4. AFFECTED ENVIRONMENT

Chapter 4 describes the affected environment associated with the production of tritium in commercial light water reactors. The chapter begins with a brief introduction, followed by descriptions of the affected environment at each of the alternative reactor sites being considered for tritium production.

4.1 INTRODUCTION

In accordance with Council on Environmental Quality regulations, the affected environment is "interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment," (40 CFR 1508.14).

The descriptions of the affected environment provide bases for understanding the direct, indirect, and cumulative effects of the alternatives. The localities and characteristics of each potentially affected environmental resource are described for each site. The scope of the discussions varies with each resource to ensure that all relevant issues are included. The level of detail in the description of each resource also varies with the expectation of a potential impact to the resource. Resources expected to be impacted by the proposed action are discussed in more detail than those resources that are not likely to be affected. For instance, the descriptions of land resources, geology and soils, and archaeological and historic resources that are not expected to be impacted because of limited, if any, construction activities are less detailed. On the other hand, ambient conditions are described in greater detail for air and water resources that could be affected by the plant's intake and discharges at each site. This information serves as a basis for analyzing key air and water quality parameters to obtain results that can be compared with regulatory standards.

Socioeconomic conditions are described for the counties and communities that could be affected by regional population changes associated with the proposed program. The affected environment discussions include projections of regional growth and related socioeconomic indicators. Each region is large enough to encompass any growth related to direct project employment, as well as any secondary jobs that may be created by the program. As for other environmental resources, the level of detail is commensurate with the expected socioeconomic impacts from the proposed action. For the currently operating units, only the socioeconomic impacts associated with incremental, tritium-related changes to the plants are considered. This environmental impact statement (EIS) provides less detail concerning current conditions for the operating units, Watts Bar Nuclear Plant Unit 1 (Watts Bar 1) and Sequoyah Nuclear Plant Units 1 and 2 (Sequoyah 1 and 2). However, more detail is provided for the partially constructed Bellefonte Nuclear Plant Units 1 and 2 (Bellefonte 1 and 2).

In addition to the natural and human environmental resources discussed above, the affected environment sections include a number of issues related to the ongoing activities at each site. These issues involve effluents from facility operations; waste and spent nuclear fuel management; and radiological and hazardous impacts during normal operation and from potential accidents.

4.2 AFFECTED ENVIRONMENT

4.2.1 Watts Bar Nuclear Plant Unit 1

As discussed in Section 3.2.5, one of the reactor options under consideration is the irradiation of tritium-producing burnable absorber rods (TPBARs) at Watts Bar 1. This option is based on the assumption that Watts Bar 1 would operate at its licensed full power output for the generation of electricity, with no reduced operability attributable to the production of tritium. The tritium production activity would be considered a secondary mission of the unit.

Preliminary construction of Watts Bar 1 started in spring 1973 (TVA 1995a). The major construction elements were largely completed by 1985. From 1985 to 1992, Watts Bar 1 underwent extensive reviews and modifications. Construction work was put on hold in December 1990. Work was resumed in November 1991 and, after extensive site review, the U.S. Nuclear Regulatory Commission (NRC) gave the site permission to resume full construction activities in May 1992. Watts Bar 1 was granted a full power operating license on February 7, 1996, and began commercial operation in May 1996. In October 1997, four lead test assemblies (fuel assemblies containing TPBARs) were inserted in the Watts Bar 1 reactor core in a demonstration to provide confidence to regulators and confirm that tritium production in a commercial light water reactor (CLWR) is both technically reasonable and safe. The status of this demonstration is described in Section 1.5.1.2.

Watts Bar 1 is described briefly in Section 3.2.5.1. Detailed descriptions of the site, buildings, structures, systems, and operations are provided in the licensing and environmental documents for the plant, which are listed below.

- TVA (Tennessee Valley Authority), *Watts Bar Nuclear Plant, Final Safety Analysis Report, through Amendment 91*, (TVA 1995c).

- NRC (U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Regulation), *Final Environmental Statement Related to the Operation of Watts Bar Nuclear Plant, Units 1 and 2, Tennessee Valley Authority* (NRC 1995b).

- NRC (U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation), *Final Environmental Statement Related to Operation of Watts Bar Nuclear Plant Unit Nos. 1 and 2, Tennessee Valley Authority* (NRC 1978).

The regional and local climatology and meteorology of the Watts Bar 1 site was described in the *Final Environmental Statement Related to Operation of Watts Bar Nuclear Plant Units 1 and 2* (NRC 1978) and was re-evaluated in 1995 (NRC 1995b) with consideration of additional data accumulated in the intervening years. It was determined that the records used for the 1978 Final Environmental Statement provide an adequate representation of regional climatic conditions. This information was updated with the inclusion of more recent climatological and meteorological data for Chattanooga, Tennessee.

The following sections describe the affected environment at the Watts Bar 1 site for land resources, air quality, noise, water resources, geology and soils, ecology, cultural resources, and socioeconomics. In addition, the radiation and hazardous chemical environment, the waste management conditions, and the spent nuclear fuel considerations at Watts Bar 1 are described.

4.2.1.1 Land Resources

Land Use

Watts Bar 1 is on the Watts Bar Reservation in Rhea County, Tennessee, approximately 80 kilometers (50 miles) northeast of Chattanooga, Tennessee, and 50 kilometers (31 miles) north-northeast of the Sequoyah Nuclear Plant site (TVA 1995c). The location of the site is shown in **Figure 4–1**. The Watts Bar Reservation on which Watts Bar 1 is located is a 716-hectare (1,770-acre) area on the west bank of the Chickamauga Reservoir. Watts Bar 1 is on the Tennessee River at River Mile 528 (River Mile refers to the distance along the Tennessee River measured from its mouth). The site layout is shown in **Figure 4–2.** The Watts Bar Nuclear Plant site already is dedicated to power generation.

The region of influence for land use includes lands within 3.2 kilometers (2 miles) of the Watts Bar Reservation. Land uses in the vicinity of Watts Bar 1 are classified as industrial, agricultural, forest, and recreational. The reservation that encloses the Watts Bar 1 site is maintained by TVA for the U.S. Government. In addition to Watts Bar 1, the reservation contains the Watts Bar Steam Plant, which has not operated since 1983 and has been deleted from the air emission permit for the area; the Watts Bar Dam and Hydroelectric Plant; the TVA Central Maintenance Facility; and the Watts Bar Resort Area (TVA 1995c).

Industry

The only significant industrial facility in the vicinity of Watts Bar, although it is not operating at the present time, is the Watts Bar Steam Plant, a 240-megawatt coal-fired power plant that was shut down and placed in standby mode by TVA in 1983.

Agriculture

The total area of Rhea County and nearby Meigs County is approximately 1,290 square kilometers (498 square miles), of which about 34 percent, or 440 square kilometers (170 square miles), is unforested and used for agriculture (GISP 1998a, GISP 1998c).

Forest

Forests in the two-county area amount to 84,800 hectares (209,500 acres). They tend to be scattered along narrow ridges. Approximately 14 percent of forested land consists of loblolly-shortleaf pine. Hardwood forests of the oak-hickory type cover 62 percent of the forested land. The remainder supports mixtures of oak and pine (DOA 1998a, DOA 1998d).

Recreation

The Watts Bar Reservation and the adjacent Watts Bar Resort are major recreation attractions in the immediate vicinity of the plant. In general, the Watts Bar and Chickamauga Reservoirs attract a high level of water-based recreation. The peak usage time is April 15 through October 15 (TVA 1971). Demand for recreation results in a large influx of daytime and overnight users.

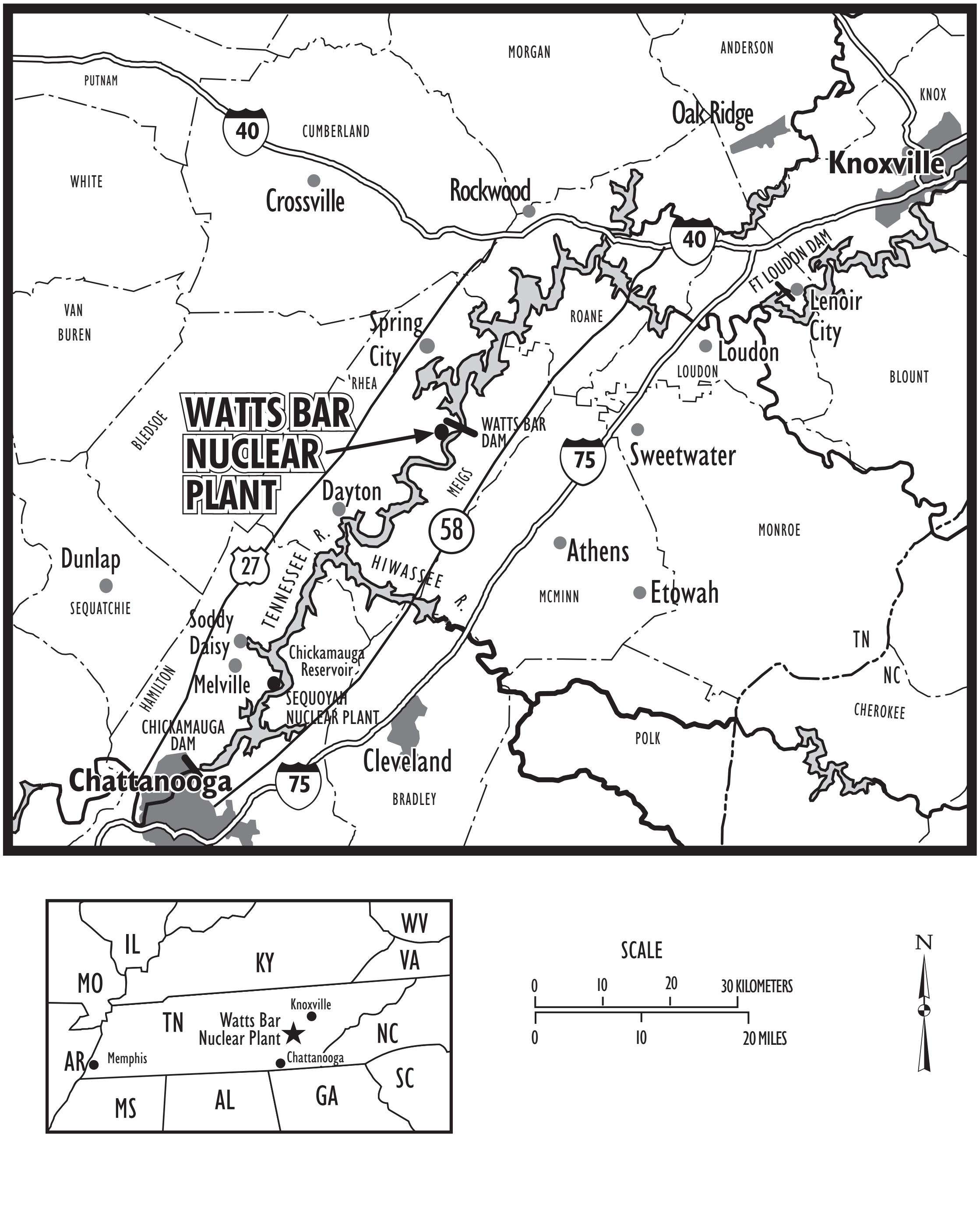

Figure 4–1 Location of the Watts Bar Nuclear Plant Site

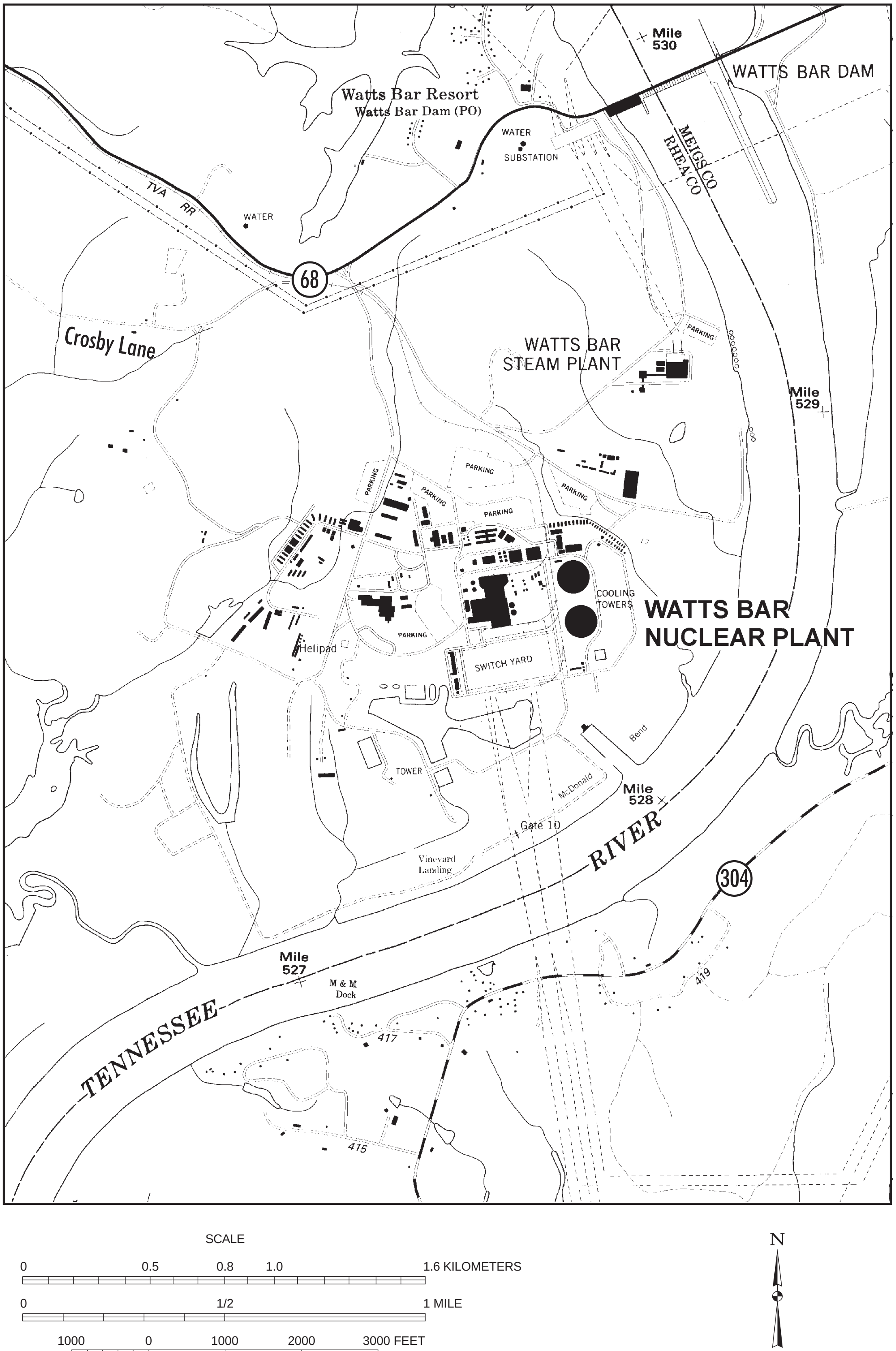

Figure 4–2 Watts Bar Nuclear Plant Site

Nature Reserves

The Hiwassee Waterfowl Refuge, Ocoee Wildlife Management Area, and the Yellow Creek Wildlife Management Area are located within 64 kilometers (40 miles) of the Watts Bar Reservation. There are three state forests and one national forest within 48 kilometers (30 miles) of the site: Falls Creek Falls State Park and Forest, Bledsoe State Forest, Mount Roosevelt State Forest, and Cherokee National Forest.

Visual Resources

The region of influence for visual resources includes those lands from which the site is visible. The major visual elements of the plant already exist, including the cooling towers, containment structures, turbine building, and transmission lines. Views of Watts Bar 1 from passing river traffic on the Tennessee River are partially screened by the wooded area east of the plant. Distant glimpses of the plant site can be seen from the coves and hollows along the river, as well as from various area roads such as State Route 68 (TVA 1995c).

Based on the Bureau of Land Management Visual Resource Management method, the existing landscape at the site would be classified as Class 3 or 4. Class 3 includes areas where there has been a moderate change in the landscape and these changes may attract attention, but do not dominate the view of the casual observer. Class 4 includes areas where major modifications to the character of the landscape have occurred. These changes may be both dominant features of the view and the major focus of viewer attention (DOI 1986a).

During operation of Watts Bar 1, the vapor plume associated with the cooling towers can be visible up to 16 kilometers (10 miles) away. The plume length and frequency of occurrence varies with atmospheric conditions, being most visible during cooler months and after the passage of weather fronts. Plumes would be less visible during the summer months, when hazy conditions persist and morning fog is more common. Vapor plumes are visible at times from nearby residential areas, State Route 68, and other nearby roads (TVA 1972).

4.2.1.2 Noise

The most common measure of environmental noise impact is the day-night average sound level. The day-night average sound level is a 24-hour sound level with a 10-decibels A-weighted (dBA) penalty added to sound levels between 10:00 p.m. and 7:00 a.m. to account for increased annoyance due to noise during nighttime hours. The U.S. Environmental Protection Agency (EPA) has developed noise level guidelines for different land-use classifications based on day-night average and equivalent sound levels. The U.S. Department of Housing and Urban Development has established noise impact guidelines for residential areas based on day-night average sound levels. Some states and localities have established noise control regulations or zoning ordinances that specify acceptable noise levels by land-use category. The State of Tennessee has not developed a noise regulation that specifies the numerical community noise levels that are acceptable.

For the purpose of this document, a day-night average sound level of 65 dBA is the level below which noise levels would be considered acceptable for residential land and outdoor recreational uses. Estimated sound levels at the three residences nearest the site boundary at distances between 900 meters (3,000 feet) and 1,800 meters (6,000 feet) from the transformers and cooling towers, including the noise from the plant and background noise, are between day-night average sound levels of 53 and 63 dBA. Intermittent sound levels at these locations range from 84 to 103 dBA as a result of operating air-blast circuit breakers and steam venting (NRC 1995b). Generally the noise levels at these residences are below a day-night average sound level of 65 dBA and are considered acceptable. Watts Bar 1 is a licensed, operating nuclear power reactor. Testing of the emergency warning siren system occurs on a regular basis and results in outdoor noise levels of about 60 dBA in areas within a radius of about 16 kilometers (10 miles) of the site. TVA typically tests siren systems on a given day of the month at noon.

4.2.1.3 Air Quality

Watts Bar 1 is located in the Eastern Tennessee/Southwestern Virginia Interstate Air Quality Control Region. Baseline air quality data for the Watts Bar Nuclear Plant has been collected since 1969, prior to the start of construction of Watts Bar 1. Ambient concentrations of criteria pollutants, determined by measuring air quality in the vicinity of Watts Bar 1, are shown in **Table 4–1** with the applicable National Ambient Air Quality Standards and Tennessee State Ambient Air Quality Standards.

Table 4–1 Comparison of Baseline Watts Bar 1 Ambient Air Concentrations with Most Stringent Applicable Regulations and Guidelines

Criteria Pollutant	*Averaging Time*	*Most Stringent Regulation or Guideline[a] ($\mu g/m^3$)*	*Baseline Concentration ($\mu g/m^3$)[b]*
Carbon monoxide	8-hour 1-hour	10,000[c] 40,000[c]	1,250 1,250
Lead	Calendar quarter	1.5 [c]	0.03
Nitrogen dioxide	Annual	100 [c]	26.3
Ozone	8-hour (4th highest, averaged over 3 years)	157 [c,d]	e
Particulate matter[d]	PM_{10} Annual 24-hour (interim) 24-hour 99th percentile (3-year average) $PM_{2.5}$ Annual (3-year average) 24-hour (98th percentile average over 3-years)	 50 [c] 150 [c] 150 [c] 15[c] 65[c]	 20.3 39 e f f
Sulfur dioxide	Annual 24-hour 3-hour	80 [c] 365 [c] 1,300 [c]	10.5 65.5 204
Other Regulated Pollutants			
Gaseous fluoride (as hydrogen fluoride)	30-day 7-day 24-hour 12-hour	1.2[g] 1.6[g] 2.9[g] 3.7[g]	h h h h
Total suspended particulates	24-hour	150 [g]	39 [I]

$\mu g/m^3$ = micrograms per cubic meter.
PM_n = particulate matter sized less than or equal to *n* micrometers.

