estimates was 0.0013 mSv (0.13 mrem) to the child liver compared to 0.00064 mSv (0.064 mrem) to the child liver from the environmental-based estimates. These estimates were between 0.32 and 0.65 percent of the 0.20 mSv (20-mrem) dose limit (Duke 2001d).

- The air dose due to noble gases in gaseous effluents was 0.00084 mSv (0.084 mrad) gamma (0.42 percent of the 0.20-mGy [20-mrad] gamma dose limit)[(a)] and 0.00031 mGy (0.031 mrad) beta (0.08 percent of the 0.40-mGy [40-mrad] beta dose limit)[(a)] (Duke 2001d). Noble gases are not collected as part of the REMP; therefore, an environmental-based estimate was not calculated (Duke 2001d).

- The critical organ dose from gaseous effluents due to iodine-131, iodine-133, tritium, and particulates with half-lives greater than 8 days is 0.0055 mSv (0.55 mrem), which is approximately 2 percent of the 0.30-mSv (30-mrem) dose limit[(a)] (Duke 2001d).

Duke does not anticipate any significant changes to the radioactive effluent releases or exposures from McGuire operations during the renewal period, and, therefore, the impacts to the environment are not expected to change.

(a) The dose limit is twice the dose limit in CFR Part 50, Appendix I, because the limit is per reactor unit and McGuire has two operating reactor units.

2.2.8 Socioeconomic Factors

The staff reviewed the McGuire Environmental Report (ER) and information obtained from several county, city, and economic development staff during a site visit from September 24 to 28, 2001. The following information describes the economy, population, and communities near the McGuire site.

2.2.8.1 Housing

Approximately 1370 employees work at McGuire Units 1 and 2. Approximately 23 percent of these employees live in Mecklenburg County, 22 percent live in Lincoln County, 13 percent live in Gaston County, 11 percent live in Iredell County, and the rest live elsewhere in the region (see Table 2-3).

Table 2-3. McGuire Employee Residence Information by County

County	Number of Personnel	Percent	Cumulative Percent
Mecklenburg	318	23	23
Lincoln	305	22	46
Gaston	180	13	59
Iredell	155	11	70
Catawba	121	9	79
Cabarrus	93	7	86
Rowan	63	5	90
South Carolina	63	5	95
Other North Carolina	48	4	98
Other States	21	2	100
Total	1367	100	–

Source: Duke (2001a)

Duke refuels each nuclear unit at the McGuire site every 18 to 24 months. During these refueling outages, site employment increases by approximately 1015 temporary workers for 30 to 40 days. No major plant refurbishment activities were identified as necessary beyond routine replacement of components as part of normal plant maintenance (Duke 2001a). Duke has no plans to augment its current work force during the term of the license renewal period (Duke 2001a).

Table 2-4 provides the number of housing units, vacancies, vacancy percentages, and 10-year census percentage change for the seven counties in which 90 percent of McGuire employees reside. The vacancy rate for the principal counties of residence is similar, between 5 and 9 percent.

Table 2-4. Housing Units and Housing Units Vacant by County During 1990 and 2000

	1990	2000	Approximate Percentage Change
MECKLENBURG COUNTY			
Housing Units	216,416	292,780	35
Occupied Units	200,219	273,416	37
Percent Vacant	7	7	0
LINCOLN COUNTY			
Housing Units	20,189	25,717	27
Occupied Units	18,764	24,041	28
Percent Vacant	7	7	0
GASTON COUNTY			
Housing Units	69,133	78,842	14
Occupied Units	65,347	73,936	13
Percent Vacant	5	6	20
IREDELL COUNTY			
Housing Units	39,191	51,918	32
Occupied Units	35,573	47,360	33
Percent Vacant	9	9	0
CATAWBA COUNTY			
Housing Units	49,192	59,919	22
Occupied Units	45,700	55,533	22
Percent Vacant	7	7	0
CABARRUS COUNTY			
Housing Units	39,713	52,848	33
Occupied Units	37,515	49,519	32
Percent Vacant	6	6	0
ROWAN COUNTY			
Housing Units	46,264	53,980	17
Occupied Units	45,512	49,940	10
Percent Vacant	8	7	-13

2.2.8.2 Public Services

Public services include utilities (e.g., water supply), education, and transportation.

- **Water Supply**

  The CMUD, the largest public water and wastewater utility in the Carolinas, provides drinking water to more than 700,000 people via an estimated 192,000 active water service connections in the City of Charlotte and greater Mecklenburg County—including the towns of Matthews, Mint Hill, Pineville, Huntersville, Davidson, and Cornelius. The drinking water is pumped from the Catawba River—either at Mountain Island Lake or Lake Norman—to one of three treatment plants where the water is cleaned, tested, and pumped into the distribution system. The three plants treat and deliver an average of roughly 386 million L/day (102 million gpd) of water on about half the system's capacity.

  Six groundwater wells at McGuire supply certain low-volume needs totaling less than 0.0063 m^3/s (100 gpm). The site also has a passive dewatering system for the reactor building and auxiliary buildings. The total water usage at McGuire from CMUD for the year 2000 was 71.4 million liters (18.9 million gallons). Based on this figure, McGuire's average daily consumption of CMUD-supplied potable water was 0.0023 m^3/s (0.052 million gpd). CMUD estimates that the average annual system demand will be 7.14 m^3/s (163 million gpd) through the year 2030. McGuire's usage is 0.03 percent of the total system usage.

- **Education**

  The Charlotte-Mecklenburg schools serve about 106,000 students in 86 elementary, 27 middle, and 16 high schools, as well as 9 special programs, not counting an extensive pre-kindergarten program. There is excess capacity in general for all grade levels except high school, for which enrollment equals capacity. This does not include local school or individual classroom-level allocations, for which there may be space/teacher/resource shortfalls.

- **Transportation**

  The McGuire vicinity is served by Interstate 77 (I-77), which enters Mecklenburg County from the north and proceeds southwest through the city of Charlotte and south to Columbia, South Carolina. North Carolina Highway 16 (NC-16) provides north-south travel on the west side of the Catawba River. Sixteen miles west of McGuire, U.S. Highway 321 (US 321) runs north and south through the city of Gastonia. Highway NC-73 runs east and west and passes McGuire at the south end of Lake Norman.

Interstate 85 (I-85) is a major east-west highway that traverses the middle of the county through the city of Charlotte.

The plant is located approximately halfway between NC-16 and I-77. Road access to the McGuire site is via NC-73, a two-lane road for most of its length between NC-16 and I-77. An access railroad enters the site from the south along NC-73.

Duke contacted the North Carolina Department of Transportation (NCDOT) Statewide Planning Branch for information on traffic counts near McGuire. The NCDOT provided Average Annual Daily Traffic (AADT) count data and Level of Service (LOS)[(a)] designations for the requested locations (Duke 2001a). The AADTs and LOS designation for roads in the vicinity of McGuire are shown in Figure 2.6. The highest AADT counts are south on NC-16 to NC-73, and then along NC-73 to SR 2145. NC-16 is a major corridor for traffic to and from the Charlotte area. The portion of NC-73 between NC-16 and SR 2145 is a major corridor of travel to Interstate I-77. In summary, the LOS on NC-73 in the vicinity of McGuire is D—a high-density, stable flow in which speed and freedom to maneuver are severely restricted and where small increases in traffic will generally cause operational problems.

Continued growth in population, unrelated to McGuire operations, will likely occur in the areas through the period of the extended license. This growth will necessitate increases in traffic capacity to accommodate the population increase. Traffic planning for the region is conducted by the Mecklenburg-Union Metropolitan Planning Organization (MUMPO). The MUMPO maintains a 20-year planning horizon for transportation improvements in the region (MUMPO 1999). The most recent plan extends to the year 2020 and is reviewed and revised on a 5-year cycle. The current plan does not include improvements to the road system near McGuire.

2.2.8.3 Offsite Land Use

The majority of the land area in the region near McGuire is a mixture of pasture, cropland, forest, and residential development. The shoreline of Lake Norman is developed with both vacation and permanent residences, along with campgrounds, boat launch areas, marinas, golf courses, and small retail establishments. The dominant land uses are residential housing (38 percent) and vacant (44 percent).

Two wildlife refuges are close to the plant site. Cowan's Ford Wildlife Refuge abuts the plant site beginning at the Cowan's Ford Dam and extends south about 11 km (7 mi) along the

(a) LOS is a qualitative measure describing operational conditions within a traffic stream and their perception by motorists (NRC 1996).