[a] The more stringent of Federal and state standards are presented if both exist for the averaging time. Tennessee State and National Ambient Air Quality Standards are the same for the criteria pollutants. The National Ambient Air Quality Standards (40 CFR 50), other than those for ozone, particulate matter, lead, and those based on annual averages, are not to be exceeded more than once per year. The 1-hour ozone standard is attained when the expected number of days per year with maximum hourly average concentrations above the standard is ≤ 1. The 1-hour ozone standard applies only to nonattainment areas. The 8-hour ozone standard is attained when the 3-year average of the annual fourth-highest daily maximum 8-hour average concentration is less than or equal to 157 $\mu g/m^3$. The interim 24-hour PM_{10} (particulate matter sized less than or equal to 10 micrometers) standard is attained when the expected number of days with a 24-hour average concentration above the standard is ≤ 1. The annual arithmetic mean particulate matter standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard.

[b] Based on ambient air quality monitoring data at a Loudon County location for 1996 and 1997, except for lead that is from the Rockwood monitor in Roane County (1996) and PM_{10} from Bradley County (1994 and 1995). Concentrations shown are maximums for the averaging period.

[c] Federal standard.

[d] EPA recently revised the ambient air quality standards for particulate matter and ozone. The new standards, finalized on July 18, 1997, change the ozone primary and secondary standards from a 1-hour concentration of 235 µg/m³ (0.12 parts per million) to an 8-hour concentration of 157 µg/m³ (0.08 parts per million). During a transition period while states are developing state implementation plan revisions for attaining and maintaining these standards, the 1-hour ozone standard would continue to apply in nonattainment areas (62 FR pages 38855-38894). For particulate matter, the current PM_{10} annual standard is retained and two $PM_{2.5}$ (particulate matter size less than or equal to 2.5 micrometers) standards are added. These standards are set at 15 µg/m³ for the 3-year annual average arithmetic mean based on community-oriented monitors, and 65 µg/cubic meters for the 3-year average of the 98th percentile of 24-hour concentrations at population-oriented monitors. The current 24-hour PM_{10} standard is revised to be based on the 3-year average of the 99th percentile of 24-hour concentrations. The existing PM_{10} standards would continue to apply in the interim period (62 FR 38652).

[e] There is insufficient data to compare to the standard.

[f] Compliance with the new $PM_{2.5}$ standards was not evaluated since current emissions data for $PM_{2.5}$ are not available.

[g] State standard.

[h] No local monitoring data is available for gaseous fluoride.

[I] PM_{10} value is presented and would underestimate the total suspended particulates concentration. No monitoring data is available for total suspended particulates.

Source: 62 FR pages 38855-38894, 62 FR 38652, TN DEC 1994, TVA 1998a.

The area in which Watts Bar 1 is located is designated by the EPA as an attainment area with respect to the National Ambient Air Quality Standards for criteria pollutants (40 CFR 81). For locations that are in an attainment area for criteria pollutants, prevention of significant deterioration regulations limit pollutant emissions from new sources and establish allowable increments of pollutant concentrations. Class I areas include national wilderness areas, memorial parks larger than 2,020 hectares (5,000 acres), national parks larger than 2,340 hectares (6,000 acres), and any areas redesignated as Class I. The Class I areas closest to Watts Bar 1 are the Joyce Kilmer–Slickrock National Wilderness Area and the Great Smoky Mountains National Park. These Class I areas are located approximately 80 kilometers (50 miles) from Watts Bar 1 (TVA 1998e).

Sources of criteria nonradiological air pollutant emissions at Watts Bar 1 include five diesel-powered emergency generators; two diesel generators for security power and fire protection pumps; site and employee vehicles; two auxiliary boilers; two natural-draft cooling towers; a lube oil system; two fixed-roof, No. 2 fuel oil storage tanks; a paint shop; and a sandblast shop. Small quantities of toxic chemicals and metals are emitted from testing and operation of the diesel fuel-fired equipment, resulting in contributions to offsite concentrations of less than 0.0001 percent of the threshold limit value of any of these pollutants. One-tenth of the threshold limit value often is used as a guideline in identifying pollutants that may be of concern and should be evaluated in more detail. Ozone is produced by corona discharge (ionization of air) in the operation of transmission lines and substations, particularly at the higher voltages, and by operation of electrical equipment such as motors and generators. TVA minimizes corona discharges by optimizing, to the extent practicable, the design and construction of its transmission facilities (TVA 1997c).

The calculated concentrations of carbon monoxide, nitrogen dioxide, particulate matter, and sulfur dioxide resulting from operation of the auxiliary steam boilers are two or more orders of magnitude below the ambient standards shown in Table 4–1 (NRC 1995b). Compliance with the new $PM_{2.5}$ standards was not evaluated since current emissions data for $PM_{2.5}$ are not available. When the calculated concentrations from onsite sources are combined with concentrations from offsite sources, the ambient air quality standards for carbon monoxide, nitrogen oxide compounds, particulate matter, and sulfur dioxide continue to be met.

The occurrence of visible plumes has been evaluated for Watts Bar 1. Naturally occurring fog with visibility equal to or less than 0.4 kilometers (0.25 miles) occurs in the vicinity of Watts Bar 1 for about 35 days per year (TVA 1995c). Occurrences of the plume descending to the ground or causing localized surface fogging are expected to be rare. Some localized fog may occur on rare occasions on top of Walden Ridge, about 13 kilometers (8 miles) to the west-northwest (TVA 1995c).

Gaseous Radioactive Emissions

Watts Bar 1 has three primary sources of gaseous radioactive emissions:

- Discharges from the gaseous waste management system
- Discharges associated with the exhaust of noncondensable gases in the main condenser in the case of a primary to secondary leak exists
- Radioactive gaseous discharges from the building ventilation exhaust, including discharges from the reactor building, reactor auxiliary building, and fuel-handling building

The gaseous waste management system collects fission product gases (mainly noble gases) that accumulate in the primary coolant. A portion of the primary coolant continually is diverted to the primary coolant purification, volume, and chemical control system to remove contaminants and adjust the chemistry and volume. Noncondensable gases are stripped and sent to the gaseous waste management system, a series of gas storage tanks where the extended holdup time allows short half-life radioactive gases to decay, leaving only a small quantity of long half-life radionuclides to be released to the atmosphere. The annual gaseous radioactive emissions from Watts Bar 1 normal operation are shown in **Table 4–2**.

Table 4–2 Annual Radioactive Gaseous Emissions at Watts Bar 1

Emission	*Quantity*
Fission gases (Curies)	283
Tritium (Curies)	5.6

Source: TVA 1998e.

Meteorology and Climatology

The regional and local climatology and meteorology of the Watts Bar site, described in the *Final Environmental Statement Related to Operation of Watts Bar Nuclear Plant Units 1 and 2* (NRC 1978), was re-evaluated in 1995 (NRC 1995b) with consideration of additional data accumulated in the intervening years. It was determined that the records used for the 1978 Final Environmental Statement provide an adequate representation of regional climatic conditions. This information has been updated with more recent data for Chattanooga, Tennessee.

Regional Climate

The Great Tennessee Valley, located between the Cumberland Plateau to the west and the Appalachian Mountains to the east, is an area of complex local terrain. This results in localized variations in temperatures and winds.

As a whole, the area experiences a moderate climate with cool winters averaging 1° to 2°C (2° to 4°F) warmer than plateau areas to the west. In the winter, severe weather is rare. Snowfall is variable from year to year, ranging from none to heavy. Appreciable accumulations seldom last more than a few days. Occasional ice storms may be severe enough to cause some damage.

The summer temperature rises to as high as 35°C (95°F). Thunderstorms frequently reduce afternoon temperatures by 6° to 8°C (10° to 15°F). The annual average temperature determined from data recorded from 1961 to 1990 at the Chattanooga Airport is 15.2°C (59.3°F); the average daily minimum temperature in January is -2.2°C (28°F), and the average daily maximum temperature in July is 31.7°C (89.0°F) (NOAA 1997a).

Precipitation is fairly uniform throughout the year. The average annual precipitation is approximately 133.5 centimeters (52.57 inches). Severe thunderstorms may result in hail and damaging winds. Prevailing winds are from the south-southwest. The average annual wind speed is 1.82 meters per second (4.07 miles per hour) (TVA 1995c).

Severe Weather

The current estimate of tornado strike probability at the Watts Bar site is 0.00018 per year (18 chances in 100,000 in a given year) with a recurrence interval of 5,400 years (NRC 1995b). The maximum sustained windspeed reported in Chattanooga was 132 kilometers per hour (82 miles per hour).

Thunderstorms occur on approximately 50 days per year. Freezing precipitation occurs, on the average, every other year. Air stagnation within the site area is expected to occur for about 6 days annually (TVA 1995c, TVA 1998e).

Local Meteorological Conditions

Winds tend to be light. The direction of flow is up and down the Tennessee River Valley. Nighttime stable atmospheric conditions with light winds are driven by local conditions. Neutral atmospheric stability conditions are prevalent during the transition between day and night. The frequencies of calm winds during extremely unstable atmospheric conditions (stability classes A and B) are lower than expected. Although unusual, this shift in stability class is not significant because it occurs infrequently and under conditions associated with relatively good dispersion.

4.2.1.4 Water Resources

Surface Water

The Watts Bar Reservation is located at Tennessee River Mile 528 at the northern end of the Chickamauga Reservoir (TVA 1998e). Chickamauga Reservoir is TVA's sixth largest reservoir. The reservoir is 95 kilometers (59 miles) long on the Tennessee River and 51 kilometers (32 miles) long on the Hiwassee River, covering an area of 14,300 hectares (35,350 acres) with a volume of 775 million cubic meters (628,000 acre-feet). At the Watts Bar 1 site, the reservoir is about 335 meters (1,100 feet) wide, with cross-sectional depths ranging between 5.5 meters (18 feet) and 7.9 meters (26 feet).

The Tennessee River above Chattanooga is one of the most highly regulated rivers in the United States. The TVA reservoir system is operated for flood control, navigation, and power generation, with flood control a prime purpose. Particular emphasis is placed on protection of Chattanooga, 66 kilometers (41 miles) downstream from the Watts Bar Nuclear Plant.

During the steam cycle, heat from the Watts Bar 1 turbine is released when the steam passes through a condenser cooled with recirculated water from the Tennessee River. This water is cooled by passing it through a natural-draft evaporative cooling tower. Although the system is designated as a closed type, makeup water from the Tennessee River is needed to replace water losses from evaporation, drift, and blowdown.

At full power, the temperature of the water flowing through the condenser is raised by approximately 20°C (36°F). About 156,000 liters per minute (41,300 gallons per minute) of water are withdrawn from the

Tennessee River to make up for water lost in the cooling system. Blowdown from the natural-draft cooling tower is discharged into the river at a normal rate of 106,593 liters per minute (28,160 gallons per minute). "Blowdown" is a maintenance process to remove excess dissolved solids left after the water evaporates.

On the Watts Bar 1 site, two temporary chemical holding ponds are available for use to retain and treat chemicals from the turbine building. The smaller pond is lined and holds 3,800 cubic meters (1 million gallons). The larger, unlined pond has a volume of 19,000 cubic meters (5 million gallons). The ponds discharge via outfall pipe 103 to the large outdoor holding pond. This discharge is monitored in accordance with the plant's State of Tennessee 1993 National Pollutant Discharge Elimination System (NPDES) Permit (TN DEC 1993a).

Blowdown from the natural-draft cooling towers is routed to a multiport diffuser system (outfall pipe 101) in the main channel of the Tennessee River at River Mile 527.9 in accordance with the NPDES Permit. Makeup water and other water supply requirements are taken from an intake channel and pumping station at Tennessee River Mile 528. When there is low flow from the Watts Bar Dam, cooling tower blowdown is routed to a holding pond. The maximum intake pumping flow rate is approximately 4.5 cubic meters per second (160 cubic feet per second) (TVA 1997b). At this flow, the diffuser exit jet velocity would be 2 meters per second (6.6 feet per second). The discharge temperature varies depending on the cooling tower performance, which is a function of the ambient air temperature, from 5°C (41°F) in January to 33°C (91°F) in July. With a 35°C (95°F) maximum blowdown temperature, the average monthly temperature difference between the discharge and the river temperature varies from -5.8°C (-10.5°F) in winter and spring to 22.3°C (40.2°F) during summer and fall (TVA 1998e).

TVA has completed an environmental assessment of a proposed modification to Watts Bar 1 called the supplemental condenser cooling water project (TVA 1997g). As previously discussed, the Watts Bar 1 condenser circulating cooling water system uses a natural-draft cooling tower to reject waste heat from the steam cycle. The cooling capability of the tower is significantly affected by site meteorological conditions. As the ambient temperatures become higher, the tower-cooled water temperature also increases. The warmer water from the tower results in a decrease in the net megawatt-electric power output of Watts Bar 1 due to an increase in the condenser backpressure above the optimum design value. If the temperature of the water to the main condenser could be reduced, the efficiency and output of Watts Bar 1 could be improved. Therefore, TVA investigated the feasibility of supplementing cooling tower thermal performance by routing cooler water from upstream of the Watts Bar Dam to mix with and lower the temperature of the water from the tower.

The proposed project would provide between 435,313 and 511,020 liters per minute (115,000 and 135,000 gallons per minute) of water from the Watts Bar Reservoir to Watts Bar 1, depending on the pool elevation, to supplement the cooling capacity of the existing cooling tower. The proposed project would use some of the existing structures and components at the nonoperational Watts Bar Steam Plant to take advantage of the gravity flow and eliminate the need for new pumps. This project would use the existing intake structure at the Watts Bar Dam and most of the existing large-diameter pipe from the dam to the Watts Bar Steam Plant to supply supplemental cooling water to Watts Bar 1. New pipe between the Watts Bar Steam Plant and the Watts Bar 1 cooling towers would be installed. The discharge structure at the Watts Bar Steam Plant would be integrated into the project.

The environmental assessment of this proposed supplemental condenser cooling water project for Watts Bar 1 concluded that the construction and operation of this system would have no significant adverse environmental impacts with the appropriate implementation of the commitments delineated in the environmental assessment. Special emphasis was placed on the thermal discharge limits, and relevant analyses were performed to demonstrate no significant thermal impacts. TVA has completed most of the work on this project, and the supplemental condenser cooling water system is expected to be in service in April 1999.

Surface Water Quality

The Tennessee Department of Environment and Conservation classifies the streams and creeks of Tennessee based on water quality, stream uses, and resident aquatic biota. Classifications are defined in the State of Tennessee's water quality standards. Monitoring data are presented in **Table 4–3**. Surface water quality measurements made during the period of operation of Watts Bar 1, when compared with preoperational monitoring values, show that Watts Bar 1 operations have no significant effect on surface water quality (TVA 1997b).

Table 4–3 Summary of Surface Water Quality Monitoring in the Vicinity of the Watts Bar Site

Parameter	*Unit of Measure*	*Water Quality Criteria*	*Average Water Body Concentration*
Radiological			
Alpha (gross)	picocuries per liter	15[a]	0.433
Beta (gross)	picocuries per liter	50[b]	3.75
Tritium	picocuries per liter	20,000[a]	less than 300[c]
Nonradiological			
Manganese	milligrams per liter	0.05[d]	0.060
Nitrate (as N)	milligrams per liter	10.0[a]	0.253
Arsenic	milligrams per liter	0.05[e]	0.001
Barium	milligrams per liter	2.0[e]	0.142
Cadmium	milligrams per liter	0.005[e]	0.00014
Chromium	milligrams per liter	0.1[e]	0.0012
Lead	milligrams per liter	0.005[e]	0.0046
Mercury	milligrams per liter	0.002[e]	0.00021
pH (acidity/alkalinity)	pH units	6.0 - 9.0[e]	7.8

a National Primary Drinking Water Regulations (40 CFR 141).
b Proposed National Primary Drinking Water Regulation.
c Below lower limit of detection of 300 picocuries per liter.
d National Secondary Drinking Water Regulations (40 CFR 143).
e Tennessee General Water Quality Criteria for Domestic Water Supply (TN DEC 1995).
Source: TVA 1998e, TVA 1998b, TN DEC 1998a, TVA 1997b.

Surface Water Use and Rights

There are 20 surface water users within 80 kilometers (50 miles) downstream of the Watts Bar 1 site; 6 are water utility districts and 14 are industrial users. The continued operation of the plant is not expected to affect surface water use.

The Watts Bar 1 site can use a maximum of approximately 389,000 cubic meters (103 million gallons) of process water per day. The average quantity of water flowing by the site is 66,270,000 cubic meters (17,500 million gallons) per day. Under average flow conditions, Watts Bar 1 uses 0.6 percent of the total flow of the Tennessee River (TVA 1997b).

The major public water uses of the Chickamauga Reservoir are water supplies and recreation. There are two municipal drinking water intakes downstream from the Watts Bar site on the Chickamauga Lake. The closest downstream public water supply is Dayton, Tennessee, 39 kilometers (24.2 miles) downstream, which serves 6,900 people.

In Tennessee, the state's water rights laws are codified in the Water Quality Control Act. In effect, the water rights are similar to riparian rights in that the designated usage of a water body cannot be impaired. In order to construct intake structures for the purpose of withdrawing water from available supplies, U.S. Army Corps of Engineers and TVA permits are required.

Liquid Chemical and Radioactive Effluents

The radionuclide contaminants in the primary coolant are the source of liquid radioactive waste at Watts Bar 1. Liquid radioactive wastes vary considerably in composition. They may include nonradioactive contaminants and chemical constituents depending on the history and collection point of the liquid. Each source of liquid waste receives an individual degree and type of treatment before storage for reuse or discharge to the environment under the Watts Bar 1 NPDES Permit. To increase the efficiency of waste processing, wastes of similar characteristics are grouped together before treatment. The Watts Bar 1 liquid effluents to the environment during normal operation are shown in **Table 4–4**.

Table 4–4 Annual Chemical and Radioactive Liquid Effluents Released to the Environment from Operation of Watts Bar 1

Materials	*Quantity*
Chemicals (kilograms)	1,098,040 [a]
Tritium (Curies) Other Radionuclides (Curies)	639 [b] 1.32 [b]

[a] TVA 1996a.
[b] TVA 1998e.

Floodplains and Flood Risk

At Watts Bar 1, the 100-year floodplain for the Tennessee River varies from elevation 212.3 meters (696.6 feet) above mean sea level at River Mile 527 to elevation 212.6 meters (697.6 feet) at River Mile 529. The TVA Flood Risk Profile elevation on the Tennessee River varies from elevation 213.5 meters (700.5 feet) at River Mile 527 to elevation 213.8 meters (701.5 feet) at River Mile 529. The Flood Risk Profile is used to control flood damageable development for TVA projects. At this location, the Flood Risk Profile elevation is based on the 500-year flood elevation (TVA 1998e).

The safety-related facilities, systems, and equipment are housed in structures that provide protection from flooding for all flood conditions up to plant grade at 222 meters (728 feet). Rainfall floods exceeding this elevation would require plant shutdown. The situation producing the maximum plant site flood level was determined to be one of two events: (1) a sequence of March storms producing maximum precipitation on the watershed above Chattanooga, or (2) a sequence of March storms centered and producing maximum precipitation in the basin to the west of the Appalachian Divide and above Chattanooga. Seismic and flood events could cause dam failure surges above plant grade elevation 222 meters (728 feet). Flood waves from landslides into upstream reservoirs required no special analysis (TVA 1995c).

Groundwater

Groundwater at Watts Bar 1 is derived principally from infiltration of local precipitation and from lateral underflow from the area north of the plant site. All groundwater flow from the site is to Chickamauga Lake, either directly or via Yellow Creek. The plant site is located above the Conasauga Shale, a formation made up of about 84 percent shale and 16 percent limestone. The shales and limestones are essentially impervious to water, and the majority of the groundwater flows through the terrace deposits overlying the bedrock.

Groundwater Quality

Preoperational monitoring of groundwater was performed by analyzing data from six wells tapped into the Conasauga Shale aquifer to verify that the flow gradient was toward the Chickamauga Reservoir. The operational groundwater monitoring program uses two wells in the Conasauga Shale aquifer: one upgradient and one downgradient of the plant. Quarterly samples are taken to monitor for the consistency of groundwater constituents (NRC 1995b).

Groundwater Availability, Use, and Rights

Potable water for plant use is obtained from the Watts Bar Utility District. The utility district's water is obtained from three wells located 4 kilometers (2.5 miles) northwest of the plant (TVA 1995c). Single family wells are common in adjacent rural areas not served by the public water supply system. Industrial and drinking water supplies in the area are primarily taken from surface water sources.

Groundwater rights in the State of Tennessee are traditionally associated with the Reasonable Use Doctrine. Under this doctrine, landowners can withdraw groundwater to the extent that they exercise their rights reasonably in relation to the similar rights of others.

4.2.1.5 Geology and Soils

Geology

The Watts Bar 1 site is located in the Tennessee Section of the Valley and Ridge Province of the Appalachian Highlands (TVA 1995c). The distinguishing geological feature of the province is the series of folded and faulted mountains and valleys that overlie Paleozoic sedimentary formations totaling 12.2 kilometers (40,000 feet) in thickness. The plant is located on alluvial terrace deposits on a bend of the Tennessee River. Below these deposits lies the Middle Cambrian Conasauga, a shale formation of 84 percent shale and interbedded limestone. The shales and limestones are generally low permeability formations. The majority of the groundwater flows through the terrace deposits overlying the bedrock.