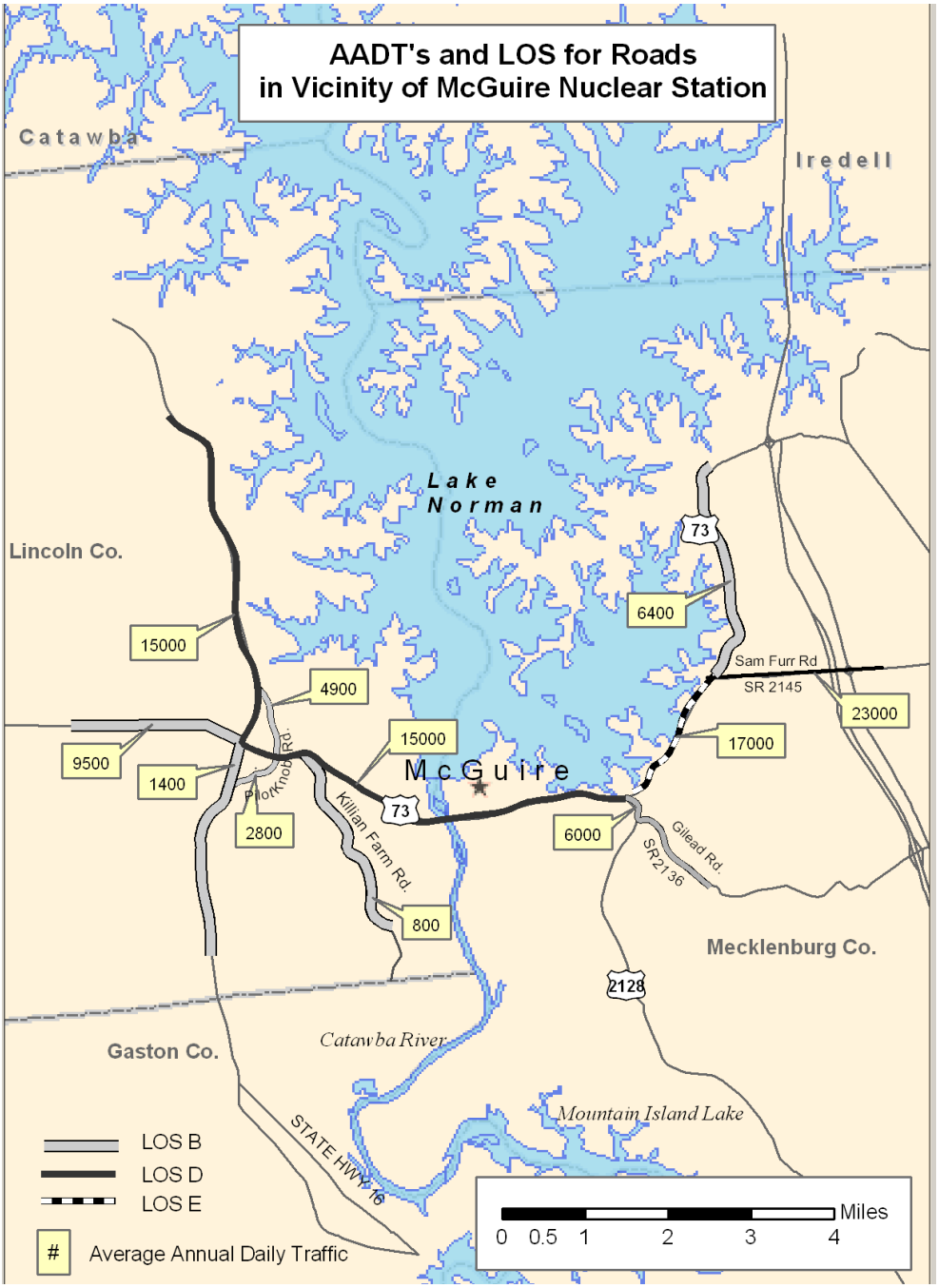

Figure 2-6. Traffic Counts and Level of Service on Roads Surrounding McGuire Nuclear Station

Catawba River. The Cowan's Ford Wildfowl Refuge is about 7 km (4 mi) south of the plant site, within an oxbow bend in the Catawba River just before it flows into Mountain Island Lake. Kings Mountain National Military Park and Kings Mountain State Park are about 48 km (30 mi) southwest of McGuire. South Mountain State Park is approximately 64 km (40 mi) to the west-northwest. Morrow Mountain State Park and a small portion of the Uwharrie National Forest are to the east within an 80-km (50-mi) radius of the McGuire site.

The Catawba Indian Reservation occupies several sites south of the plant near Rock Hill, South Carolina. The nearest of these sites is approximately 48 km (30 mi) from the McGuire site.

2.2.8.4 Visual Aesthetics and Noise

McGuire is visible from a few vantage points on adjoining roads and from Lake Norman. However, its presence does not seem to affect the many recreational boaters or the relatively expensive homes that dot the shoreline. Very little noise from the nuclear station is evident from offsite.

2.2.8.5 Demography

Population was estimated in the region of McGuire in an 80-km (50-mi) zone in 16-km (10-mi) concentric rings. Population estimates for the 80-km (50-mi) area surrounding the site are based on information from the *Updated Final Safety Analysis Report* for McGuire (Duke 2000a).

- **Resident Population Within 80 km (50 mi)**

  In 2000, an estimated 2,425,097 people lived within 80 km (50 mi), and 904,943 lived within 32 km (20 mi) of McGuire.

  Within 80 km (50 mi) of McGuire are located all or parts of 23 counties in North Carolina and 6 in South Carolina. Within this circle is one major city with a population over 500,000 (2000 Census)—Charlotte, North Carolina. The next largest city is Gastonia, North Carolina, to the southwest, with a population of 66,277 (2000 Census) and Rock Hill, South Carolina, on Highway 21, with a population of 49,765 (2000 Census). Population data for the counties surrounding McGuire (in which 90 percent of McGuire employees live) are shown in Table 2-5.

Table 2-5. Historic and Projected Population in the Principal McGuire Area of Impact - the Seven Counties with 90 Percent of the McGuire Employees

County	1980	1990	2000	2010	2020
Mecklenburg	404,270	511,481	695,454	888,137	1,089,258
Lincoln	42,372	50,319	63,780	77,234	90,778
Gaston	162,568	175,093	190,365	203,623	215,587
Iredell	82,538	92,935	122,660	152,177	182,758
Catawba	105,208	118,412	141,685	163,889	186,058
Cabarrus	85,895	98,935	131,063	164,700	200,092
Rowan	99,186	110,605	130,340	150,599	171,889

Source: 1980 census data available at http://www.nationalatlas.gov/census1980m.html. 1990 and 2000 census data available at http://factfinder.census.gov. Projections for 2010 and 2020 are available at http://demog.state.nc.us/.

- **Transient Population**

There is very little transient population, either from seasonal travelers or migrant workers, in the vicinity of McGuire (personal communication with Richard W. Jacobsen, Jr., Director, Mecklenburg County Department of Social Services, October 2001; personal communications with Steve Patterson, Charlotte–Mecklenburg Planning Commission, March 2002; personal communication with Donny Hicks, Executive Director, Gaston County Economic Development Commission, March 2002). McGuire is actually in a relatively affluent part of Mecklenburg and surrounding counties, in part because the homes and lots on Lake Norman are considered very desirable.

2.2.8.6 Economy

According to the North Carolina Department of Commerce, Economic Development Information System (available at http://cmedis.commerce.state.nc.us/region/carolinas.asp), Mecklenburg County is in the Charlotte Regional Partnership, one of seven economic development regions in North Carolina. Charlotte is the hub of this economic development region. Population growth in Mecklenburg County over the past 20 years is shown in Table 2-5. This region's population and employment grew more rapidly than the state totals in recent years. The largest employment sectors in this region are manufacturing and wholesale/retail trade, while the fastest-growing sectors are construction and services. The business failure rate and business startup rate are slightly below the state average. Per-capita income and average wages are approximately 7 percent above the statewide levels. The unemployment rate is lower than the state average, and the region's poverty rate is the lowest in North Carolina.

Charlotte, the Piedmont Triad, and the Research Triangle region are the state's economic "hot spots," with growth predicted at 19 percent, 17 percent, and 15 percent, respectively, by the

year 2005. Firms such as Hilton Hotels, Marriott Hotels, Hannaford Brothers, Coltec, SeaLand, Omni Hotels, Nations Bank, Hearst Corp., Black & Decker, and Canteen are located in Charlotte. Charlotte's financial sector is also growing and includes Nations Bank and First Union Bank.