The controlling feature of the geologic structure at the site is the Kingston thrust fault that developed 250 million years ago. The fault has been inactive for many millions of years, and recurrence of movement is not expected. The fault lies to the northwest of the site area and is not involved in the foundation of any of the major plant structures (TVA 1995c).

Seismology

Watts Bar 1 was designed based on the largest historic earthquake to occur in the Southern Appalachian Tectonic Province—the 1897 Giles County, Virginia, earthquake (intensity: Modified Mercalli VIII and Richter magnitude of 6 to 7). The safe-shutdown earthquake for the plant was established at a maximum horizontal acceleration of 0.18 g (g = acceleration due to gravity) and a simultaneous maximum vertical acceleration of 0.12 g (TVA 1995c). The safe-shutdown earthquake is defined as the earthquake that produces the maximum ground vibration for which: (1) the reactor coolant pressure boundary, (2) the capability to shut down the reactor and maintain it in the shutdown mode, and (3) the capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposures comparable to the guideline exposures are designed to remain functional (10 CFR 100, Appendix A).

Soils

Extensive evaluation was made of the soils on the Watts Bar 1 site, and foundation requirements were devised for all of the plant structures related to the specific location and safety classification of each. The unconsolidated deposits overlying bedrock were primarily alluvial deposits consisting of fine grained, finely sorted soils and clays with micaceous sand and some quartz gravel. The general requirements for Safety Category I structures involve use of in-situ soil, compacted granular fill, or in-situ rock as foundation material (TVA 1995c).

4.2.1.6 Ecological Resources

Terrestrial Resources

The Watts Bar Reservation is located within the Ridge and Valley Physiographic Province. This province lies between the Blue Ridge Mountains and the Cumberland Plateau and is characterized by prominent, northwest-trending ridges and adjacent valleys. The Tennessee River flows through this province, roughly paralleling the alignment of the valleys. The Watts Bar 1 site is located in an area heavily impacted by agricultural activities. The site was further altered during its conversion to an industrial site. Terrestrial biological communities outside the immediate plant area have not been substantially impacted by the existing power plant. No areas on site are identified as critical areas for terrestrial plant and animal species protected under state or Federal laws.

Terrestrial Wildlife

The Watts Bar 1 site vicinity, as a result of exclusion control, serves the function of an informal preserve and continues to support a variety of terrestrial plant and animal communities. No further expansion of the current operations area is anticipated. Game species in the vicinity of the site include white-tailed deer, gray squirrel, raccoon, wild turkey, ruffed grouse, cottontail rabbit, and bobwhite quail. Good squirrel populations occur in large stands of hardwoods, while raccoons and rabbits are most common in the wide, rolling valleys between the ridges.

The mixture of forest and open vegetative types of terrain and the large degree of openness within the forest provide an abundance of niches favoring a diverse bird population. The diverse habitat sites surrounding the plant site also support varied and abundant populations of snakes, frogs, salamanders, and other reptiles.

Wetlands

The potential wetland areas identified in the vicinity of the Watts Bar 1 site are: (1) palustrine, bottomland hardwood deciduous, temporarily flooded wetlands and (2) fringe wetlands. They are indicated in **Figure 4–3**.

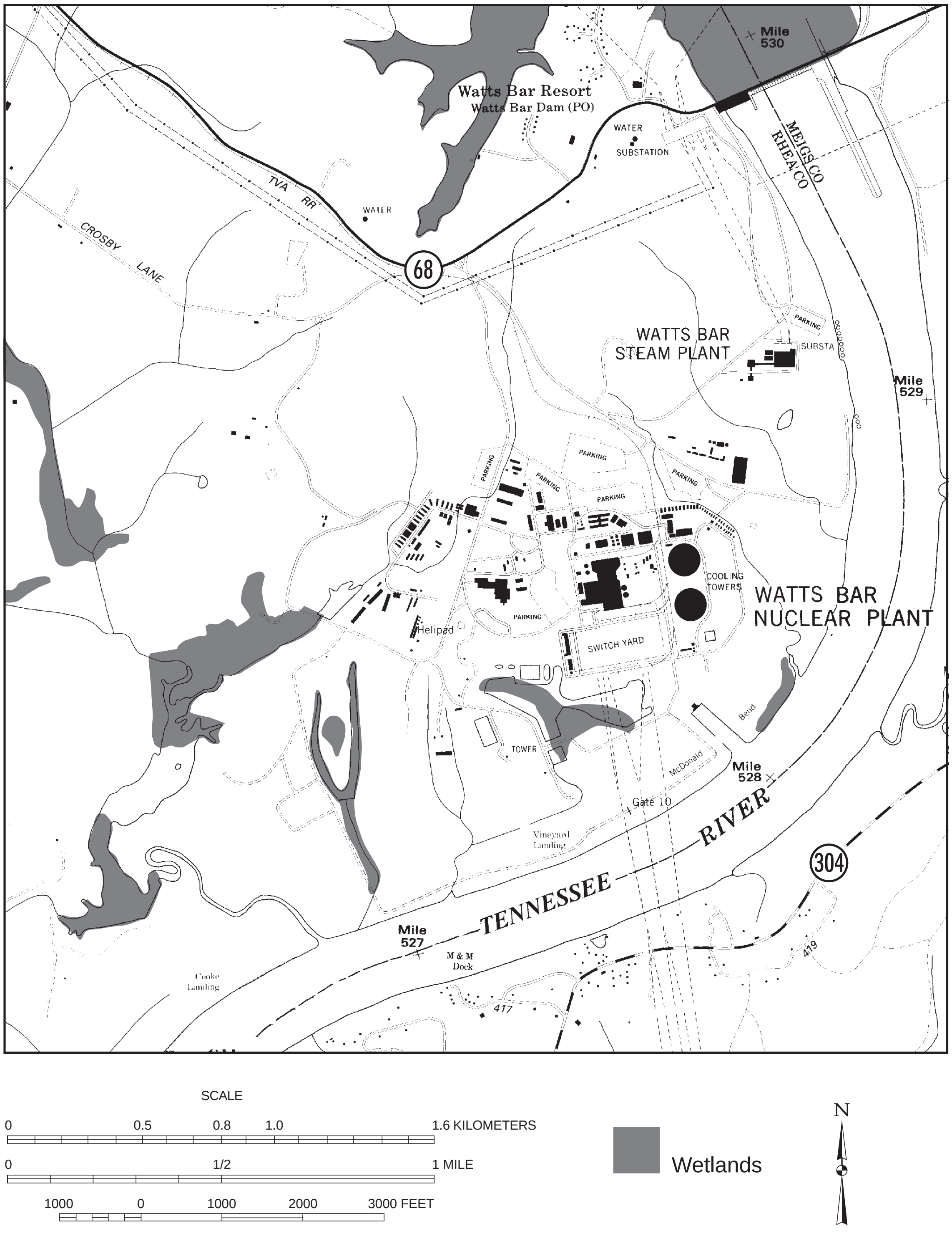

Figure 4–3 National Wetlands Inventory Map of Watts Bar Nuclear Plant Site Vicinity

Aquatic Resources

The Watts Bar 1 site (at Tennessee River Mile 528) is in the riverine portion of Chickamauga Reservoir, approximately 3.2 kilometers (2 miles) downstream of Watts Bar Dam. The quality of the water at the Watts Bar 1 intake is generally satisfactory, but negatively influenced, particularly in summer and fall, by water releases from Watts Bar Reservoir, 3.2 kilometers (2 miles) upstream. Water standing at the face (the forebay) of the Watts Bar Dam becomes stratified, particularly in warmer weather, and consequently becomes oxygen deficient. In 1996, an aerator was installed in the forebay of the Watts Bar Reservoir to reduce stratification and provide higher dissolved oxygen levels in reservoir releases.

Watts Bar 1 began commercial generation on May 27, 1996, and operated at an 84 percent capacity factor through its first cycle. Trends and similarities noted during preoperational monitoring and comparisons with operational data were used to determine potential plant-induced effects to aquatic communities and water quality.

Plankton

Evaluation of the entrainment of icthyoplankton (fish eggs and larvae) during the first year of operation of Watts Bar 1 revealed the presence of only a few varieties and at low densities (TVA 1997d). Eggs and larvae passing the Watts Bar 1 water intake are primarily spawned in the Watts Bar Reservoir and exposed to passage through the hydroelectric generation turbines at Watts Bar Dam. Very few eggs or larvae of species known to spawn in tailwaters (the downstream side of the dam) were collected, indicating that most spawning in Chickamauga Reservoir occurs downstream of the Watts Bar Nuclear Plant (TVA 1997d). The entrainment of eggs and larvae at the Watts Bar 1 water intake is characterized as extremely low (counts of 449 and 267 during the period sampled). These low levels are largely attributed to the low use of water (0.6 percent) passing the plant (TVA 1997b).

Fish Communities

Fish community sampling results after Watts Bar 1 began operation were found to be consistent with the preoperational results (TVA 1997d). The slight differences were attributed to the differences in the sample design. The 1977–1985 data were collected on a monthly basis throughout the year, and the 1990–1995 data were collected only once during the fall of each year. Important species evaluated in the comparison of preoperational and operational conditions were largemouth bass, spotted bass, redear sunfish, white bass, emerald shiner, common carp, brook silversides, log perch, bluegill, smallmouth bass, spotted sucker, and yellow bass.

Results of the first year's monitoring compared with preoperational data indicate that operation of Watts Bar 1 has not adversely impacted the tailwater fish population below Watts Bar Dam. Fish impingement on the Watts Bar 1 water intake traveling screens was virtually nonexistent.

Aquatic Macrophytes

Aquatic plants in the Watts Bar Reservoir covered 0.04 square kilometers (10 acres) during the late 1970s. Coverage increased to about 2.8 square kilometers during the 1980s, but decreased back to the 1970s levels by the early 1990s. An extended drought in the mid- to late 1980s enhanced conditions for growth of aquatic macrophytes. A return to more normal rainfall and runoff conditions resulted in a return to early 1980s densities. Eurasian watermilfoil, *Myriophyllum spicatum,* and spiny-leafed naiad, *Najas minor*, remain the dominant species. Populations of aquatic macrophyte species in the Chickamauga Reservoir fluctuated similarly over the same period, primarily in response to river flow conditions (NRC 1995b).

Mussel and Clam Communities

The Tennessee River downstream from Watts Bar Dam is inhabited by a relatively diverse native mussel community. Sampling conducted several times during the last 14 years indicates that 31 species are present; however, the 5 most abundant species account for 90 percent of the total. Many of the mussels present in this part of the Tennessee River are quite old, and most species may not have reproduced successfully in the last 30 or more years. The long-term trend is a reduction in abundance and species richness (TVA 1997b; NRC 1995b).

The 16-kilometer (9.9-mile) reach of the Tennessee River from Watts Bar Dam (Tennessee River Mile 529.9) downstream to Hunter Shoal (Tennessee River Mile 520) has been designated a mollusk sanctuary by the State of Tennessee. While commercial harvest of mussels is prohibited within the sanctuary, the age and species composition of the surviving mussel stocks in this river reach do not support any commercial harvest, even outside of the sanctuary (NRC 1995b).

In addition to the native mussels, this part of the Tennessee River is inhabited by a large population of the Asiatic clam, *Corbicula fluminea*, and an increasing population of the zebra mussel, *Dreissena polymorpha*. The Asiatic clam has been present in the Watts Bar Dam tailwater for at least 25 years, but the zebra mussel was first found there in 1993 (TVA 1997b).

Threatened and Endangered Species

Several terrestrial and aquatic species that occur in the vicinity of the Watts Bar 1 site are listed as endangered or threatened by the U.S. Fish and Wildlife Service and/or state agencies in Tennessee (**Table 4–5**). The status and biology of Federally listed species in the vicinity of the Watts Bar site were described in detail in the Biological Assessment included in the 1995 NRC Final EIS (NRC 1995b), which is incorporated here by reference. More current information on the status of the federally listed species is included, where available, in the following discussion.

Table 4–5 Listed Threatened or Endangered Species Potentially On or Near the Watts Bar Site

Common Name	*Scientific Name*	*Federal*	*State*
Mollusks			
Dromedary Pearlymussel	*Dromus dromas*	Endangered	Endangered
Pink Mucket	*Lampsilis abrupta/Lampsilis orbiculata*	Endangered	Endangered
Rough Pigtoe	*Pleurobema Plenum*	Endangered	Endangered
Fanshell	*Cyprogenia stegaria*	Endangered	Endangered
Fish			
Blue Sucker	*Cyprogenia stegaria*	Not listed	Threatened
Snail Darter	*Percina tanasi*	Threatened	Threatened
Amphibians			
Eastern Hellbender	*Cryptobranchus a. alleganiensis*	Not listed	In need of management
Birds			
Bald Eagle	*Haliaeetus leucocephalus*	Threatened	Threatened
Osprey	*Pandion haliaetus*	Not listed	Threatened
Mammals			
Gray Bat	*Myotis grisescens*	Endangered	Endangered

Source: NRC 1995b, TVA 1998a, Tennessee 1994, DOI 1998a.

Plants

No Federally or state-listed plants are known to occur on or in the immediate vicinity of the Watts Bar site.

Terrestrial Animals

Bald eagles, listed as threatened, visit the Watts Bar site during the winter, where they roost on trees near the reservoirs and forage for fish. The nearest reported eagle nest is about 6.4 kilometers (4 miles) south-southwest of the plant. This nest site was first used in 1994 and has been inactive since 1996. Gray bats roost in caves throughout the year and primarily feed over water on adult insects. The nearest cave in which gray bats have been found is located about 6 kilometers (3.7 miles) downstream from the Watts Bar site. Because of frequent human visitation, this cave is not regularly occupied by bats. Gray bats have also been reported in three other caves between 15 and 30 kilometers (10 and 20 miles) from the Watts Bar site. Only one of these three caves is, at present, regularly occupied by gray bats. Gray bats may also forage over the reservoir adjacent to and downstream from the plant site.

The State of Tennessee lists the osprey as threatened. Ospreys feed primarily on fish and regularly occur along the Tennessee River adjacent to the Watts Bar site (NRC 1995b). Ospreys also have recently nested in the immediate vicinity of the Watts Bar Dam.

Aquatic Animals

Five aquatic species found in the Tennessee River near the Watts Bar site are on the Federal lists of endangered or threatened wildlife. Four of these species are endangered mussels (dromedary pearlymussel, pink mucket, rough pigtoe, and fanshell), and the other species is a threatened fish (the snail darter). Of these species, only the pink mucket and snail darter have been observed in this part of the river within the last decade. The State of Tennessee has listed the blue sucker as a threatened species and the hellbender to be "in need of management." Both of these species have been observed only on rare occasions in the Watts Bar Dam tailwater (NRC 1995b).

Three other aquatic species, all Federally listed as endangered, were found in preimpoundment surveys of nearby portions of the Tennessee River. These species are the birdwing pearlymussel, *Conradilla caelata;* white wartyback pearlymussel, *Plethobasus cicatricosus;* and the Cumberland monkeyface pearlymussel, *Quadrula intermedia.* They all inhabit gravel riffles in medium to large rivers and have not been found in the Watts Bar tailwater or in Chickamauga Reservoir for 25 years.

4.2.1.7 Archaeological and Historic Resources

For the past 1,200 years, through changing climates and environmental conditions, the Tennessee River Valley has attracted humans because of its system of water routes and its abundance of natural resources. Surveys of the Watts Bar 1 site and vicinity have identified numerous archaeological resources (Schroedl 1978, Calabrese 1976). Data recovery excavations were undertaken in 1971. Other archaeological sites exist along the reservoir shoreline downstream from the Watts Bar 1 site. However, it is important to note that no systematic archaeological survey was conducted to identify buried sites that could be present in the area of potential effect.

No sites listed in the *National Register of Historic Places* are located at or near the Watts Bar 1 site. Sites that are potentially eligible for listing in the National Register within the Watts Bar Reservation include the Watts Bar Steam Plant and the Watts Bar Dam.

Construction of Watts Bar 1 is complete, and the reactor has operated since May 1996. The operation experience to date indicates that there is no impact on archaeological or historic resources on or near the Watts Bar site.

4.2.1.8 Socioeconomics

Watts Bar 1 is located near the town of Spring City, Rhea County, in eastern Tennessee. The precise location is latitude 35°36'10" north and longitude 84°47'25" west (NRC 1998d). Spring City is about 27 kilometers (17 miles) northeast of Dayton, Tennessee, and 80 kilometers (50 miles) northeast of Chattanooga, Tennessee. Highway access to Spring City is via Route 27 and nearby Route 68. Route 27 links the town to Dayton (Rhea County seat) and Route 68, both to the south; to Chattanooga in the southwest; and to Interstate Highway 40, about 40 kilometers (25 miles) north. Route 68 links Spring City to Interstate Highway 75.

Demography

The region of influence had an estimated overall population of about 890,600 in 1990 (DOC 1992). The number of households in the region of influence was about 343,000 in 1990, while the number of families was about 254,000. **Table 4–6** shows general demographic data for Spring City, Rhea County, and the Watts Bar 1 region of influence. The Watts Bar region of influence was defined as the area within 80 kilometers (50 miles) of the Watts Bar Nuclear Plant.

Table 4–6 General Demographic Characteristics of Spring City, Rhea County, and the Watts Bar 1 Region of Influence 1990

Demographic Measure	*Spring City*	*Rhea County*	*Region of Influence*
Total population (1990)	2,199	24,344	890,617
Total population (1995/96, as noted)	2,381 (1996)	26,833 (1995)	NA
Families (1990)	614	6,976	254,319
Households (1990)	867	9,128	343,067
Male (1990)	982	11,728	428,137
Female (1990)	1,217	12,616	462,481

Sources: DOC 1992, DOC 1998c.

For Spring City, the population increased approximately 8 percent from 1990 to 1996. Rhea County had an estimated population of 26,833 in 1995, up from 24,344 in 1990 (Dayton/Rhea EDC 1998). The county is projected to continue growing to a population of 30,000 in the year 2000, and to 35,000 in 2010. **Table 4–7** shows the population distribution by ethnic group in Spring City, Rhea County, and the Watts Bar region of influence in 1990.

Figure 4–4 shows the racial and ethnic composition of the projected population residing in the affected area projected for the year 2025. Data for low-income households from the 1990 Census are presented in **Figure 4–5**. Low-income households are those with incomes of 80 percent or lower than the median income for the counties. As indicated in this figure, approximately 40 percent of the total households are low-income households (see also Appendix G).

Table 4–7 Population Distribution by Ethnic Group in Spring City, Rhea County, and the Watts Bar 1 Region of Influence (1990 U.S. Census)

Ethnic Group or Subgroup (U.S. Census Definitions)	*Spring City*		*Rhea County*		*Watts Bar 1 Region of Influence*	
	Population	*Percentage of Total Population*	*Population*	*Percentage of Total Population*	*Population*	*Percentage of Total Population*
White not of Hispanic origin	2,033	92.45	23,472	96.42	806,864	91.10
Black not of Hispanic origin	139	6.32	528	2.17	64,922	7.33
American Indian, Aleut, or Eskimo not of Hispanic origin	10	0.45	72	0.30	2,672	0.30
Asian or Pacific Islander not of Hispanic origin	8	0.36	33	0.14	5,390	0.61
Other race not of Hispanic origin	0	0.00	56	0.23	285	0.05
White of Hispanic origin	0	0.00	103	0.42	4,058	0.46
Black of Hispanic origin	0	0.00	4	0.02	146	0.02
American Indian, Aleut, or Eskimo of Hispanic origin	0	0.00	12	0.05	93	0.01
Asian or Pacific Islander of Hispanic origin	0	0.00	0	0.00	92	0.01
Other race of Hispanic origin	9	0.41	64	0.26	1,146	0.13
Hispanic total	9	0.41	183	0.75	5,535	0.62
Total population (all ethnic groups)	2,199	100.00	24,344	100.00	885,667	100.00

Sources: DOC 1992, DOC 1998c.
Note: Sum of items may not add up to population total due to rounding error.

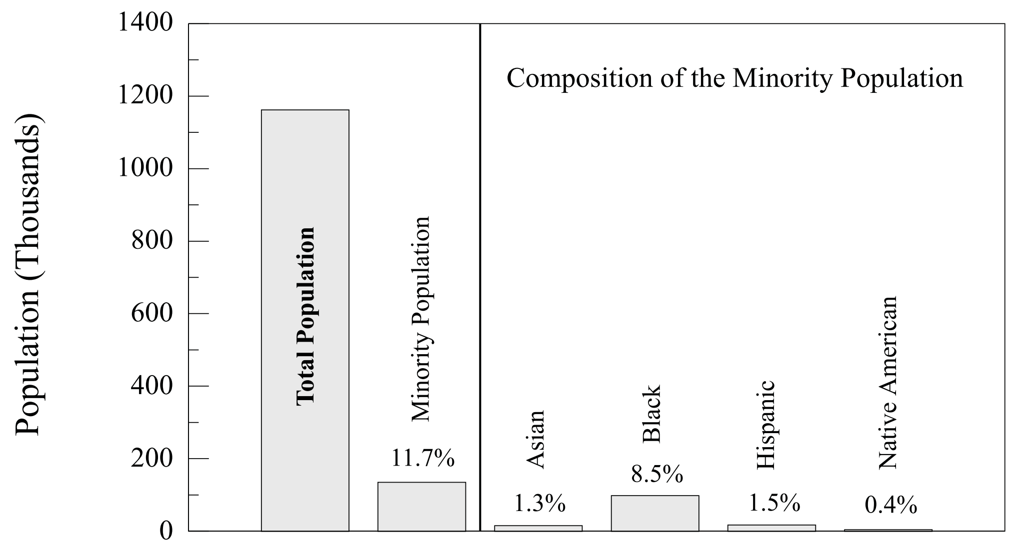

Figure 4–4 Racial and Ethnic Composition of the Minority Population Residing Within 80 Kilometers (50 Miles) of Watts Bar 1 Projected for the Year 2025

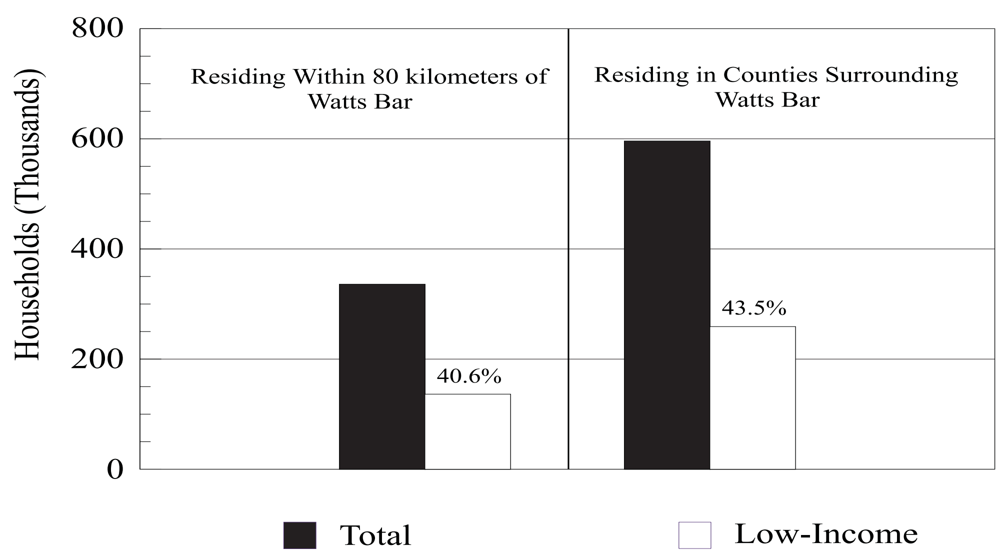

Figure 4–5 Low-Income Households Residing Within 80 Kilometers (50 Miles) of Watts Bar 1 (1990)

Income

Total personal income in Rhea County was $417 million in 1996, up from $404 million in 1995 (DOC 1998a). Comparable figures for neighboring Meigs County were $132 million in 1996 and $127 million in 1995. Per capita income in Rhea County was $15,323 in 1996, up from $15,078 in 1995. Rhea and Meigs counties were respectively ranked seventy-first and eighty-fourth in the State of Tennessee in terms of per capita income in 1996. **Table 4–8** summarizes income data for Spring City and Rhea County.

Table 4–8 Income Data Summary for Spring City and Rhea County (1989)

Income Measure	*Spring City*	*Rhea County*
Per capita income	$9,412	$9,333
Median household income	$19,757	$19,915
Median family income	$24,028	$23,789
Median housing value	$41,300	$45,100

Source: DOC 1998c.

Community Services

Education, public safety, and health care were examined to determine the level of community services for the region of influence.

Education

There are 418 schools with a capacity for 130,107 students within an 80-kilometer (50-mile) radius of the Watts Bar 1 site. The average student-to-teacher ratio is approximately 17:1.

Public Safety

City, county, and state law enforcement agencies provide police protection to residents of the region of influence. The average officer-to-population ratio is 1.3:1,000 persons. Fire protection services are provided by both paid and volunteer firefighters. The ratio of firefighters to the population is 0.6:1,000.

Health Care

The region of influence includes 34 hospitals with a total of 4,861 beds. All of the hospitals are operating below capacity.

Local Transportation

The nearest land transportation route is State Route 68, about 1.6 kilometers (1 mile) north of the site. Other surface roads in the Watts Bar 1 site vicinity are State Route 58, 4.8 kilometers (3 miles) southeast; State Route 30, 9.7 kilometers (6 miles) south; U.S. Highway 27, 11.3 kilometers (7 miles) northwest; and Interstate Highway 75, 12.9 kilometers (8 miles) southeast. A main line of the CNO&TP Railroad (Norfolk Southern Corporation) passes about 11.3 kilometers (7 miles) west of the site. A TVA railroad spur connects with the main line and serves Watts Bar 1. The spur from Spring City to the Watts Bar 1 site would require refurbishment prior to use. On the site, several hundred feet of rail that have been removed would have to be replaced if rail spent fuel shipping casks had to be accommodated (TVA 1998a). The Tennessee River is navigable past the site and is used as a major barge route (TVA 1995c). These transportation routes are shown in **Figure 4–6**.

The major surface roads mentioned above and the network of local roads connecting with them adequately serve the needs of the local communities and TVA employees at the Watts Bar 1 site.

4.2.1.9 Public and Occupational Health and Safety

Radiation Environment

Background radiation exposure to individuals in the vicinity of the Watts Bar site is presented in **Table 4–9**. The annual doses to individuals from background radiation are expected to remain constant over time. Thus, any incremental change in the total dose to the population would be a function only of a change in the size of the population.

Table 4–9 Sources of Background Radiation Exposure to Individuals in the Vicinity of the Watts Bar Site[a]

Source	*Total Effective Dose Equivalent (millirem per year)*
Natural Background Radiation	
Cosmic and cosmogenic radiation	28
External terrestrial radiation	28
In the body	39
Radon in homes (inhaled)	200
Total	295
Other Sources of Radiation	
Release of radioactive material in natural gas, mining, ore processing, etc.	5
Diagnostic x-rays and nuclear medicine	53
Nuclear energy	0.28
Consumer and industrial products	0.03
Total	355

[a] Values are based on average national data, not measured values at the Watts Bar site.
Source: TVA 1998b.

Radionuclides released in emissions and effluents from Watts Bar 1 are a potential source of radiation exposure to individuals in the vicinity of Watts Bar 1 and are additional to the background radiation values listed. Calculations of radiation doses to individuals and the population surrounding the plant were performed by TVA using measurements from the various radiological monitoring points around the plant during operation in 1997, as well as conservative assumptions regarding both individual and population exposure time. The doses are presented in **Table 4–10**.

Radiation doses to the onsite worker include the background dose plus an additional dose from working in the facility.

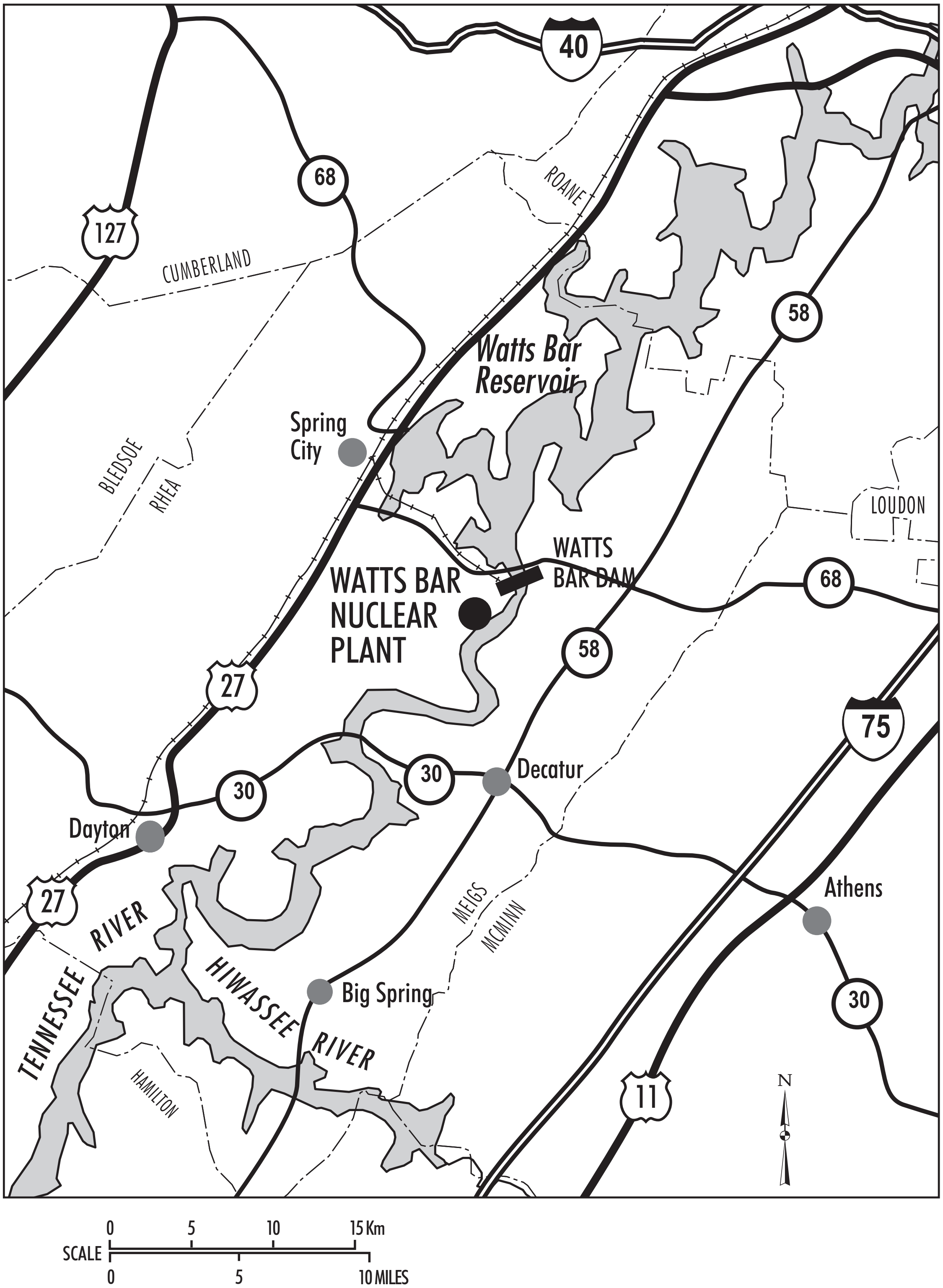

Figure 4–6 Transportation Routes in the Vicinity of the Watts Bar Nuclear Plant Site

Table 4–10 Annual Doses to the General Public During 1997 From Normal Operation at Watts Bar 1, (Total Effective Dose Equivalent)

Affected Environment	Airborne Releases		Liquid Releases		Total	
	Most Stringent Standard [a]	Based on Actual Measurements	Most Stringent Standard [a]	Calculated on the Basis of Actual Measurements	Most Stringent Standard [a]	Calculated on the Basis of Actual Measurements
Maximally exposed offsite individual (millirem)	5	0.036	3	0.25	25	0.29
Population within 80 kilometers (person-rem)[b]	None	0.068	None	0.44	None	0.51
Average dose to an individual within 80 kilometers (millirem)[c]	None	0.000063	None	0.00042	None	0.00048

a From 10 CFR 50, Appendix I (design objectives for equipment to control releases of radioactive materials in effluents from nuclear power reactors). The standard for the maximally exposed offsite individual (25 millirem per year for the total body from all pathways) is given in 40 CFR 190.
b Population used: 1,066,600.
c The average is obtained by dividing the population dose by the population living within an 80-kilometer (50-mile) radius of Watts Bar 1.

Source: TVA 1998e.

Direct Radiation

Radiation fields are produced in nuclear plant environments as a result of radioactivity contained within the reactor and its associated components. Doses from sources within the plant are primarily due to nitrogen-16, a radionuclide produced in the reactor core. Since the primary coolant of pressurized water reactors is contained in a heavily shielded area of the plant, dose rates in the vicinity of pressurized water reactors are generally less than 5 millirem per year.

Low-level radioactive storage containers outside the plant are estimated to contribute less than 0.01 millirem per year at the site boundary (NRC 1978).

The plant operator committed to design features and operating practices that ensure that individual occupational radiation doses are within the occupational dose limits defined in 10 CFR 20, and that individual and total plant population doses would be as low as is reasonably achievable. The combined radiation doses received by the onsite worker are shown in **Table 4–11**.

Table 4–11 Annual Worker Doses from Normal Operation of Watts Bar 1 During 1997

Affected Environment	Standard [a]	Dose [b]
Average worker (millirem)	None	104
Maximally exposed worker (millirem)	5,000	1,269
Total workers (person-rem)	None	112

a NRC regulatory limit from 10 CFR 20.
b Based on 1,073 badged workers.

Source: TVA 1998e.

Chemical Environment

Nonradioactive chemical wastes from Watts Bar 1 include boiler blowdown water treatment wastes (sludges and high saline streams whose residues are disposed of as solid wastes and biocides), boiler metal cleaning, floor and yard drains, and stormwater runoff.

Regeneration (chemical removal of radioactive waste) of ion exchange resins accounts for 596,000 kilograms per year (657 tons per year) of neutralized sulfate and sodium salts. Other water purification processes produce 196,500 kilograms per year (217 tons per year) phosphate and aluminum hydroxide residue. Processes for defouling facility piping produce 22,000 kilograms per year (24 tons per year) of organic residue byproducts and halites (oxygenated chlorine and bromine ions).

Operation of Watts Bar 1 takes into account the storage of process chemicals and disposal of waste products. Adverse health impacts to the public are minimized through administrative and design controls to decrease hazardous chemical releases to the environment and achieve compliance with permit requirements (such as air emissions and NPDES Permit requirements). The effectiveness of these controls is verified by monitoring information and inspecting compliance with mitigation measures.

Section 4.2.1.3, Table 4–1, and Section 4.2.1.4, Table 4–3, contain data on quantities of concentrated chemical concentrations in ambient air and surface water in the vicinity of Watts Bar 1.

Emergency Preparedness

The license issued by the NRC for the operation of Watts Bar 1 is based in part on a finding that there is reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency. This finding by the NRC is based on: (1) a review of the Federal Emergency Management Agency findings; (2) determinations that state and local emergency plans are adequate and give reasonable assurance that they can be implemented; and (3) the NRC's assessment that the applicant's onsite emergency plans are adequate and give reasonable assurance that they can be implemented.

The Watts Bar 1 emergency plan establishes that evacuation is the most effective protective action that can be taken to cope with radiological incidents. The plan provides the details of an evacuation plan. Risk counties, identified as McMinn, Meigs, and Rhea, are tasked with preparing evacuation plans for citizens within the 16-kilometer (10-mile) emergency planning zone and determining the number of people to be evacuated from the zone. Host counties, identified as Hamilton, Roane, Cumberland, and McMinn, are assigned responsibility to identify suitable shelters for evacuees. A State Emergency Operation Center would provide the focus for emergency reaction (e.g., notifications, protective action, evacuation implementation). Fixed sirens would alert residents and transients within the 16-kilometer (10-mile) emergency planning zone with backup provided, if needed, by emergency vehicle sirens and loudspeakers. The State Emergency Operation Center Director would involve the counties' Emergency Management Directors as required.

The Emergency Alert System and the National Oceanic and Atmospheric Administration Weather Radio would be used to provide emergency information and instructions.

The evacuation would be ordered and accomplished by designated sectors. The designated evacuation routes would be patrolled by traffic assistance teams.

The American Red Cross would operate mass care shelters in the host counties. Shelter information points would be established on each evacuation route to help direct evacuees to their assigned shelters.

Considerable planning is involved in evacuation planning. Training, education, and practice runs are used to further the probability of successful evacuation in the event it is ever required.

4.2.1.10 Waste Management

As with any major industrial activity, Watts Bar 1 generates waste as a consequence of its normal operation. The wastes fall into four broad categories: hazardous waste, nonhazardous solid waste, low-level radioactive waste, and sanitary liquid waste. No high-level waste, as it is defined by the Nuclear Waste Policy Act of 1992, is generated at the Watts Bar 1 site. **Table 4–12** summarizes the annual amount of waste generated at the Watts Bar 1 site in each category.

Table 4–12 Annual Waste Generation at Watts Bar 1

Category	*Volume or Mass Per Year*
Hazardous waste (cubic meters)	1.025
Non-hazardous solid waste (kilograms)	863,438
Low-level radioactive waste (cubic meters)	40
Mixed waste (cubic meters)	less than 1

Source: TVA 1998e.

Hazardous Waste

Hazardous wastes typically generated at Watts Bar 1 include paints, solvents, acids, oils, radiographic film and development chemicals, and degreasers. Neutralization is the only waste treatment performed on site. Hazardous wastes are normally stored in polyethylene containment systems during accumulation. An approved storage building is utilized to store hazardous wastes for either 90 or 180 days, depending on the plant's hazardous waste generator status (i.e., small quantity or large quantity generator) at the time. Waste is transported to an offsite hazardous waste storage facility or disposal facility prior to exceeding the 90- or 180-day storage limit.

Low-Level Radioactive Waste

During the fission process, an inventory of radioactive fission and activation products builds up within the reactor (in the fuel and the materials of construction). A small fraction of these radioactive materials escapes and contaminates the reactor coolant. These contaminants are removed from the coolant by a radioactive waste treatment system. Watts Bar 1 uses separate radioactive waste treatment systems for gaseous, liquid, and solid waste treatment. Residues from the gaseous and liquid waste treatment systems (filters, resins, dewatered solids) are combined and disposed of with the solid, low-level radioactive waste. The other important category of low-level radioactive waste is the solidified and dewatered treated product from gaseous and liquid waste treatment systems. Contaminated protective clothing, paper, rags, glassware, compactible and noncompactible trash, and reactor components and equipment comprise the majority of solid low-level radioactive waste at Watts Bar 1.

Before disposal, compactible trash, with the exception of irradiated metals, is shipped to a commercial processor where it is compacted to a lesser volume and shipped to the Barnwell, South Carolina, low-level radioactive waste disposal facility. Incineratable trash is shipped to a commercial waste incinerator in Oak Ridge, Tennessee, where the material is burned to ashes before final disposal at the Barnwell facility. Metal waste is either decontaminated and recycled or melted to form shielding blocks. TVA does not send irradiated metals for volume reduction due to their excessive dose rate. Instead, this material accumulates until a sufficient amount is on hand to ship directly to the Barnwell disposal facility. Any radioactive waste from these processes is shipped for disposal at the Barnwell disposal facility (TVA 1998a).

Mixed Waste

Mixed waste is material that is both hazardous and radioactive. Typical sources of mixed low-level radioactive waste at Watts Bar 1 are: beta-counting fluids (e.g., zylene, toluene) for use in liquid scintillation detectors, polychlorinated biphenyls susceptible to contact with radioactive contamination as a result of an accidental transformer spill or explosion, isopropyl alcohol used for cleaning radioactive surfaces, chelating agents, and various acids.

Waste Minimization Practices

The Watts Bar 1 site has an active waste minimization program that consists of the following practices:

- Useful portions of construction and demolition materials are salvaged for resale.
- Segregated storage areas are maintained for each type of recoverable material.
- Scrap treated lumber is sold or placed in dumpsters for disposal by the solid-waste disposal contractor at an offsite permitted landfill.
- Inert construction and demolition wastes are collected for disposal at the onsite permitted landfill.
- Waste paper is placed in bins or dumpsters and sold to an offsite recycle facility.
- Aluminum cans are recycled and sold.
- Nonrecoverable solid wastes are placed in dumpsters for disposal by the solid waste disposal contractor.
- Special wastes (e.g., desiccants, oily wastes, insulation) are collected and stored and then disposed of by incineration. Asbestos is sent to an approved special waste landfill for disposal.
- Used oil, fluorescent tubes, and antifreeze are collected and stored in drums and tanks and recycled.
- Medical wastes are collected and disposed of in accordance with the medical waste disposal procedure for TVA medical facilities.
- Plant sanitary wastewater is routed to the sanitary wastewater treatment plant and then treated for release in accordance with the NPDES Permit.
- Metal-cleaning wastewater (e.g., trisodium phosphate, acetic acid, etc.) is discharged into approved storage ponds for future disposal in accordance with the NPDES Permit.
- Wastewater from floor and equipment drains in nonradiation areas is routed through sumps to the turbine building sump for discharge in accordance with the NPDES Permit.
- Surplus chemicals are sold; lead acid batteries are recycled; refrigerant is recovered and recycled; and solvent recovery equipment is used for painting operations.
- Steps to use biodegradable solvents and cleaners to replace hazardous chemicals in various cleaning operations have been incorporated to the extent practical.