Table 2-6 shows the employment by sector and wages in the Mecklenburg area. Table 2-7 shows the employment of the 20 largest manufacturing companies, as reported by the North Carolina Department of Commerce, Economic Development Information System. McGuire's 1370 employees would place it sixth among public and private concerns behind Mecklenburg County itself.

Table 2-6. Employment and Earnings in Key Economic Sectors in Mecklenburg County, North Carolina

	Workforce		Average Weekly Earnings ($)	
	Number	**Percent**	**County**	**State**
Agriculture	4,864	0.90	472.16	383.00
Construction	32,622	6.30	690.74	571.00
Finance/Insurance/Real Estate (F/I/RE)	58,199	11.30	1,124.78	844.00
Government	48,103	9.40	724.07	621.00
Manufacturing	49,765	9.70	855.04	689.00
Retail Trade	84,054	16.40	409.79	334.00
Wholesale Trade	45,101	8.80	870.05	733.00
Service	145,914	28.40	676.46	550.00
Transportation/Communications/ Public Utilities (T/C/PU)	45,150	8.80	945.34	757.00
Total Workforce[(a)]	513,722	100.00		

(a) Mining is excluded because of its very small share of employment in NC and for confidentiality reasons.

Source: North Carolina Department of Commerce, Economic Development Information System available at http://cmedis.commerce.state.nc.us/countyprofiles/county.profile.asp?county=Mecklenburg

The unemployment rates for Mecklenburg County and surrounding localities are shown in Table 2-8. Most are below the North Carolina State average of 3.6 percent (U.S. Department of Labor 2001), with the notable exception of Gaston County, reflecting the diverse and healthy economy of the region.

Table 2-7. Twenty Largest Manufacturers in Mecklenburg County

Company	Primary Product Category	Staff
IBM Corp.	Electronic Computers	3000
Solectron Technology Inc.	Printed Circuit Boards	2500
Continental General Tire Inc.	Tires and Inner Tubes	1700
Lance Inc.	Potato Chips and Similar Products	1600
Microsoft Corp.	Prepackaged Software	1300
Knight Publishing Co.	Newspapers: Publishing and Printing	1000
Interstate Brands Corp.	Bread, Bakery Products Except Cookies and Crackers	900
Frito-Lay Inc.	Potato Chips and Similar Products	720
Clariant Corp.	Cyclic-Crudes, Intermediates, Dyes and Org. Pigments	650
Siemens Westinghouse Power	Steam, Gas, and Hydraulic Turbines and Engines	610
Charlotte Pipe and Foundry Co.	Gray Iron Foundries	520
Blythe Construction Inc.	Commercial Physical and Biological Research	500
Connor, Wilton Packaging Limited Liability Company	Corrugated and Solid Fiber Boxes	500
Hoechst Celanese Corp.	Commercial Physical and Biological Research	500
Continental General Tire Inc.	Tires and Inner Tubes	400
Compass Group North America	Food Preparations	400
Carolina Tractor/Equipment Co.	Machinery and Equipment, Industrial and Commercial	400
AmeriSteel Corp.	Blast Furnaces, Coke Ovens, Steel and Rolling Mills	400
Okuma Machine Tools Inc.	Machine Tool Accessories	400
Conbraco Industries Inc.	Valves and Pipe Fittings	350

Source: North Carolina Department of Commerce, Economic Development Information System available at http://cmedis.commerce.state.nc.us/countyprofiles/countyprofile.asp?county=Mecklenburg

McGuire paid about $8.5 million in property taxes to both Mecklenburg County and the town of Huntersville in fiscal year 1998-99. This represents about 2 percent of the property tax revenue and about 1 percent of the total operating budget of Mecklenburg County. McGuire also pays $333,333 per year to Huntersville, representing 7 percent of its property tax and 4 percent of its operating budget, as shown in Table 2-9.

Table 2-8. Unemployment in Counties Surrounding McGuire

County	2000 Annual Unemployment Rates (%)
Cabarrus	2.6
Catawba	2.2
Gaston	6.1
Iredell	3.3
Lincoln	4.1
Mecklenburg	2.5
Rowan	4.8
State of North Carolina	3.6

Source: U.S. Department of Labor, Bureau of Labor Statistics, 2000 data (DOL 2001)

Table 2-9. Property Tax Revenues Generated in Mecklenburg County: 1998-2001[(a)]

Tax or Fiscal Year	Total Mecklenburg County Property Tax Revenues ($)[(b)]	Property Tax Paid to Mecklenburg County by McGuire ($)[(c)]	McGuire Property Taxes as a Percentage of Total County Property Tax Revenue	Total County Operating Budget ($)[(b)]	McGuire Property Taxes as a Percentage of Total County Operating Budget
1998	385,673,079	8,100,866	2	760,190,762	1
1999	399,009,088	7,624,712	2	850,502,587	1
2000	445,135,437	7,421,517	2	940,575,290	1
2001	473,588,913	9,311,874	2	1,029,528,662	1

(a) In addition, McGuire pays $333,333 a year to the town of Huntersville, a part of an agreement for payments in lieu of annexation of the McGuire site by the town of Huntersville. The payments will be made on an annual basis until the year 2027, when the agreement expires. The total revenues received in 1999 by the town of Huntersville were $9,462,699, of which $4,832,573 were revenues from property taxes (Duke 2001a, Section 4.18) The payment by McGuire represents about 7 percent of Huntersville's property tax revenue and 4 percent of its total operating budget.
(b) Source: Personal communication from Mecklenburg-Charlotte Tax Assessor, February 2002
(c) Source: Personal communication from North Carolina Department of Revenue, Property Tax Division, March 2002

2.2.9 Historic and Archaeological Resources

This section discusses the cultural background and the known historic and archaeological resources at McGuire and in the surrounding area. This section draws on information contained in the McGuire ER (Duke 2001a) and from archives and records stored at the North

Carolina Department of Cultural Resources, Office of Archives and History, as well as published literature that treats the history of the North Carolina Piedmont (Piedmont).

2.2.9.1 Cultural Background

McGuire is in the southwest section of the Piedmont geologic province. The Piedmont is a large, highly dissected plateau covering some 58,000 km^2 (20,000 mi^2) between the coastal plain and the foothills of the Blue Ridge Mountains (Ward 1983). The Piedmont has an archaeological sequence that extends back at least 12,000 years before the present.

The Piedmont's cultural history can be divided into five major periods: Paleoindian (10,000 B.C., and perhaps as early as 13,000 B.C., to around 8000 B.C.), Archaic (8000 to 500 B.C.), Woodland (500 B.C. to around A.D. 1000), Mississippian (A.D. 1000 to around 1500), and Historic and Modern (A.D. 1500 to the present).

During the Paleoindian period, the native peoples seemingly were organized into small mobile bands with a hunting- and a fishing-based economy. Animals hunted included megafauna, such as the now extinct mammoth. The environment of the Paleoindian period was significantly different from the present. This was at the end of the last ice age, in which the climate was cooler than at present and glaciers covered much of the northern portion of North America.

The transition between the Paleoindian and Archaic periods was accompanied by substantial environmental change. As glaciers began to melt, sea level began to rise. These changing environmental conditions led to a greater dependance on river systems and the beginnings of the use of domesticated plants. Middle Archaic sites in the Piedmont are numerous and likely reflect small groups of socially noncomplex peoples widely ranging across the landscape (Anderson 1996). Middle and Late Archaic archaeological sites typically exhibit greater evidence of sedentary economies, such as the presence of storage pits, extensive refuse middens, and large quantities of fire-cracked rock. Archaic period habitation sites appear to have been divided into base camps used during the the spring, summer, and winter months, and smaller upland sites used during the fall for deer hunting and nut gathering.

In the Woodland period, Native American cultures reached their modern configurations as noted at the time of initial European contact in the 16th and 17th centuries. The middle of the Woodland period witnessed the establishment of large sedentary base camps in river valleys, with associated smaller resource-gathering sites being established in surrounding areas.

Toward the end of the Woodland period and during the subsequent Mississippian period, Native American villages throughout the Midwest and much of the Southeast apparently were organized into chiefdom-level societies (Bense 1994; Perdue 1985). The use of long-houses, palisades, earth lodges, mounds and other earthen works, and designated burial grounds are hallmarks of the Mississippian period.

The staff assumes that the ancestors of the modern Catawba Indians lived in the region surrounding McGuire and the Catawba River at the time of historic contact with the Europeans (Perdue 1985; Merrell 1989; Lee 1997; De Vorsey 1998). The Catawba are an eastern Siouan-speaking tribe who likely lived in the Carolinas for several hundred years before European contact.

The Historic period in North Carolina began in the early 16th century with the first incursions of European explorers along the Carolina Coast (Bense 1994; Cumming 1998; De Vorsey 1998). Beginning around 1660, a steady stream of Euroamericans began moving from Virginia into the coastal sounds and rivers of North Carolina (Perdue 1985; Lee 1997). In 1670, the Carolina colony was established by the British at Charles Town (modern Charleston). The stream of settlers finally led to a series of conflicts between the tribes and the settlers, with the most serious being the Tuscarora, Yamassee, and Cheraw Wars of 1711-1718. In these wars, the Catawba first assisted the Euroamericans against Tuscarora and then turned on the Euroamericans, particularly in the Yamassee War. Ultimately, the Catawba joined the Cherokee in making peace.

In 1701, the surveyor John Lawson reported that several thousand Catawba Indians were observed living in many different villages (Perdue 1985; Lee 1997). By 1738, smallpox and other diseases had reduced the tribe to around 1000 people people living in six villages in proximity along the Catawba River in the area around the present border between South and North Carolina. A second smallpox epidemic in 1759-1760 further reduced the Catawba population.

By 1750, so many Euroamericans had moved into the Piedmont that Anson County was created, a county which then covered roughly the western half of North Carolina. Mecklenburg County itself was carved out from Anson County and established in 1763. The current county boundaries were set up in 1842. Treaties in 1760 and 1763 set up an approximately 39-km^2 (15-mi^2) reservation for the Catawba tribe at the eastern edge of South Carolina; however, these lands were soon overrun by Euroamerican colonists. In 1768, the town of Charlotte was incorporated at the juncture of two major transportation and trade routes (Rogers and Rogers 1996). John Collet's detailed 1770 map of North Carolina (Cumming 1998, Plates), depicts Charlotte (Charlottesburgh) and the small nearby Catawba Tribal Reservation but depicts no settlements, mills, or transportation corridors in the general vicinity of McGuire.

In early 1779, the British concentrated on consolidating their power in the southern states during the American Revolution. Charles, First Lord Cornwallis, entered Charlotte on September 28, 1780. However, his reception was so contested that Lord Cornwallis retreated from Charlotte to Charleston on October 14, 1780.

In December 1780, Nathanael Greene, the commanding general for the Continental Army in the South, arrived in Charlotte. Greene decided that the Charlotte area did not contain enough provisions to satisfactorily supply his army, so he removed the majority of the Army to the Pee Dee River to the east of Charlotte. Some 1000 men under the command of General Daniel Morgan were sent to northwest South Carolina. The British general, Lord Cornwallis began to pursue Morgan, who was fleeing east to attempt to rejoin with Greene. Greene, riding west from his camp, met Morgan at the Catawba River, and was joined by General William Lee Davidson, the local militia commander for the area.