4.2.1.11 Spent Fuel Management

When nuclear reactor fuel has been irradiated to the point that it no longer contributes to the operation of the reactor, or when it is found to have cladding leaks that allow radioactive gaseous emissions, the fuel assembly is termed “spent nuclear fuel” and is removed from the reactor core and stored in the spent fuel storage pool or basin. The Nuclear Waste Policy Act of 1982, as amended, assigned the Secretary of Energy the responsibility for the development of a repository for the disposal of high-level radioactive waste and spent nuclear fuel. When such a repository is available, spent nuclear fuel would be transported for disposal from the nuclear power reactors to the repository. Until a repository is available, spent nuclear fuel would be stored in the reactor pools or in other acceptable, NRC-licensed storage locations. Because of the uncertainty associated with opening a repository, this EIS assumes spent fuel would be stored at the reactor facility for the duration of the proposed action (i.e., 40 years).

Storage Capacity

Storage cells have been provided in the Watts Bar 1 spent fuel storage pool to hold 1,383 fuel assemblies. A reserve capacity is required for a full-core discharge (193 fuel assemblies) in the event it becomes necessary to remove fuel from the reactor vessel. The remaining storage capacity is 1,190 fuel assemblies. As of January 1998, the spent fuel inventory at Watts Bar 1 was 84 assemblies, leaving a usable storage capacity of 1,106 fuel assemblies.

Management Practice

The normal (projected equilibrium average) refueling batch size is 80 fuel assemblies, with the refueling frequency established at 18 months. The current capacity for storing spent nuclear fuel is adequate through the year 2016 (fuel cycle number 14). However, Watts Bar 1 already is licensed for a total spent nuclear fuel storage pool capacity of 1,607 fuel assemblies, an increase of 224 fuel assemblies over the present capacity. As it becomes necessary, dry storage facilities can be added to extend the plant life.

4.2.2 Sequoyah Nuclear Plant Units 1 and 2

As discussed in Section 3.2.5, one of the reactor options under consideration is the irradiation of TPBARs in Sequoyah Nuclear Plant Units 1 and 2 (Sequoyah 1 and 2). This option is based on the assumption that Sequoyah 1 and 2 would operate at their licensed full power output for the generation of electricity, with no reduced operability attributable to the production of tritium. The tritium production activity would be considered a secondary mission of the units.

The TVA Board authorized the construction of the Sequoyah Nuclear Plant in August 1968. On October 15 1968, an application to construct the plant was filed with the U.S. Atomic Energy Commission. A provisional construction permit was granted on May 27, 1970. Unit 1 began commercial operation on July 1, 1981. Unit 2 began commercial operation on June 1, 1982. The units were shut down in 1985 and resumed operation in 1988. Sequoyah 1 and 2 are described briefly in Section 3.2.5.2. Detailed descriptions of the site, building structures, systems, and operations are provided in the following licensing and environmental documentation:

- TVA, *Final Environmental Statement, Sequoyah Nuclear Plant Units 1 and 2* (TVA 1974a).

- TVA, *Sequoyah Nuclear Plant Updated Final Safety Analysis Report, Amendment 12* (TVA 1996b).

The following sections describe the affected environment at the Sequoyah Nuclear Plant site for land resources, noise, air quality, water resources, geology and soils, biotic resources, cultural resources, and socioeconomics. In addition, radiation and hazardous chemical environments and the waste management conditions and spent nuclear fuel considerations at Sequoyah 1 and 2 are described.

4.2.2.1 Land Resources

Land Use

The Sequoyah Nuclear Plant site is on a 212-hectare (525-acre) site near the center of Hamilton County, Tennessee, on a peninsula on the western shore of Chickamauga Reservoir at River Mile 484.5, as shown in **Figure 4–7**. A map of the site is shown in **Figure 4–8**. The Sequoyah Nuclear Plant site is approximately 12 kilometers (7.5 miles) northeast of the nearest city limit of Chattanooga, Tennessee. The corridor to the southwest of the site that encompasses the city of Chattanooga is considered a growth area in Hamilton County. The remaining area surrounding the site is rather sparsely settled. Development consists of scattered dwellings and associated small-scale farming. The sectors east of the site and the Chickamauga Reservoir are expected to retain their rural character (TVA 1996b). Land uses in the vicinity of the Sequoyah Nuclear Plant are classified as industrial, agricultural, forest, and recreational.

Industry

There is no significant industrial development in the immediate vicinity of the Sequoyah Nuclear Plant site. Chattanooga, an industrial center, lies 12 kilometers (7.5 miles) southwest of the site. A center of diversified light industry, Cleveland, lies 23 kilometers (14 miles) east-southeast of the site (TVA 1996b).

Agriculture

Nearly 28 percent of the 224,000 hectares (554,500 acres) that constitute the land area of Hamilton and Bradley Counties, Tennessee, about 62,500 hectares (154,400 acres), is dedicated to farming. Crop land accounts for 33,500 hectares (82,700 acres) of the total agricultural area. (GISP 1998d, GISP 1998e)

Forest

The total area of forested land in Hamilton County, Tennessee, is 85,270 hectares (210,700 acres). This area is made up of approximately 19 percent loblolly and short-leaf pine (softwood) forests, 59 percent oak-hickory forests, and the remainder is oak-pine stands (DOA 1998a, DOA 1998d).

Recreation

Water-based recreation is supported by the Chickamauga Reservoir, particularly in late spring, summer, and early fall. There are three primary public recreation facilities, Harrison Bay and Booker T. Washington State Parks and the Chester Frost County Park, as well as numerous commercial marinas, group camps, cottage developments, and small formal and informal public access areas along the reservoir shoreline (TVA 1996b).

Nature Reserves

The Soddy Creek waterfowl management area is located 4.8 kilometers (3 miles) upstream from the Sequoyah Nuclear Plant site. The Hiwassee Island Refuge is located 24 kilometers (15 miles) upstream. The Hiwassee Island Refuge is the principal waterfowl unit on the Chickamauga Reservoir.

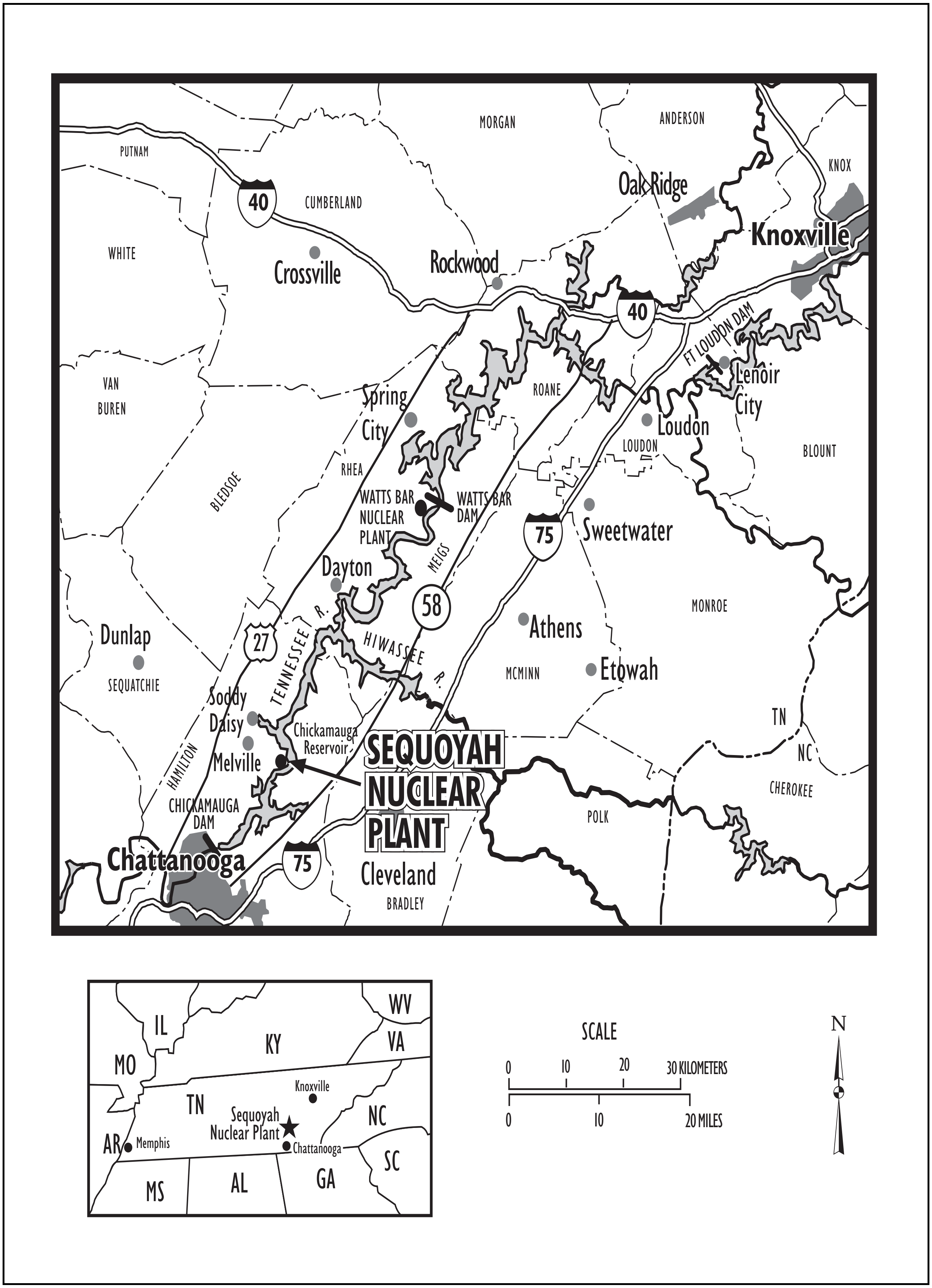

Figure 4–7 Location of the Sequoyah Nuclear Plant Site

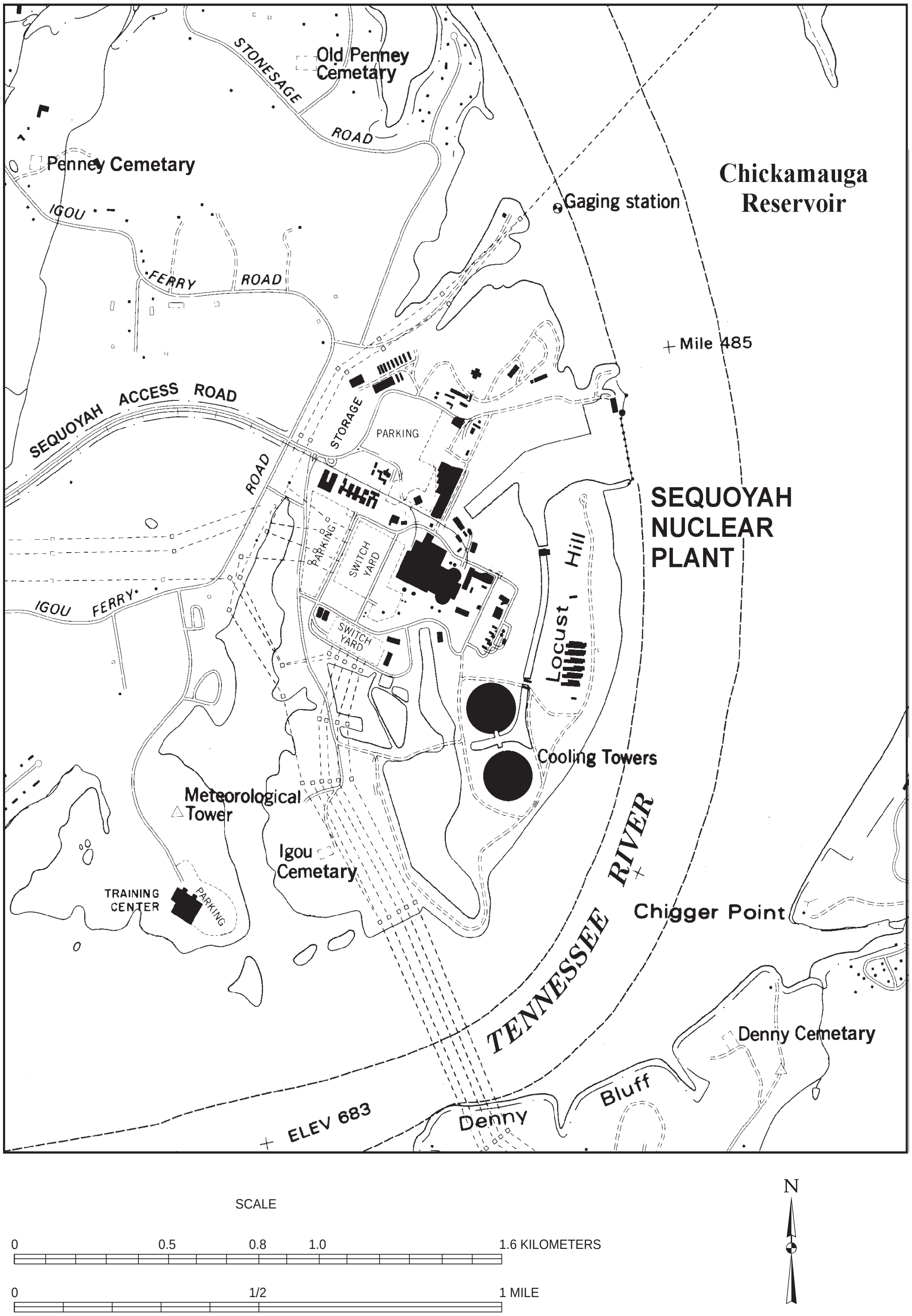

Figure 4–8 Sequoyah Nuclear Plant Site

Visual Resources

The major visual elements of the plant already exist, including the cooling towers, containment structures, turbine building, and transmission lines. Views of Sequoyah 1 and 2 from passing river traffic on the Tennessee River are partially screened by the wooded area east of the plant (TVA 1974a). The plant can be viewed from White Oak Mountain on the east side of the river. Distant glimpses of the plant site can be seen from the coves and hollows along the river and from various roads in the area, including U.S. Highway 27.

Based on the Bureau of Land Management Visual Resource Management method, the existing landscape at the Sequoyah Nuclear Plant site would be classified as Visual Resource Management Class 3 or 4. Class 3 includes areas where there has been a moderate change in the landscape and these changes may attract attention, but do not dominate the view of the casual observer. Class 4 includes areas where major modifications to the character of the landscape have occurred. These changes may be both the dominant features of the view and the major focus of viewer attention (DOI 1986a).

During operation of Sequoyah 1 and 2, the vapor plume associated with the cooling towers may be visible up to 10 miles away. Cooling towers are used approximately 2 percent of the time, usually during periods of low river flow or peak summer temperatures. The plume length and frequency of occurrence with direction varies with atmospheric conditions, being most visible during cooler months and after the passage of weather fronts. Vapor plumes are visible at times from nearby residential areas, U.S. Highway 27, Tennessee State Highway 58, and County Highway 5550 (TVA 1974a).

4.2.2.2 Noise

The most common measure of environmental noise impact is the day-night average sound level. The day-night average sound level is a 24-hour sound level with a 10-dBA penalty added to sound levels between 10:00 p.m. and 7:00 a.m to account for increased annoyance due to noise during nighttime hours. The EPA has developed noise level guidelines for different land-use classifications based on day-night average sound levels and equivalent sound levels. The U.S. Department of Housing and Urban Development has established noise impact guidelines for residential areas based on day-night average sound levels. Some states and localities have established noise control regulations or zoning ordinances that specify acceptable noise levels by land-use category. The State of Tennessee has not developed a noise regulation that specifies the numerical community noise levels that are acceptable.

For the purpose of this document, noise impacts are assessed using a day-night average sound level of 65 dBA as the level below which noise levels would be considered acceptable for residential land uses and outdoor recreational uses. Generally the noise levels off site are below day-night average sound levels of 65 dBA and are considered acceptable. Testing of the emergency warning siren system occurs on a regular basis and results in outdoor noise levels of about 60 dBA in areas within a radius of about 16 kilometers (10 miles) of the site. TVA typically tests siren systems on a given day of the month at noon.

4.2.2.3 Air Quality

Sequoyah 1 and 2 are located in Hamilton County in south-central Tennessee in the Chattanooga Interstate Air Quality Control Region. Ambient concentrations of criteria pollutants determined by monitoring air quality in the vicinity of Sequoyah 1 and 2 are compared with the applicable National Ambient Air Quality Standards and Tennessee State Ambient Air Quality Standards in **Table 4–13**.

Table 4–13 Comparison of Baseline Sequoyah 1 and 2 Ambient Air Concentrations with Most Stringent Applicable Regulations and Guidelines

Criteria Pollutant	Averaging Time	Most Stringent Regulation or Guideline[a] (μg/m³)	Baseline Concentration [b] (μg/m³)
Carbon monoxide	8-hour 1-hour	10,000[c] 40,000[c]	1,250 1,250
Lead	Calendar quarter	1.5[c]	0.03
Nitrogen dioxide	Annual	100[c]	9.4
Ozone	8-hour (4th highest averaged over 3 years)	157[c,d]	e
Particulate matter [d]	PM_{10} Annual 24-hour (interim) 24-hour 99th percentile (3-year average) $PM_{2.5}$ Annual (3-year average) 24-hour (98th percentile averaged over 3-years)	 50[c] 150[c] 150[c] 15[c] 65[c]	 20.3 39 e f f
Sulfur dioxide	Annual 24-hour 3-hour	80[c] 365[c] 1,300[c]	5.24 28.8 123
Other Regulated Pollutants			
Gaseous fluoride (as hydrogen fluoride)	30-day 7-day 24-hour 12-hour	1.2[g] 1.6[g] 2.9[g] 3.7[g]	h h h h
Total suspended particulates	24-hour	150[g]	39[i]

μg/m³ = micrograms per cubic meter

PM_n = particulate matter size less than or equal to *n* micrometers.

[a] The more stringent of the Federal and state standards is presented if both exist for the averaging time. Tennessee state and National Ambient Air Quality standards are the same for the criteria pollutants. The National Ambient Air Quality Standards (40 CFR 50), other than those for ozone, particulate matter, lead, and those based on annual averages, are not to be exceeded more than once per year. The 1-hour ozone standard is attained when the expected number of days per year with maximum hourly average concentrations above the standard is ≤ 1. The 1-hour ozone standard applies only to nonattainment areas. The 8-hour ozone standard is attained when the 3-year average of the annual fourth-highest daily maximum 8-hour average concentration is less than or equal to 157 μg/m³. The interim 24-hour PM_{10} standard is attained when the expected number of days with a 24-hour average concentration above the standard is ≤ 1. The annual arithmetic mean particulate matter standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard.

[b] Based on ambient air quality monitoring data at Bradley County location for 1994–1995, except for carbon monoxide from Loudon County (1996) and lead from the Rockwood monitor in Roane County (1996). Concentrations shown are maximums for the averaging period.

[c] Federal standard.

[d] EPA recently revised the air quality standards for particulate matter and ozone. The new standards, finalized on July 18, 1997, change the ozone primary and secondary standards from a 1-hour concentration of 235 μg/m³ (0.12 parts per million) to an 8-hour concentration of 157 μg/m³ (0.08 parts per million). During a transition period while states are developing state implementation plan revisions for attaining and maintaining these standards, the 1-hour ozone standard would continue to apply in nonattainment areas (62 FR 38855). For particulate matter, the current PM_{10} (particulate matter size less than or equal to 10 micrometers) annual standard is retained and two $PM_{2.5}$ (particulate matter size less than or equal to 2.5 micrometers) standards are added. These standards are set at 15 μg/m³ 3-year annual average arithmetic mean based on community-oriented monitors, and 65 μg/m³ 3-year average of the 98th percentile of 24-hour concentrations at population-oriented monitors. The current 24-hour PM_{10} standard is revised to be based on the 3-year average of the 99th percentile of 24-hour concentrations. The existing PM_{10} standards would continue to apply in the interim period (62 FR 38652).

[e] There is insufficient data to compare to the standard.

[f] Compliance with the new $PM_{2.5}$ standards is not evaluated since current emissions data for $PM_{2.5}$ are not available.

[g] State standard.

[h] No local monitoring data is available for gaseous fluoride.

[I] PM_{10} value is presented and would underestimate the total suspended particulates concentration. No monitoring data available for total suspended particulates.

Sources: TN DEC 1994, TVA 1998a.

The area in which Sequoyah 1 and 2 are located, the Chattanooga Interstate Air Quality Control Region, is designated by EPA as an attainment area with respect to the National Ambient Air Quality Standards for criteria pollutants (40 CFR 81). The Prevention of Significant Deterioration Class I areas closest to Sequoyah 1 and 2 are the Joyce Kilmer-Slickrock National Wilderness Area and Cohutta National Wilderness Area, Georgia. For locations that are in an attainment area for criteria pollutants, Prevention of Significant Deterioration regulations limit pollutant emissions from new sources and establish allowable increments of pollutant concentrations. Class I areas include national wilderness areas, memorial parks larger than 2,020 hectares (5,000 acres), and national parks larger than 2,340 hectares (6,000 acres). The Class I areas noted above are about 60 kilometers (37 miles) from Sequoyah 1 and 2 (TVA 1998d).

Sources of criteria air pollutant emissions at the Sequoyah Nuclear Plant site include diesel-powered emergency generators and fire protection pumps; site, trade, and employee vehicles; auxiliary boilers; and cooling towers. Small quantities of toxic chemicals and metals are emitted from the testing and operation of the diesel-fueled equipment, resulting in offsite concentrations of less than 0.0001 percent of the threshold limit value of any of these pollutants. One-tenth of the threshold limit value is often used as a guideline in identifying pollutants that may be of concern. Ozone is produced at the Sequoyah Nuclear Plant site by corona discharge (ionization of air) in the operation of transmission lines and substations, particularly at high voltages. Operation of electrical motors and generators also produces ozone. TVA minimizes corona discharge by optimizing, to the extent practicable, its design and construction of transmission facilities.

An analysis of the occurrence of visible plumes has been performed for Sequoyah. Naturally occurring fog with visibility equal to or less than 0.4 kilometers (0.25 miles) occurs in the vicinity of Sequoyah about 36 days per year. Occurrences of the plume descending to the ground or causing localized surface fogging or icing are infrequent (TVA 1974a).

Compliance with the new $PM_{2.5}$ standards was not evaluated since current emissions data for $PM_{2.5}$ are not available. When the calculated concentrations from onsite sources are combined with concentrations from offsite sources, the ambient air quality standards for carbon monoxide, nitrogen oxide compounds, particulate matter, and sulfur dioxide continue to be met.

Gaseous Radioactive Emission

Sequoyah 1 and 2 have three primary sources of gaseous radioactive emissions:

- Discharges from the gaseous waste management system
- Discharges associated with the exhaust of noncondensable gases in the main condenser if a primary to secondary leak exists
- Radioactive gaseous discharges from the building ventilation exhaust, including the reactor building, reactor auxiliary building, and the fuel handling building

The gaseous waste management system collects gaseous fission products (mainly noble gases) that accumulate in the primary coolant. A portion of the coolant is continually diverted to the coolant purification, volume, and chemical control system to remove contaminants and adjust the chemistry and volume. Noncondensable gases are stripped and sent to the gaseous waste management system, a series of gas storage tanks where the extended holdup time allows short half-life gases to decay, leaving only a small quantity of long half-life radionuclides to be released to the atmosphere. **Table 4–14** shows the annual gaseous radioactive emissions from Sequoyah 1 or Sequoyah 2.

Table 4–14 Annual Radioactive Gaseous Emissions from Sequoyah 1 or Sequoyah 2

Emission	Quantity
Fission gases (Curies)	120
Tritium (Curies)	25

Source: TVA 1998e, TVA 1999.

Meteorology and Climatology

The regional and local meteorology and climatology of the Sequoyah Nuclear Plant site described in TVA's *Final Environmental Statement, Sequoyah Nuclear Plant Units 1 and 2* (TVA 1974a) has been updated with more recent meteorological data from Chattanooga.

Regional Climate

The Sequoyah Nuclear Plant site is in the eastern Tennessee portion of the Southern Appalachian region. The predominant air masses affecting the Sequoyah Nuclear Plant site are interchangeably continental and maritime winter and spring—predominantly maritime in the summer and continental in the fall.

Data collected over a 30-year period (1961 to 1990) at the Chattanooga airport indicate the average annual temperature is 15.2°C (59.3°F); the average daily maximum temperature in July is 31.7°C (89°F); and the average daily minimum temperature in January is -2.2°C (28°F) (NOAA 1997a).

Precipitation of 0.025 centimeters (0.01 inches) or more occurs on an average of 117 days per year. The average monthly precipitation is 12.2 centimeters (4.80 inches); the maximum monthly average of 17.2 centimeters (6.76 inches) is reached in March.

Severe Weather

Wind storms with wind speeds exceeding 56 kilometers per hour (35 miles per hour), and occasionally 97 kilometers per hour (60 miles per hour), occur several times each year, particularly during winter, spring, and summer. High winds also may accompany thunderstorms that occur about 56 days per year, reaching a maximum frequency in July.

The current estimate of tornado strike probability at the Sequoyah site is 0.000044 per year (4.4 chances per 100,000 in a given year).

Local Meteorological Conditions

The terrain features of the region have some effect on the general climate. The mountain ridge and valley terrain aligned northeast-southwest over eastern Tennessee accounts for the predominant up-valley/ down-valley wind flow in lower elevations of 150 to 300 meters (500 to 1,000 feet). The Cumberland Plateau terrain at elevation 460 to 550 meters (1,500 to 1,800 feet) tends to moderate many of the migratory storms that move from the west across the region.

4.2.2.4 Water Resources

Surface Water

The Sequoyah Nuclear Plant site is located at Tennessee River Mile 484.5 on the Chickamauga Reservoir about 21 kilometers (13 miles) upstream of the Chickamauga Dam. Chickamauga Reservoir is TVA's sixth largest reservoir. The reservoir is 95 kilometers (59 miles) long on the Tennessee River and 51 kilometers (32 miles) long on the Hiwassee River, with an area of 14,300 hectares (35,356 acres) and a volume of 775 million cubic meters (628,000 acre-feet). At the Sequoyah Nuclear Plant site, the Chickamauga Reservoir is about 914 meters (3,000 feet) wide, with cross-sectional depths ranging up to 15 meters (50 feet) at normal pool elevation.

During the steam cycle, heat from Sequoyah 1 and 2 turbines is released when the steam passes through a condenser cooled with water from the Tennessee River. This water may be cooled by passing it through evaporative cooling towers. The cooling towers may be operated in open mode, helper mode, or closed mode. In open mode, the towers are not used. All cooling water is discharged first to a pond, then through diffuser pipes into the Tennessee River. In helper mode, water is cooled by the cooling towers before being discharged to the pond. From the pond, water is discharged through diffuser pipes into the Tennessee River. In closed mode, cooling is accomplished in the same manner as described for Watts Bar 1 in Section 3.2.5.1. When the cooling towers are used in closed mode, makeup water from the Tennessee River is needed to replace water losses due to evaporation, drift, and blowdown. In closed mode, most of the water is recirculated back to the condenser, and only the blowdown water is discharged to the pond. From the pond, water is discharged through diffusers into the Tennessee River. The cooling towers have only been used for approximately 2 percent of the plant operating time (TVA 1998d) to meet thermal discharge limits. At full power, the temperature of the water flowing through each condenser is raised by approximately 17°C (30°F) (TVA 1996b).

The open cooling mode using the diffuser pipes withdraws and returns 4,250,000 liters per minute (1,222,000 gallons per minute) with two units operating (TVA 1974a). In the cooling tower closed cycle cooling mode, approximately 249,745 liters per minute (65,978 gallons per minute) are withdrawn from the Tennessee River to make up for water lost through evaporation, small leaks, drift, and blowdown (TVA 1974a). When used, blowdown from a natural-draft cooling tower is discharged into the Tennessee River at a normal rate of 120,000 liters per minute (31,700 gallons per minute) (TVA 1974a).

The direct open cooling system uses a diffuser system that discharges water from diffuser pipes. One diffuser pipe is 4.9 meters (16 feet) in diameter and extends 107 meters (350 feet), while the other diffuser pipe is 5.2 meters (17 feet) in diameter and extends 213 meters (700 feet). These two pipes are perforated with several thousand 5-centimeter (2-inch) ports through which water is discharged into the Tennessee River for maximum thermal mixing (TVA 1974a). Diffusers are used to mix the blowdown with river water, thus limiting the temperature rise after mixing to less than 5.6°C (10°F) (TVA 1996c). This water is discharged under an NPDES Permit (TN DEC 1993a). Tritium production would not affect the thermal discharge characteristics of the plant.

River flow in the vicinity of the Sequoyah site is governed by hydropower operations at the upstream Watts Bar Dam (Tennessee River Mile 529.9) and the downstream Chickamauga Dam (Tennessee River Mile 471). Peaking hydropower operation at these two hydroprojects can cause short periods of zero or reverse flow near the Sequoyah Nuclear Plant site.

Surface Water Quality

The Tennessee Department of Environment and Conservation classifies the streams and creeks of Tennessee based on water quality, stream uses, and resident aquatic biota. Classifications are defined in the State of Tennessee Water Quality Standards. The Chickamauga Reservoir is classified by the Tennessee Division of Water Pollution Control as suitable for the following uses: municipal water supply, industrial water supply, fish and aquatic life, recreation, irrigation, livestock and wildlife watering, and navigation (TVA 1996b). Monitoring data for surface water in the vicinity of Sequoyah 1 and 2 are presented in **Table 4–15.**

Table 4–15 Summary of Surface Water Quality Monitoring in the Vicinity of the Sequoyah Nuclear Plant Site

Parameter	*Unit of Measure*	*Water Quality Criteria*	*Average Water Body Concentration*
Radiological			
Alpha (gross)	picocuries per liter	15[a]	1.9
Beta (gross)	picocuries per liter	50[b]	2.67
Tritium	picocuries per liter	20,000[a]	<300[c]
Nonradiological			
Manganese	milligrams per liter	0.05[d]	0.000956
Nitrate (as N)	milligrams per liter	10.0[a]	0.245
Arsenic	milligrams per liter	0.05[e]	0.00233
Barium	milligrams per liter	2.0[e]	<0.1
Cadmium	milligrams per liter	0.005[e]	0.000117
Chromium	milligrams per liter	0.1[e]	0.00333
Lead	milligrams per liter	0.005[e]	0.00142
Mercury	milligrams per liter	0.002[e]	0.0002
pH (acidity/alkalinity)	pH units	6.0–9.0[e]	7.52

[a] National Primary Drinking Water Regulations (40 CFR 141).
[b] Proposed National Primary Drinking Water Regulations.
[c] Below lower limit of detection of 300 picocuries per liter.
[d] National Secondary Drinking Water Regulations (40 CFR 143).
[e] Tennessee General Water Quality Criteria for Domestic Water Supply (TN DEC 1995).
Source: TVA 1998e, TVA 1998c, TN DEC 1998a.

Surface Water Use and Rights

From its head near Knoxville, Tennessee, to the Kentucky Dam near its mouth, the Tennessee River is a series of highly controlled multiple-use reservoirs. This chain of reservoirs provides flood control, navigation, generation of electric power, sport and commercial fishing, industrial and public water supply, waste disposal, and recreation.

There are two municipal drinking water supply intakes from the Tennessee River within 80 kilometers (50 miles) downstream of the Sequoyah site: East Side Utility and Tennessee American Water. In addition, there are nine industrial water intakes within 80 kilometers (50 miles) downstream of the Sequoyah site; the closest are the Gold Point Marina, Chickamauga Dam, Chickamauga Power Service Shop, and E.I. DuPont de Nemours and Company (TVA 1996b, TVA 1999).

In Tennessee, the state's water rights are codified in the Water Quality Control Act. Water rights are similar to riparian rights in that the designated usage of a water body cannot be impaired. To construct intake structures for the purpose of withdrawing water from available supplies, U.S. Army Corps of Engineers and TVA permits are required.

Liquid Chemical and Radioactive Effluents

The radionuclide contaminants in the primary coolant are the source of liquid radioactive effluent from Sequoyah 1 and 2. Liquid effluent varies considerably in composition. It may include nonradioactive contaminants and chemical constituents depending on the history and collection point of the liquid. Each source of liquid effluent receives an individual degree and type of treatment before storage for reuse or discharge to the environment under the Sequoyah 1 and 2 NPDES Permit. To increase the efficiency of waste processing, wastes of similar characteristics are grouped together before treatment. The Sequoyah 1 or Sequoyah 2 liquid effluent to the environment during normal operation are shown in **Table 4–16**.

Table 4–16 Annual Chemical and Radioactive Liquid Effluents from Operation of Sequoyah 1 or Sequoyah 2

Materials	*Quantity*
Chemicals (kilograms)	294,012 [a]
Tritium (Curies) Other Radionuclides (Curies)	714 [b] 1.15 [b]

[a] TVA 1996b.
[b] TVA 1998e, TVA 1999.

Floodplains and Flood Risk

At the Sequoyah Nuclear Plant the 100-year floodplain for the Tennessee River would be at elevation 209.4 meters (687 feet) above mean sea level. The TVA Flood Risk Profile elevation on the Tennessee River would be elevation 210 meters (689 feet). The Flood Risk Profile is used to control flood damageable development for TVA projects and is based on the 500-year flood elevation (TVA 1998e). The safety-related facilities, systems, and equipment are housed in structures that provide protection from flooding for all flood conditions up to plant grade at the reactor building elevation of 215 meters (705 feet). Rainfall floods exceeding this elevation would require plant shutdown. The situation producing the maximum plant site flood level was determined to be one of two events: (1) a sequence of March storms producing maximum precipitation on the watershed above Chattanooga, or (2) a sequence of March storms centered and producing maximum precipitation in the basin to the west of the Appalachian Divide and above Chattanooga. Seismic and flood events could cause dam failure surges above the plant grade elevation of 219 meters (720 feet) (TVA 1996b).

Groundwater

Groundwater at the Sequoyah Nuclear Plant site is derived principally from local precipitation. The average annual precipitation is 1.47 meters (58 inches). There is no distinct aquifer in the Conasauga Shale that underlies the Sequoyah Nuclear Plant site. The groundwater occurs in small openings that rapidly decrease in size and depth along fractures and bedding planes. The shales and limestones provide relatively low permeability compared to terrace deposits and, therefore, the majority of the discharge of groundwater occurs by movement along the strike of bedrock to the northeast and southwest into the Chickamauga Reservoir.

Groundwater Quality

A total of 16 groundwater monitoring wells have been installed at the Sequoyah Nuclear Plant site. Older monitoring wells at the site are primarily bedrock monitoring wells. Monthly groundwater levels are obtained at all wells except for two: one destroyed during cooling tower construction and the other installed with an automatic sampler for routine monitoring of radiological contaminants. Two of the wells were installed near the low-level radiological waste storage area in August 1981 to obtain background groundwater radiological data (TVA 1998e).

Groundwater Availability, Use, and Rights

There are 8 public groundwater supplies and 24 industrial water supplies drawn from wells within a 32-kilometer (20-mile) radius of the Sequoyah Nuclear Plant site. Two supplies are taken from groundwater springs. There is no groundwater use at the Sequoyah Nuclear Plant site.

Groundwater rights in the State of Tennessee are traditionally associated with the Reasonable Use Doctrine. Under this doctrine, landowners can withdraw groundwater to the extent that they exercise their rights reasonably in relation to the similar rights of others.

4.2.2.5 Geology and Soils

Geology

The controlling feature of the geologic structure at the site is the Kingston thrust fault that developed some 250 million years ago. The fault has been inactive for many millions of years and recurrence of movement is not expected. The fault crosses the northwestern portion of the site area; however, it was not involved directly in the foundation for any of the major plant structures.

Seismology

The Sequoyah Nuclear Plant site lies within the borders of the Southern Appalachian Seismotectonic Province, a Zone 1 (minor damage region) on the U.S. Geologic Survey Seismic Probability Map of the United States. The seismic history of the southeastern United States since 1776 indicates that there has been no seismic activity originating in the site area. Sequoyah 1 and 2 were designed based on the largest historic earthquake to occur in the Southern Appalachian Tectonic Province, the 1897 Giles County, Virginia, earthquake (intensity: Modified Mercalli VIII and Richter magnitude of 6 to 7). The safe-shutdown earthquake for the plant was established at a maximum horizontal acceleration of 0.18 g (g = acceleration due to gravity) and a simultaneous maximum vertical acceleration of 0.12 g (TVA 1996b). The safe-shutdown earthquake is defined as the earthquake that produces the maximum ground vibration for which: (1) the reactor coolant pressure boundary, (2) the capability to shut down the reactor and maintain it in the shutdown mode, and (3) the capability to prevent or mitigate the consequences of accidents that could result in offsite exposures comparable to the guideline exposures are designed to remain functional (10 CFR 100, Appendix A).

Soils

The Conasauga Formation provides a satisfactory and competent foundation for the plant structures. Cores from holes drilled in the plant area indicate no evidence of weathering below the upper 1.5 meters (5 feet) of the rock that would be removed under normal construction procedures. Physical testing, both static and dynamic, has shown that the unweathered rock is capable of supporting loads in excess of those that would be imposed by the plant structures. The Conasauga Formation at the site is relatively unfossiliferous and has no known areas of unique paleontological significance.

4.2.2.6 Ecological Resources

Terrestrial Resources

The Sequoyah Nuclear Plant site is located within the Ridge and Valley Physiographic Province. This province lies between the Blue Ridge Mountains and the Cumberland Plateau and is characterized by prominent, northwest-trending ridges and adjacent valleys. The Tennessee River flows through this province, roughly paralleling the alignment of the valleys. The Sequoyah Nuclear Plant site is located near the center of Hamilton County, Tennessee, approximately 12 kilometers (7.5 miles) northeast of the Chattanooga city limits. The area immediately surrounding the site is primarily open agricultural lands with scattered forests.

Terrestrial Wildlife

Hamilton and Bradley Counties, Tennessee, are in the vicinity of the Sequoyah Nuclear Plant site and provide habitat for seven upland game species: white-tailed deer, gray squirrel, raccoon, wild turkey, ruffed grouse, cottontail rabbit, and bobwhite quail. The largest deer populations are located along the western border of Hamilton County (Waldens Ridge) and in the northeastern corner of Hamilton County near the junction of the Hiwassee and Tennessee Rivers. Squirrel populations occur in large stands of hardwoods, while raccoons and rabbits are most common in the wide, rolling valleys between the ridges (TVA 1974a).

The mixture of forest and open vegetative types of terrain and the large degree of openness within the forest provide an abundance of niches favoring a diverse bird population. The diverse habitat sites surrounding the plant support varied and abundant populations of snakes, frogs, salamanders, and other reptiles (TVA 1974a).

Wetlands

The potential wetland areas identified in the vicinity of the Sequoyah Nuclear Plant site are: (1) palustrine, bottomland hardwood deciduous, temporarily flooded wetlands and (2) fringe wetlands. They are indicated in **Figure 4–9** (TVA 1974a).

Aquatic Resources

The Chickamauga Reservoir in the vicinity of the site includes areas of varying depth, blind nonflowing embayments, tributary streams, peninsulas, inundated reservoir shallows (overbank areas), and the navigation channel or old riverbed. The area is characterized by embayments and shallow overbanks that alternate between right and left banks as the channel changes course. There are extensive shallow areas in the stretch approximately 3.2 to 6.4 kilometers (2 to 4 miles) downstream from the Sequoyah Nuclear Plant site (TVA 1974a).

There are a variety of benthic substrates in the area. They range from bedrock to fine organic leaf fragments. The substrate of greatest areal extent is composed of mixed sand, clay, and silt (TVA 1974a).

Fish Communities

Preoperational monitoring for the Sequoyah Nuclear Plant site was conducted from 1971 to 1977. Operational monitoring occurred from 1980 to 1986. Species designated as important to the Chickamauga Reservoir (sauger, crappie, white bass, and channel cat fish) were monitored from 1986 to 1995.