Because there were no bridges crossing the Catawba River, Davidson and a small force were tasked to slow the advance of the British Army so that Morgan's forces would have time to join up with those of Greene. Just before daybreak the next morning, the British Army led by Cornwallis surprised Davidson's sleeping militia at Cowan's Ford. This was to prove the last bit of local action for the Charlotte area during the American Revolution.

During the period between the American Revolution and the Civil War, the Piedmont became divided into regions devoted to tobacco growing (north and east of Charlotte) and cotton growing (around and to the south of Charlotte). The period of 1789 through 1860 saw the development of plantations (primarily using African slaves for labor), independent farms, and small towns through the Piedmont, in which agriculture dominated local economies. This was facilitated by the invention of the cotton gin in 1793, which allowed short-fiber cotton to be grown virtually anywhere in the region.

The Catawba Indians were active resisters to the forced relocation plans of the Federal government during the 1820s to 1850s, such as President Andrew Jackson's Indian Removal Act of 1830 (Bense 1994). The Catawba attempted to hang onto their old reservation lands ceded in the 18th century, but in 1840 were finally forced to sell most of them to South Carolina. The Catawba then variously lived with the North Carolina Cherokee and the Oklahoma Choctaw and then surreptitiously returned to South Carolina.

The Charlotte area and the Mecklenberg County portion of the Catawba River did not play a major role in the battles and strategy of the Civil War (Barrett 1987). Some Catawba soldiers fought for the Confederacy during the Civil War.

Due to the physical effects of the Civil War and to the abolishment of slavery, the economic basis of the Southeast was fundamentally changed between 1865 and 1917 (Bense 1994). While plantations were typically returned to their former owners, plant operations became dependent on voluntary contracts or tenant farming with their labor force. Over time, plantations became smaller, averaging less than 40 ha (100 ac) by 1920. The expansion of the railroads, the rebuilding of basic infrastructure, and the Industrial Revolution all led to major changes.

The period between World War I and World War II saw the continued growth of small towns and the continuation of the use of small plantations and independent farms. In 1941, the Catawba Tribe first received Federal recognition but petitioned to terminate their status in 1959, with lands being distributed among tribal members (Merrell 1989). After a period of reassessing this decision to divest, the tribal council was reorganized and in 1973 was given state recognition by South Carolina. After a lengthy court process, Federal recognition was reinstated in 1994.

The Modern period since the end of World War II has witnessed the creation of Lake Norman, North Carolina's largest man-made lake, which reached full capacity in 1964. As a consequence, numerous residential developments have blossomed around its margins, a trend that is ongoing. Construction began in the mid-1970s on McGuire Units 1 and 2, and in 1981 and 1984, respectively, the units were put into operation.

2.2.9.2 Historic and Archaeological Resources at the McGuire Site

Historic and archaeological site file searches were conducted at the North Carolina Department of Cultural Resources, Office of Archives and History, to determine what specific historic cultural resources may be present at the McGuire site. In addition, record searches were conducted for nearby locations to gain a perspective on the types of historic resources that may be present in the previously undeveloped and unsurveyed portions of the grounds of the McGuire Nuclear Station.

These record searches revealed that there are no known historic and archaeological resources at McGuire. During the construction of McGuire, a forgotten historic marker commemorating the death of General Davidson at Cowan's Ford was discovered (Duke 2001a). Cowan's Ford and the location of Davidson's death are now inundated. General Davidson's body was interred at the Hopewell Church cemetery about 8 km (5 mi) away. In 1971, Duke incorporated this marker, as well as a new marker provided by the North Carolina Department of Archives and History, into a public area adjacent to McGuire. The markers were dedicated in 1971 and are still maintained by Duke.

An archaeological survey was not conducted at McGuire before construction activities. However, based on the records of nearby sites and properties, it is unlikely that significant Native American resources were present. A number of Native American archaeological sites were identified and recorded in the early 1960s just north of McGuire before the creation of Lake Norman. These sites were poorly defined and described but appear to represent Archaic, Woodland, and Mississippian period occupations. Most consisted of a few scattered stone and ceramic artifacts in areas heavily disturbed by historic agriculture, specifically from the cultivation of cotton. Erosion caused by cotton farming was a major impact in virtually every site, with many of the sites being exposed to bedrock.

No structures or buildings at McGuire are 50 years of age or older. A number of structures and buildings within a 5.0-km (3.1-mi) radius of McGuire have been evaluated for historic significance; however, only three of these have been determined eligible for listing in the National Register of Historic Places (Duke 2001a). These include the Ingleside house, about 3.7 km (2.3 mi) from McGuire, which was built in the 1850s; the Rural Hill Plantation, about 4.6 km (2.8 mi) from McGuire, which has features dating to the late 18th century; and the Holly Bend house, about 4.9 km (3.0 mi) from McGuire, which was built at the end of the 18th century. The Gilead Associated Reformed Presbyterian church and cemetery and the Caldwell-Rosenwald School are currently pending evaluation.

The Catawba Indian Reservation (in three separate parcels) is situated in South Carolina about 48 km (30 mi) south of McGuire.

2.2.10 Related Federal Project Activities and Consultations

The staff reviewed the possibility that activities of other Federal agencies might impact the renewal of the OLs for McGuire. Any such activities could result in cumulative environmental impacts and the possible need for the Federal agency to become a cooperating agency in preparing the SEIS [10 CFR 51.10(b)(2)].