The fish community of the Chickamauga Reservoir, as in most main stream Tennessee River impoundments, is dominated by gizzard and threadfin shad. Rough fish, especially carp, drum, and smallmouth buffalo, also contribute significantly to standing crop (biomass) estimates. Among the sport fish, largemouth and spotted

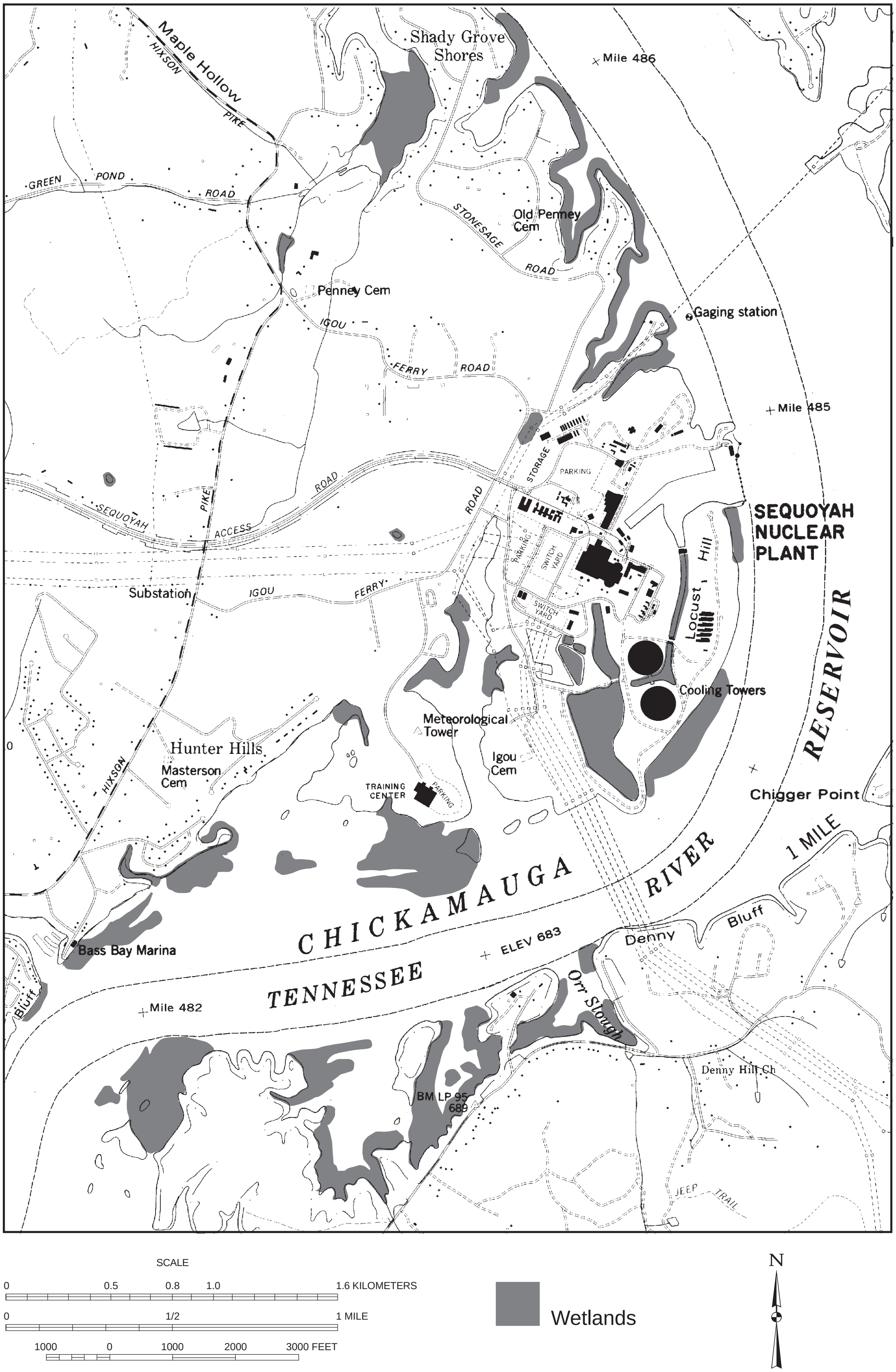

Figure 4–9 Wetlands Map of the Sequoyah Nuclear Plant Site Vicinity

bass, bluegill, redear and longear sunfish, crappie, and sauger are abundant, but smallmouth bass and walleye are rare. The Tennessee Wildlife Resources Agency reported the commercial fish harvest from Chickamauga Reservoir during 1994 to be 63,908 kilograms (140,892 pounds) of fish, primarily channel and blue catfish, buffalo, and common carp (Tennessee 1994).

Mussel and Clam Communities

Very few native mussels persist in the impounded river habitat adjacent to the Sequoyah Nuclear Plant site. Recent sampling in this part of Chickamauga Reservoir produced only a few individuals representing eight wide-ranging species. Large numbers of native mussel species occur in seminatural reaches of the Tennessee River not far downstream from Chickamauga Dam (at Tennessee River Mile 471) and in an approximate 25-kilometer (15-mile) reach downstream from Watts Bar Dam (at Tennessee River Mile 529). These areas are at least 20 kilometers (13 miles) downstream and 30 kilometers (19 miles) upstream from the Sequoyah Nuclear Plant site (Tennessee River Mile 483). There has not been any commercial harvest of native mussels from the downstream part of Chickamauga Reservoir within the last 20–25 years.

An important factor contributing to the decline in native mussel populations was the loss of habitat following impoundment of the river. Dam construction slowed the flow of the river, thereby permitting silt to settle and other bottom conditions. Mussels generally prefer gravel or a mixture of sand, mud, and gravel, but do not survive in deep silt.

While habitat for native mussels is scarce in this impounded part of the Tennessee River, suitable habitat supports large populations of the exotic Asiatic clam, *Corbicula fluminea*, and a few native snails. Also, the zebra mussel, *Dreissena polymorpha*, has been found in this area within the last few years. The Asiatic clam has been present in the Chickamauga Reservoir for at least 30 years (TVA 1998e).

Other Aquatic Life

There is an abundance of aquatic life in the Chickamauga Reservoir. The dominant spring and fall phytoplankton is typically a species of *Melosira*. The summer flora is dominated by two or three species of green algae. Blue-green algae are represented, but are not abundant. A large portion of zooplankton density is composed of rotifers. However, calenoid, copepods, and cladocerans are also plentiful.

As a rule, bottom fauna communities are not diverse and species populations are small. An exception is the Asiatic clam, *Corbicula fluminea,* which achieves densities of 2,000 per square meter (217.8 per square feet) in limited areas. Asiatic clam densities fluctuate throughout the reservoir, but densities are much less in the lacustrine portions. The most abundant insects are the burrowing mayfly, *Hexagenia bilineata*, and midges of the family *Chironomidae*.

Aquatic Macrophytes

In the reach of the Chickamauga Reservoir above the Sequoyah site (toward the Watts Bar site), some embayments support colonies of coontail, potamogetons, and cattails. A chemical control program has been used to suppress a Eurasian watermilfoil invasion. Only a few submerged or emergent macrophytes occur in the immediate area of the Sequoyah site (TVA 1974a).

Threatened and Endangered Species

The 1974 Final Environmental Statement for the Sequoyah Nuclear Plant (TVA 1974a) listed a few endangered or threatened species potentially occurring near the Sequoyah site. Based on more recent information, several terrestrial and aquatic species listed as endangered or threatened by the U.S. Fish and Wildlife Service or state agencies in Tennessee could occur in the general vicinity of the Sequoyah site (**Table 4-17**). Additional information on the status and biology of the Federally listed species in Table 4-17 (except for mountain skullcap) is contained in the biological assessment included in the 1995 NRC Watts Bar Nuclear Plant Final EIS (NRC 1995b), which is incorporated here by reference.

Table 4–17 Listed Threatened or Endangered Species Potentially On or Near the Sequoyah Nuclear Plant Site

Common Name	*Scientific Name*	*Federal*	*State*
Plants			
Large-flowered Skullcap	*Scutellaria montana*	Endangered	Endangered
Mollusks			
Orange-footed Pearlymussel	*Plethobasus cooperianus*	Endangered	Endangered
Pink Mucket	*Lampsilis abrupta/Lampsilis orbiculata*	Endangered	Endangered
Fish			
Blue Sucker	*Cyprogenia elongata*	Not Listed	Threatened
Snail Darter	*Percina tanasi*	Threatened	Threatened
Amphibians			
Eastern Hellbender	*Cryptobranchus a. alleganiensis*	Not Listed	In Need of Management
Birds			
Bald Eagle	*Haliaeetus leucocephalus*	Threatened	Threatened
Osprey	*Pandion haliaetus*	Not Listed	Threatened
Peregrine Falcon	*Falco peregrinus*	Endangered	Endangered
Mammals			
Gray Bat	*Myotis grisescens*	Endangered	Endangered
Indiana Bat	*Myotis sodalis*	Endangered	Endangered

Source: NRC 1995b, TVA 1998e, Tennessee 1994, DOI 1998a.

Plants

The large-flowered skullcap (also known as the mountain skullcap) is a perennial herb in the mint family. It is restricted to three counties in southeast Tennessee and four counties in northwest Georgia. It occurs on rocky, relatively dry forested slopes and ravines and along forested streams with gravelly, fine sandy loam soils. It was first listed in 1986, when it was known to exist at a total of 10 different locations. Since then, it has been found at many more locations and is presently known to exist at 36 sites with a minimum total population of 48,000 individuals. Because some of the recovery objectives for this species have been met, the U.S. Fish and Wildlife Service recently began a review of its status (DOI 1996, DOI 1998b).

A population of large-flowered skullcap occurs on a steep bluff across the Tennessee River from the Sequoyah Nuclear Plant site, and several other skullcap populations occur within a few kilometers of the site. No suitable habitat for this species occurs on the Sequoyah Nuclear Plant site (TVA 1998e).

A population of the small whorled pogonia, *Isotria medeoloides*, Federally listed as threatened and state-listed as endangered, occurs on Walden Ridge about 24 kilometers (15 miles) southwest of the Sequoyah Nuclear

Plant site. This widespread species occurs in open, dry deciduous woods with acid soil (DOI 1992). Little suitable habitat occurs on the Sequoyah site, and the species has not been found during field surveys of the site.

Terrestrial Animals

The bald eagle is a fairly common winter resident and rare summer resident on the Chickamauga Reservoir. Its summer population has increased in the last decade and in early 1999 a pair nested in a wooded area on the Sequoyah site. Ospreys feed primarily on fish and regularly occur on the Chickamauga Reservoir. None have been known to nest in the immediate vicinity of the Sequoyah site. The peregrine falcon formerly nested on the Cumberland Escarpment in Hamilton County and very recently nested on a bridge spanning the Chickamauga Dam tailwater. Suitable nest habitat does not occur in the vicinity of the Sequoyah plant. The peregrine falcon is, however, a rare migrant in the area. Peregrine falcons feed mostly on waterfowl, shorebirds, and, in urban areas, pigeons.

No caves inhabited by gray bats are known to be near the Sequoyah Nuclear Plant site; it is likely, however, that gray bats forage over adjacent portions of the Chickamauga Reservoir. The Indiana bat has not been observed at the Chickamauga Reservoir or elsewhere in Hamilton County. It is known to hibernate in caves in other areas of east Tennessee and in northeast Alabama and periodically is seen in riparian forests along the Chickamauga Reservoir. Little suitable habitat occurs on the Sequoyah site (TVA 1998e).

Aquatic Animals

No endangered or threatened aquatic species are known or are likely to occur in the impounded part of the Chickamauga Reservoir adjacent to the Sequoyah Nuclear Plant site. Present conditions in this part of the reservoir are quite unlike the flowing water, rocky bottom habitats in which nearly all the Tennessee River's endangered and threatened species normally occur.

Four protected aquatic species listed in Table 4-17 occur in the Tennessee River not far downstream from Chickamauga Dam, 20 kilometers (13 miles) downstream from the Sequoyah site. Of these species, only the endangered pink mucket and the threatened snail darter have been encountered in the Chickamauga Dam tailwater within the last decade. The State of Tennessee has listed the blue sucker as a threatened species and the hellbender to be "in need of management." Both of these species have been observed only on rare occasions in the Chickamauga Dam tailwater.

Three other aquatic species, all Federally listed as endangered, were found in preimpoundment surveys of nearby portions of the Tennessee River. These species are the fine-rayed pigtoe, *Fusconaia cuneolus*, the tuberculed-blossom pearlymussel, *Epioblasma torulosa Dysnomia torulosa*, and the Cumberland monkeyface pearlymussel, *Quadrula intermedia*. They all inhabit gravel riffles in medium to large rivers and have not been found in the Chickamauga Reservoir or its tailwaters for 25 years.

4.2.2.7 Archaeological and Historic Resources

No archaeological survey was conducted prior to the initiation of construction activities at the Sequoyah Nuclear Plant site. An archaeological survey of the site was conducted on June 16, 1973, after construction activity was well advanced (TVA 1974a).

No properties on the National Register of Historic Places were identified by a Tennessee Historical Commission review of the Sequoyah Nuclear Plant site (TVA 1974a).

Construction of Sequoyah 1 and 2 is complete, and the reactors have operated since 1980 and 1982, respectively. The operational experience to date has not identified any impact on archaeological or historic resources on or near the Sequoyah Nuclear Plant site.

4.2.2.8 Socioeconomics

The Sequoyah Nuclear Plant is near the town of Soddy Daisy, in Hamilton County, Tennessee. Its precise location is latitude 35°13'24" north and longitude 85°5'16" west (NRC 1998d). Soddy Daisy is about 11 kilometers (7 miles) northeast of Chattanooga, Tennessee, and about 129 kilometers (80 miles) southwest of Knoxville, Tennessee. Highway access from the plant to Soddy Daisy and Chattanooga is via State Route 27. State Route 27 also links the plant to State Route 68 to the north, to Interstate Highway 40 about 73 kilometers (45 miles) to the north, and to State Routes 11, 127, 41, and Interstate Highway 75.

Demography

According to the U.S. Census, the population of Soddy Daisy was 8,240 in April 1990 (DOC 1998c). The estimated population in mid-1996 was 8,884, indicating a growth rate from 1990 to 1996 of almost 8 percent.

Hamilton County had an estimated population of 285,536 in 1990 (DOC 1998c). It also had 79,031 families and 111,380 households in that year. **Table 4–18** shows demographic data for Soddy Daisy, Hamilton County, and the Sequoyah region of influence. The Sequoyah region of influence was defined as the area within 80 kilometers (50 miles) of the Sequoyah Nuclear Plant.

Table 4–18 General Demographic Characteristics of Soddy Daisy, Hamilton County, and the Sequoyah Region of Influence (1990 U.S. Census)

Demographic Measure	*Soddy Daisy*	*Hamilton County*	*Sequoyah Region of Influence*
Total population	8,240	285,536	857,880
Families	2,468	79,031	245,206
Households	3,213	111,380	325,243
Male	3,961	134,510	413,227
Female	4,279	151,026	444,654

Sources: DOC 1992, DOC 1998c.

The Sequoyah region of influence had an estimated population of 857,880 in 1990 (DOC 1992). The number of households in the region of influence was about 325,000 in 1990; the number of families was about 245,000. **Table 4–19** shows Hispanic and non-Hispanic populations residing within 80 kilometers (50 miles) of the Sequoyah Nuclear Plant site.

Table 4–19 Population Distribution by Ethnic Group in Soddy Daisy, Hamilton County, and the Sequoyah Region of Influence (1990 U.S. Census)

Ethnic Group or Subgroup (U.S. Census Definitions)	*Soddy Daisy*		*Hamilton County*		*Sequoyah Region of Influence*	
	Population	*Percentage of Total Population*	*Population*	*Percentage of Total Population*	*Population*	*Percentage of Total Population*
White not of Hispanic origin	8,176	99.22	226,222	79.23	758,404	90.20
Black not of Hispanic origin	36	0.44	54,251	19.00	69,553	8.27
American Indian, Aleut, or Eskimo not of Hispanic origin	8	0.10	762	0.27	2,714	0.32
Asian or Pacific Islander not of Hispanic origin	0	0.00	2,339	0.82	3,601	0.43
Other race not of Hispanic origin	0	0.00	97	0.03	178	0.02
White of Hispanic origin	7	0.09	1,237	0.43	3,674	0.44
Black of Hispanic origin	0	0.00	126	0.04	199	0.02
American Indian, Aleut, or Eskimo of Hispanic origin	0	0.00	10	0.00	53	0.01
Asian or Pacific Islander of Hispanic origin	13	0.16	42	0.01	62	0.01
Other race of Hispanic origin	0	0.00	450	0.16	2,403	0.29
Hispanic total	20	0.24	1,865	0.65	6,391	0.76
Total population (all ethnic groups)	8,240	100.00	285,536	100.00	840,840	100.00

Note: Sum of items may not add up to population total due to rounding error.
Source: DOC 1992, DOC 1998c.

Figure 4–10 shows the projected racial and ethnic composition of the population residing within 80 kilometers (50 miles) of the Sequoyah Nuclear Plant site. Low-income households, as determined from 1990 Census data, are presented on **Figure 4–11**. Low-income households are those with incomes of 80 percent or lower than the median income of the counties. As indicated in that figure, approximately 43 percent of the total households are low-income households (see Appendix G).

Income

Per capita income in Soddy Daisy was $10,709 in 1989, while median household and family income were $22,115 and $27,022, respectively (DOC 1998c). Total personal income in Hamilton County was $7.4 billion in 1996, up from $7.13 billion in 1995 (DOC 1998a). Per capita income in the county was $25,401 in 1996, up from $24,316 in 1995. Hamilton County was ranked fourth in the State of Tennessee in terms of per capita income in 1996. **Table 4–20** summarizes income data for Soddy Daisy and Hamilton County.

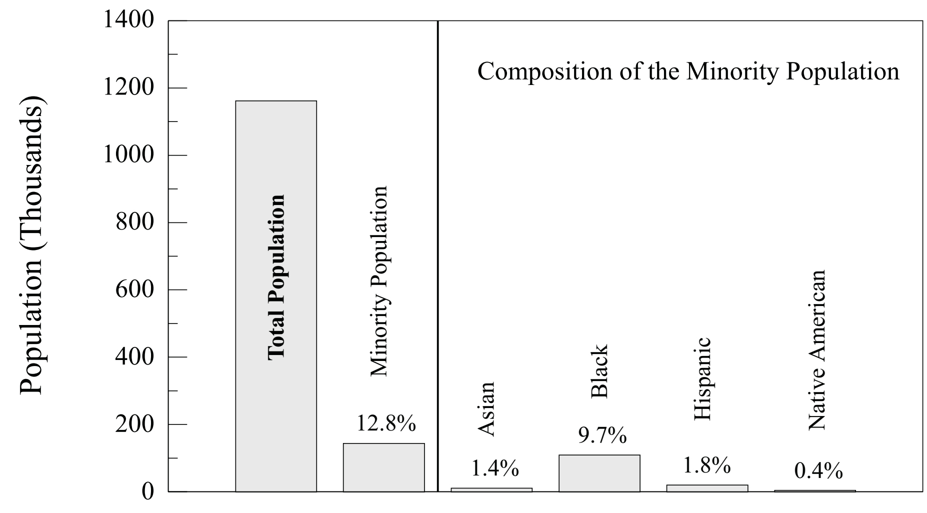

Figure 4–10 Racial and Ethnic Composition of the Minority Population Residing in Counties Within 80 Kilometers (50 Miles) of the Sequoyah Nuclear Plant Projected for the Year 2025

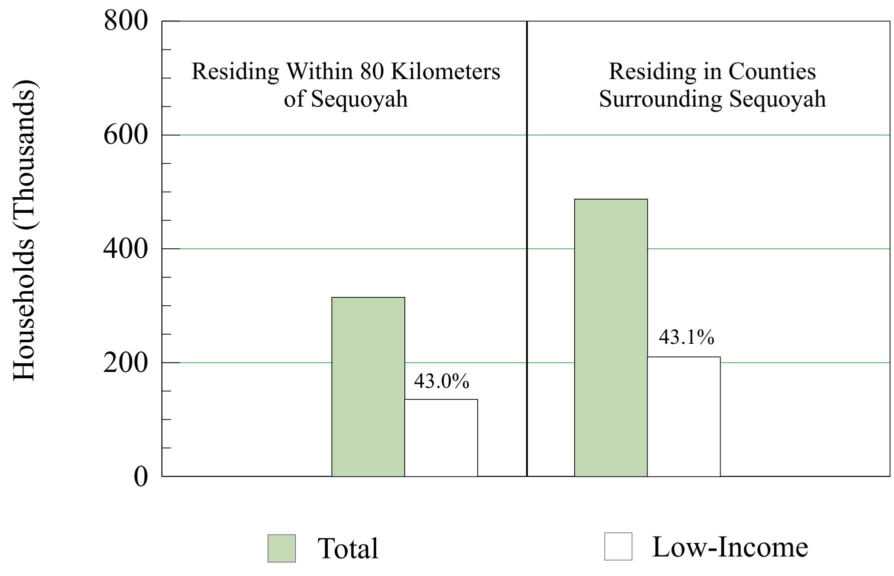

Figure 4–11 Low-Income Households Residing Within 80 Kilometers (50 Miles) of the Sequoyah Nuclear Plant (1990)

Table 4–20 Income Data Summary for Soddy Daisy and Hamilton County (1989)

Income Measure	*Soddy Daisy*	*Hamilton County*
Per capita income	$10,709	$13,619
Median household income	$22,115	$26,523
Median family income	$27,022	$32,185
Median housing value	$46,700	$61,700

Sources: DOC 1998c.