The Federal Power Commission, now the FERC, issued a license (FERC Project No. 2232) to Duke Power Company on September 17, 1958, for the Catawba-Wateree hydroelectric project (FERC 2001a). One component of the project is the Cowan's Ford Dam hydroelectric station. The Cowan's Ford Dam impounds Lake Norman. The license for the Catawba-Wateree project will expire August 31, 2008 (FERC 2001a). Under current FERC rules, Duke Power will need to file a notice of intent with FERC by August 2003 declaring whether or not it intends to seek a new license for the Catawba-Wateree hydroelectric project (18 CFR 16.6). Assuming that Duke Power intends to seek a new license, it will need to file an application for the relicensing of the project at least two years before the license expires. FERC will prepare an environmental

assessment or an EIS under NEPA in conjunction with reviewing the application. FERC's procedures for processing a license application are set out in a handbook (FERC 2001b).

The Federal lands closest to McGuire are within the Kings Mountain National Military Park. The park is located near Blacksburg, South Carolina, and is operated by the National Park Service. The park is approximately 48 km (30 mi) southwest of McGuire.

The Native American land closest to the McGuire site is the Catawba Indian Reservation. The tribe occupies a 260-ha (640-ac) reservation in York County, South Carolina, near the city of Rock Hill. The reservation is approximately 48 km (30 mi) south of McGuire.

Duke's Catawba Nuclear Sation is located approximately 48 km (30 mi) south of McGuire. Duke has requested that the NRC renew the OLs for the Catawba plant also.

After reviewing the Federal activities in the vicinity of McGuire, the staff determined that no Federal project activities could result in cumulative impacts or would make it desirable for another Federal agency to become a cooperating agency for preparing the SEIS.

The NRC is required under Section 102 of NEPA to consult with and obtain the comments of any Federal agency that has jurisdiction by law or special expertise with respect to any environmental impact involved. During the preparation of this draft SEIS, the NRC staff consulted with the FWS. The consultation correspondence is included in Appendix E.

2.3 References

10 CFR 20. Code of Federal Regulations, Title 10, *Energy*, Part 20, "Standards for Protection Against Radiation."

10 CFR 50. Code of Federal Regulations, Title 10, *Energy,* Part 50, "Domestic Licensing of Production and Utilization Facilities."

10 CFR 54. Code of Federal Regulations, Title 10, *Energy,* Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

10 CFR 61. Code of Federal Regulations, Title 10, *Energy,* Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste."

10 CFR 71. Code of Federal Regulations, Title 10, *Energy*, Part 71, "Packaging and Transportation of Radioactive Material."

10 CFR 42. Code of Federal Regulations, Title 10, *Energy*, Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste."

18 CFR 16. Code of Federal Regulations, Title 18, *Conservation of Power and Water Resources*, Part 16, "Procedures Relating to Takeover and Relicensing of Licensed Projects."

40 CFR 81. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 81, "Designation of Areas for Air Quality Planning Purposes."

40 CFR 190. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations."

Anderson, D. G. 1996. "Approaches to Modeling Regional Settlement in the Archaic Period Southeast." In *Archaeology of the Mid-Holocene Southeast*, eds. K. E. Sassaman and D. G. Anderson, pp. 157-176. University Press of Florida, Gainesville.

Barrett, J. G. 1987. *North Carolina as a Civil War Battleground, 1861-1865*. North Carolina Division of Archives and History, Raleigh.

Bense, J. A. 1994. *Archaeology of the Southeastern United States*. Academic Press, New York.

Cole, B. 2001. Letter from U.S. Fish and Wildlife Service State Supervisor, Asheville Field Office, Asheville, North Carolina to Cynthina A. Carpenter, Chief, Risk Informed Initiatives, Environmental Decommissioning and Rulemaking Branch, Division of Nuclear Regulatory Improvement Programs, Office of Nuclear Reactor Regulation, Nuclear Regulatory Commission. Subject: "McGuire Nuclear Station, Units 1 and 2, License Renewal Project, Mecklenburg County, North Carolina (Docket Nos. 50-369 and 50-370)." November 1, 2001.

Cumming, W. P. 1998. *The Southeast in Early Maps*. Third edition. University of North Carolina Press, Chapel Hill, North Carolina.

De Vorsey, L., Jr. 1998. "American Indians and the Early Mapping of the Southeast." In *The Southeast in Early Maps*, third edition, by W. P. Cumming, pp. 65-98. University of North Carolina Press, Chapel Hill, North Carolina.

Duke Energy Corporation (Duke). 2000a. *Duke Energy Company McGuire Nuclear Station Updated Final Safety Analysis Report.* Revision 9, Oct. 14, 2000. Charlotte, North Carolina.

Duke Energy Corporation (Duke). 2000b. *McGuire Nuclear Station Annual Radioactive Effluent Release Report (January 1, 1999 Through December 31, 1999)*. Charlotte, North Carolina.

Duke Energy Corporation (Duke). 2001a. *Applicant's Environmental Report—Operating License Renewal Stage—McGuire Nuclear Station*. Charlotte, North Carolina.

Duke Energy Corporation (Duke). 2001b. *Application to Renew the Operating Licenses of McGuire Nuclear Station, Units 1 and 2 and Catawba Nuclear Station, Units 1 and 2*. Charlotte, North Carolina.

Duke Energy Corporation (Duke). 2001c. *McGuire Nuclear Station Annual Radioactive Effluent Release Report (January 1, 2000 Through December 31, 2000)*. Charlotte, North Carolina.

Duke Energy Corporation (Duke). 2001d. *McGuire Nuclear Station Units 1 and 2—Annual Radiological Environmental Operating Report—2000*. Charlotte, North Carolina.

Duke Energy Corporation (Duke). 2001e. *McGuire Nuclear Station Units 1 and 2 Offsite Dose Calculation Manual (ODCM).* Revision 42, January 2001. Charlotte, North Carolina.

Duke Power Company. 1985. McGuire Nuclear Station 316(a) Demonstration. Charlotte, North Carolina.

Elliott, D. L., C. G. Holladay, W. R. Barchet, H. P. Foote, and W. F. Sandusky. 1986. *Wind Energy Resource Atlas of the United States*. DOE/CH 10093-4, U.S. Department of Energy, Washington, D.C. <http://rredc.nrel.gov/wind/pubs/atlas/titlepg.html> (accessed March 26, 2002).

Federal Water Pollution Control Act (FWPCA). 33 USC 1251, et seq.

Fridell, J. A. 2001. *Carolina heelsplitter in North Carolina*. U.S. Fish and Wildlife Service, Asheville, North Carolina. <http://nc-es.fws.gov/mussel/carolheel.html> (accessed September 12, 2001).

Gaddy, L. L. 2001. *Biological Assessment for Endangered, Threatened, and Noteworthy Species, Wetlands, and Significant Natural Areas in Association with McGuire Nuclear Station and Related Power Transmission Lines*. Prepared for Duke Power Company, Charlotte, North Carolina, March 2001.

Hall, J. J. and T. J. Wilda. 2000. *Corbicula* Populations and Their Biofouling Potential in the McGuire Nuclear Station Intake Structures in 1999. Duke Power Company internal report, Charlotte, North Carolina.

Hall, J. J. and T. J. Wilda. 2001. *Corbicula* Populations and Their Biofouling Potential in the McGuire Nuclear Station Intake Structures in 2000. Duke Power Company internal report, Charlotte, North Carolina.

Lee, E. L. 1997. *Indian Wars in North Carolina*. North Carolina Division of Archives and History, Raleigh, North Carolina.

Mecklenburg County Department of Environmental Protection (MCDEP). 2000. *State of the Environment 2000*. Charlotte, North Carolina. <http://www.co.mecklenburg.mn.us/cenv/SOER/SOER.htm> (accessed October 3, 2001).

Mecklenburg – Union Metropolitan Planning Organization (MUMPO). 1999. Charlotte, North Carolina.

Menhinick, E. F. 1991. *The Freshwater Fishes of North Carolina*. Delmar Co., Charlotte, North Carolina.

Merrell, J. H. 1989. *The Indians' New World: Catawbas and Their Neighbors from European Contact Through the Era of Removal.* W. W. Norton & Company, Inc., New York.

National Climatic Data Center. (NCDC) 2001. "Local Climatological Data Annual Summary With Comparative Data, Charlotte, North Carolina." Asheville, North Carolina.

National Environmental Policy Act of 1969 (NEPA). 42 USC 4321, et seq.

North Carolina Department of Environment and Natural Resources (NCDENR). 1999. *Catawba River Basinwide Water Quality Plan*. Division of Water Quality, Water Quality Section, Raleigh, North Carolina.

Perdue, T. 1985. *Native Carolinians: The Indians of North Carolina*. North Carolina Division of Archives and History, Raleigh, North Carolina.

Ramsdell, J. V., and G. L. Andrews. 1986. Tornado Climatography of the Contiguous United States. NUREG/CR-4461, U.S. Nuclear Regulatory Commission, Washington, D.C.

Rogers, J. R., and A. T. Rogers. 1996. *Charlotte and Its Historic Neighborhoods*. Arcadia Publishing, Charleston, South Carolina.

Town of Huntersville. 2001. "The Zoning Ordinance of the Town of Huntersville." <http://www.huntersville.org/planning/ordinances.htm> (accessed February 15, 2002).

U.S. Department of Energy (DOE). 2001. "U.S. Wind Energy Resource Map." <http://www.eren.doe.gov/wind/we_map.html> (accessed March 27, 2001)

U.S. Department of Labor (DOL). 2001. "State and Regional Unemployment. 2000 Annual Averages." <ftp://ftp.bls.gov/pub/news.release/srgune.txt> (accessed February 27, 2001).

U.S. Environmental Protection Agency (EPA). 2002. "Proposed Carolina Heelsplitter Critical Habitat". <http://www.epa.gov/fedrgstr/EPA-SPECIES/2001/July/Day-11/e16867.htm> (accessed March 20, 2002).

U.S. Federal Energy Regulatory Commission (FERC). 2001a. *Hydroelectric Projects Under Commission License*. <http://www.ferc.gov/hydro/docs/projlic.pdf> (accessed February 18, 2002).

U.S. Federal Energy Regulatory Commission (FERC). 2001b. *Hydroelectric Project Licensing Handbook*. <http://www.ferc.gov/hydro/docs/licensing_handbook.pdf> (accessed February 18, 2002).

U.S. Nuclear Regulatory Commission (NRC). 1976. "*Final Environmental Statement Related to Operation of William B. McGuire Nuclear Station, Units 1 and 2, Duke Power Company*." Docket Nos. 50-369 and 50-370, NUREG-0063, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1991. "Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Pressurized Water Reactors." NUREG-1301, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. NUREG-1437, Volumes 1 and 2, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1999a. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Supplement 2, Oconee Nuclear Station*. NUREG-1437, Supp. 2, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1999b. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report*, "Section 6.3 – Transportation,

Table 9.1 Summary of findings on NEPA issues for license renewal of nuclear power plants, Final Report." NUREG-1437, Volume 1, Addendum 1, Washington, D.C.

Ward, H. T. 1983. "A Review of Archaeology in the North Carolina Piedmont: A Study of Change." In *The Prehistory of North Carolina: An Archaeological Symposium*, eds. M. A. Mathis and J. J. Crow, pp. 53-81. North Carolina Division of Archives and History, Raleigh, North Carolina.

Water Resources Development Act of 1999. Pub. L. 106-53, August 17, 1999, 113 Stat. 269.