Community Services

Education, public safety, and health care were examined to determine the level of community services for the region of influence.

Education

There are 396 schools within an 80-kilometer (50-mile) radius of the Sequoyah Nuclear Plant site, with a capacity of 135,755 students. The average student-to-teacher ratio is 17:1.

Public Safety

City, county, and state law enforcement agencies provide police protection to residents of the region of influence. The average officer-to-population ratio is 1.4:1,000 persons. Fire protection services are provided by both paid and volunteer firefighters. The ratio of firefighters to the population is 0.7:1,000.

Health Care

The region of influence includes 31 hospitals with a total of 3,672 beds. All of the hospitals are operating below capacity.

Local Transportation

The nearest land transportation routes are State Route 58, about 8 kilometers (5 miles) east of the site and paralleling the east bank of the Tennessee River, and U.S. Highway 27, also 8 kilometers (5 miles) from the site on the west side of the river. State Route 60 passes the northeast quadrant of the site at a distance of about 16 kilometers (10 miles). Interstate Route 75 passes the site from northeast to southwest at a distance of about 14.5 kilometers (9 miles) en route to Chattanooga. A main line of the CNO&TP Railroad (Norfolk Southern Corporation) runs adjacent to Interstate Highway 27 west of the site. The TVA railroad spur connecting the Sequoyah Nuclear Plant site is in good condition from the plant to the CNO&TP tie-in. On the site, 61 meters (200 feet) of track have been removed from the auxiliary building railroad bay. Replacement of this track and other maintenance of the onsite track would be necessary before it could be used. The Tennessee River is navigable past the site and is used as a major barge route (TVA 1996b). These transportation routes are shown in **Figure 4–12**.

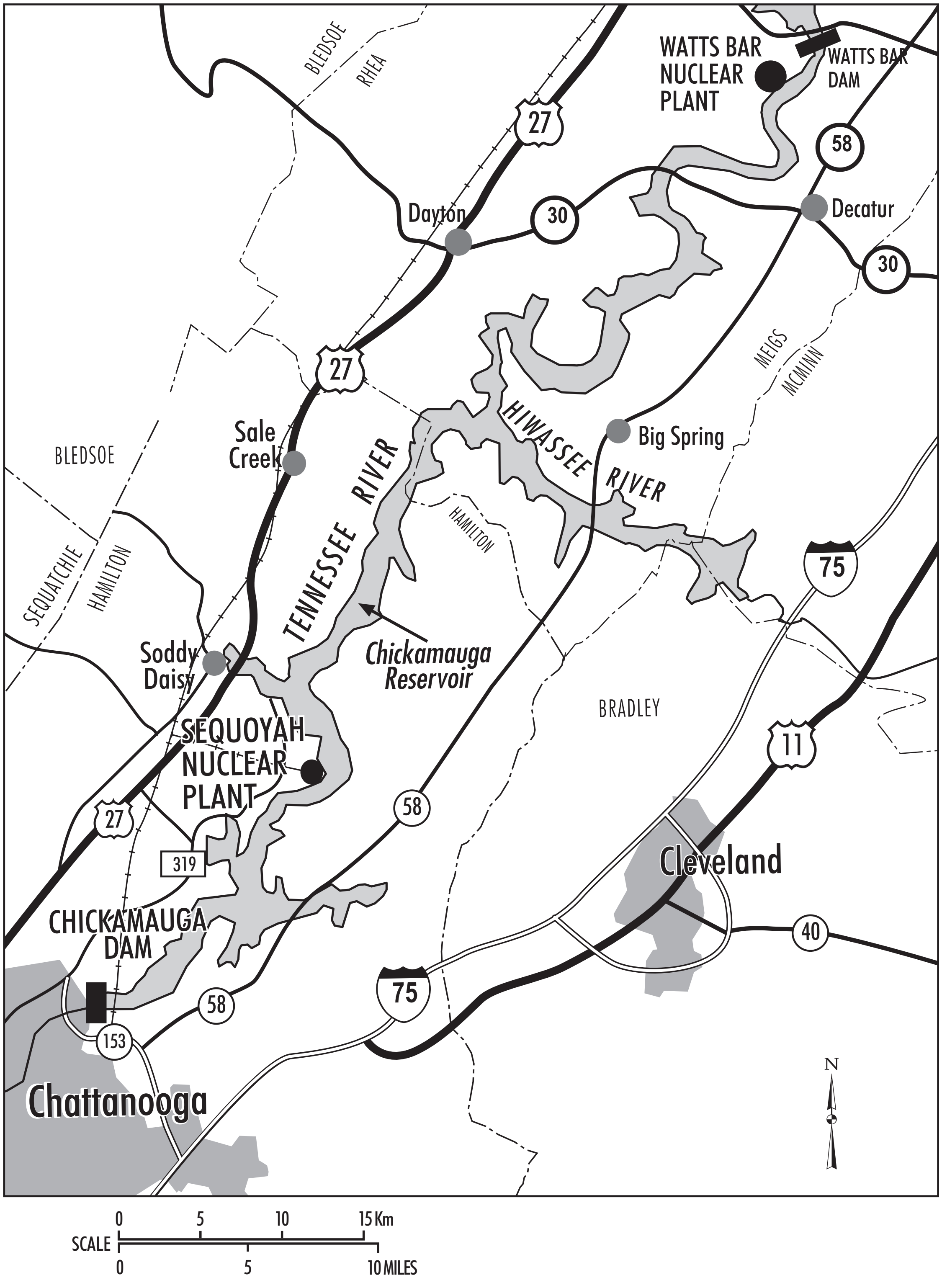

Figure 4–12 Transportation Routes in the Vicinity of the Sequoyah Nuclear Plant Site

The major surface roads mentioned above and the network of local roads connecting with them adequately serve the needs of the local communities and TVA employees at the Sequoyah Nuclear Plant site.

4.2.2.9 Public and Occupational Health and Safety

Radiation Environment

Background radiation exposure to individuals in the vicinity of the Sequoyah Nuclear Plant site is expected to be the same as for the Watts Bar site. The background radiation exposure at the Sequoyah site is presented in **Table 4–21.** The annual doses to individuals from background radiation are expected to remain constant over time. Thus, any incremental change in the total dose to the population would be a function only of a change in the size of the population.

Table 4–21 Sources of Background Radiation Exposure to Individuals in the Vicinity of the Sequoyah Nuclear Plant Site[a]

Source	***Total* Effective Dose Equivalent (millirem per year)**
Natural Background Radiation	
Cosmic and cosmogenic radiation	28
External terrestrial radiation	28
In the body	39
Radon in homes (inhaled)	200
Total	295
Other Sources of Radiation	
Release of radioactive material in natural gas, mining, ore processing, etc.	5
Diagnostic x-rays and nuclear medicine	53
Nuclear energy	0.28
Consumer and industrial products	0.03
Total	355

[a] Values are based on average national data, not measured values at the Sequoyah site.
Source: TVA 1998b.

Radionuclides released in effluents from Sequoyah 1 and 2 are a potential source of radiation exposure to individuals in the vicinity of Sequoyah 1 and 2 and are additional to the background radiation values listed. Calculations of radiation doses to individuals and the population surrounding the plant were performed by TVA using measurements from the various radiological monitoring points around the plant during operation in 1997, as well as conservative assumptions regarding individual and population exposure time. The doses are presented in **Table 4–22.**

Radiation doses to onsite workers include the same background dose received by the general public plus an additional dose from working in the facility.

Table 4–22 Annual Doses to the General Public During 1997 from Normal Operation at Sequoyah 1 or Sequoyah 2 (Total Effective Dose Equivalent)

Affected Environment	Airborne Releases		Liquid Releases		Total	
	Most Stringent Standard[a]	Calculated Based on Actual Measurements	Most Stringent Standard[a]	Calculated on the Basis of Actual Measurements	Most Stringent Standard[b]	Calculated on the Basis of Actual Measurements
Maximally exposed offsite individual (millirem)	5	0.031	3	0.022	25	0.053
Population within 80 kilometers (50 miles), (person-rem) [b]	None	0.37	None	0.79	None	1.16
Average dose to an individual within 80 kilometers (50 miles) (millirem) [c]	None	0.00039	None	0.00085	None	0.0012

[a] From 10 CFR 50, Appendix I (design objectives for equipment to control releases of radioactive materials in effluents from nuclear power reactors). The standard for the maximally exposed individual (25 millirem per year total body from all pathways) is given in 40 CFR 190.
[b] Population used: 933,852.
[c] The average is obtained by dividing the population dose by the 50-mile radius population.
Source: TVA 1998e.

Direct Radiation

Radiation fields are produced in nuclear plant environs as a result of the radioactivity contained in the reactor and its associated components. Doses from sources within the plant are largely due to nitrogen-16, a radionuclide produced from the primary coolant in the reactor core. Since the primary coolant of pressurized water reactors is contained in a heavily shielded area of the plant, dose rates from direct radiation in the vicinity of pressurized water reactors are generally less than 5 millirem per year.

The plant operator committed to design features and operating practices that ensure that individual occupational radiation doses are within the occupational dose limits defined in 10 CFR 20, and that individual and total plant operational doses would be as low as is reasonably achievable. The combined radiation doses received by the onsite worker are shown in **Table 4–23**.

Table 4–23 Annual Worker Doses from Normal Operation at Sequoyah 1 or Sequoyah 2 During 1996

Affected Environment	Standard[a]	Dose[b]
Average worker (millirem)	None	90
Maximally exposed worker (millirem)	5,000	≤ 2,000
Total workers (person-rem)	None	132

[a] NRC regulatory limit: 10 CFR 20.
[b] TVA 1996 report based on 1,470 badged workers per unit.
Source: NRC 1997b.

Chemical Environment

Nonradioactive chemical wastes from Sequoyah 1 and 2 include boiler blowdown, water treatment wastes (sludges and high saline streams whose residues are disposed of as solid wastes and biocides), boiler metal cleaning, floor and yard drains, and stormwater runoff. Processes for defouling facility piping produce about 22,000 kilograms per year (24 tons per year) of organic residue byproducts and halites (oxygenated chlorine and bromine ions) per reactor.

Operation of Sequoyah 1 and 2 takes into account the storage of process chemicals and disposal of the waste products. Adverse health impacts to the public are minimized through administrative and design controls to decrease hazardous chemical releases to the environment and to achieve compliance with permit requirements (such as air emissions and NPDES Permit requirements). The effectiveness of these controls is verified by monitoring information about and inspecting compliance with mitigation measures.

Section 4.2.2.3, Table 4–13, and Section 4.2.2.4, Table 4–15, contain data on chemical concentrations in ambient air and surface water in the vicinity of the Sequoyah site.

Emergency Preparedness

The license issued by the NRC for the operation of Sequoyah 1 and 2 is based in part on a finding that there is reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency. This finding by the NRC is based on: (1) a review of the Federal Emergency Management Agency findings; (2) determinations that state and local emergency plans are adequate and give reasonable assurance that they can be implemented; and (3) the NRC's assessment that the applicant's onsite emergency plans are adequate and give reasonable assurance that they can be implemented.

The Sequoyah Nuclear Plant emergency plan (Annex H) establishes that evacuation is the most effective protective action that can be taken to cope with radiological incidents. The plan provides the details of the evacuation plan. Risk counties, identified as Bradley and Hamilton Counties, are tasked with preparing evacuation plans for citizens within the 16-kilometer (10-mile) emergency planning zone and determining the number of people to be evacuated from the zone. Host counties, identified as Meigs, Rhea, and Sequatchie, are assigned responsibility to identify suitable shelters for evacuees. A State Emergency Operation Center would provide the focus for emergency reaction, e.g., notifications, protective action, and evacuation implementation. Fixed sirens would alert residents and transients within the 16-kilometer (10-mile) emergency planning zone with backup provided, if needed, by emergency vehicle sirens and loudspeakers. The State Emergency Operation Center Director would involve the counties' Emergency Management Directors as required.

The Emergency Alert System and the National Oceanic and Atmospheric Administration Weather Radio would be used to provide emergency information and instructions.

The evacuation would be ordered and accomplished by designated sectors. The designated evacuation routes would be patrolled by traffic assistance teams.

The American Red Cross would operate mass care shelters. Shelter information points would be established on each evacuation route to help direct evacuees to their assigned shelters.

Considerable planning is involved in evacuation planning. Training, education, and practice runs are utilized to further the probability of successful evacuation in the event it is ever required.

4.2.2.10 Waste Management

As with any major industrial activity, Sequoyah 1 and 2 generate waste as a consequence of normal operation. Such wastes include hazardous waste, nonhazardous solid waste, low-level radioactive waste, and sanitary liquid waste. **Table 4–24** summarizes the annual amount of waste generated at the Sequoyah Nuclear Plant site in each category.

Table 4–24 Annual Waste Generation at Sequoyah 1 and 2

Waste Type	*Volume or Mass*
Hazardous waste (cubic meters)	1.196
Nonhazardous waste (kilograms)	1,301,966
Low-level radioactive waste (cubic meters)	383
Mixed waste (cubic meters)	less than 1

Source: TVA 1998e.

Hazardous Waste

Hazardous wastes typically generated at Sequoyah 1 and 2 include paints, solvents, acids, oils, radiographic film and development chemicals, and degreasers. Neutralization is the only waste treatment performed on site. Hazardous wastes are normally stored in polyethylene containment systems during accumulation. An approved storage building is used to store hazardous wastes for either 90 or 180 days, depending on the plant's hazardous waste generator status (i.e., small quantity or large quantity) at the time. Waste is transported to an offsite hazardous waste storage or disposal facility prior to exceeding the 90- or 180-day storage limit.

Low-Level Radioactive Waste

During the fission process, an inventory of radioactive fission and activation products builds up within the reactor (in the fuel and the materials of construction). A small fraction of these radioactive materials escape and contaminate the reactor coolant. The primary coolant system also receives radioactive contaminants. These contaminants are removed from the coolant by a radioactive waste treatment system. Sequoyah 1 and 2 use separate radioactive waste treatment systems for gaseous, liquid, and solid waste treatment. Residues from the gaseous and liquid waste treatment systems (filters, resins, dewatered solids) are combined and disposed of with the solid, low-level radioactive waste. Contaminated protective clothing, paper, rags, glassware, compactible and noncompactible trash, and reactor components and equipment constitute the majority of solid low-level radioactive waste at Sequoyah 1 and 2.

Before disposal, compactible trash (with the exception of irradiated metals) is shipped to a commercial processor where it is compacted to a lesser volume and shipped to the Barnwell low-level radioactive waste disposal facility in South Carolina. Trash that can be incinerated is shipped to a commercial waste incinerator in Oak Ridge, Tennessee, where the material is burned to ashes before final disposal at the Barnwell facility. Metal waste is either decontaminated and recycled or melted to form shielding blocks. Any radioactive waste from these processes is shipped to the Barnwell disposal facility (TVA 1998a). TVA does not send irradiated metals for volume reduction due to their excessive dose rate. Instead, this material accumulates until a sufficient amount is on hand to ship directly to the Barnwell disposal facility.

Mixed Waste

Mixed waste is material that is both hazardous and radioactive. No mixed waste has been generated at Sequoyah since 1990. Past sources of mixed low-level radioactive waste at TVA nuclear plants have included beta-counting fluids (e.g., zylene, toluene) for use in liquid scintillation detectors, polychlorinated biphenyls susceptible to contact with radioactive contamination as a result of an accidental transformer spill or explosion, isopropyl alcohol used for cleaning radioactive surfaces, chelating agents, and various acids.

Waste Minimization Practices

The Sequoyah Nuclear Plant site has an active waste minimization program that consists of the following practices:

- Useful portions of construction and demolition materials are salvaged for resale.
- Segregated storage areas are maintained for each type of recoverable material.
- Scrap treated lumber is sold or placed in dumpsters for disposal by the solid waste disposal contractor at an offsite permitted landfill.
- Inert construction and demolition wastes are collected for disposal at the onsite permitted landfill.
- Waste paper is placed in bins or dumpsters and sold to an offsite recycle facility.
- Aluminum cans are recycled and sold.
- Nonrecoverable solid wastes are placed in dumpsters for disposal by the solid waste disposal contractor.
- Special wastes (e.g., desiccants, oily wastes, insulation) are collected and stored and then disposed of by incineration. Asbestos is sent to an approved special waste landfill for disposal.
- Used oil, fluorescent tubes, and antifreeze are collected and stored in drums or tanks and recycled.
- Medical wastes are collected and disposed of in accordance with the medical waste disposal procedure for TVA medical facilities.
- All plant sanitary wastewater is discharged directly to the Hamilton County Public Operated Treatment Works.
- Metal-cleaning wastewater (e.g., trisodium phosphate, acetic acid) is discharged into approved storage ponds for future disposal in accordance with the NPDES Permit.
- Wastewater from floor and equipment drains in nonradiation areas is routed through sumps to the turbine building sump for discharge in accordance with the NPDES Permit.
- Surplus chemicals are sold; lead acid batteries are recycled; refrigerant is recovered and recycled; and solvent recovery equipment is used for painting operations.
- Steps to use biodegradable solvents and cleaners to replace hazardous chemicals in various cleaning operations have been incorporated to the extent practical.

4.2.2.11 Spent Fuel Management

When nuclear reactor fuel has been irradiated to the point that it no longer contributes to the operation of the reactor, the fuel assembly is termed spent nuclear fuel and is removed from the reactor core and stored in the spent fuel storage pool or basin. The Nuclear Waste Policy Act of 1982, as amended, assigned to the Secretary of Energy the responsibility for the development of a repository for the disposal of high-level radioactive waste and spent nuclear fuel. When such a repository is available, spent nuclear fuel will be transported for disposal from the nation's nuclear power reactors to the repository. Until a repository is available, spent nuclear fuel must be stored in the reactor pools or in other acceptable, NRC-licensed storage locations. Because of the uncertainty associated with opening a repository, this EIS assumes spent fuel would be stored at the Sequoyah site for the duration of the proposed action (i.e., 40 years).

Storage Capacity

Storage cells have been provided in the Sequoyah 1 and 2 spent fuel storage pools to hold 2,089 fuel assemblies. A reserve capacity is required for a discharge of one complete core (193 fuel assemblies) in the event it becomes necessary to remove fuel from one of the reactor vessels. An administrative policy requires the reserve spent fuel pool to have the capacity to discharge two complete cores (386 fuel assemblies). The remaining storage capacity is 1,703 fuel assemblies. As of January 1998, the spent fuel storage inventory at Sequoyah 1 and 2 was 1,214 assemblies, leaving a usable storage capacity of 489 fuel assemblies.

Management Practice

The normal (projected equilibrium average) refueling batch size is 80 spent fuel assemblies, with the refueling frequency established at 18 months. The current capacity for storing spent nuclear fuel is adequate through the year 2001 (following Unit 1 fuel cycle Number 11). However, Sequoyah 1 and 2 already are licensed for an additional storage rack that would increase the capacity by 193 assemblies (one full core) to a total spent fuel storage pool capacity of 2,282 fuel assemblies. After Unit 2 Reload 12, scheduled for year 2003, Sequoyah 1 and 2 will no longer be able to retain a two-full-core storage reserve.

4.2.3 Bellefonte Nuclear Plant Units 1 and 2

As discussed in Section 3.2.5.3, one of the reactor options under consideration is the irradiation of TPBARs in Bellefonte 1 or both Bellefonte 1 and 2 after they have been completed and licensed for operation by the NRC. An assumption incorporated in this option is that the units would operate for the generation of electricity at their licensed full-power output with no reduced operability attributable to the production of tritium. However, the irradiation of TPBARs for tritium production would be considered the primary mission of the plant.

Bellefonte 1 and 2 were issued a construction permit by the Atomic Energy Commission in December 1974. By 1988, Unit 1 was 90 percent complete, and Unit 2 about 57 percent complete. On July 29, 1988, TVA notified the NRC that completion of construction of the Bellefonte Nuclear Plant was being deferred. A lower-than-expected load forecast for the near future was given as the reason for deferral. On March 23, 1993, TVA notified the NRC of its plans to complete Bellefonte 1 and 2. This decision was the result of an extensive, three-year study that concluded completion of the facility as a nuclear power plant was viable. In December 1994, the TVA Board announced that Bellefonte would not be completed as a nuclear plant without a partner. Construction was halted again and has remained stopped pending completion of a comprehensive evaluation of TVA's power needs (TVA 1997f).

Since December 1994, engineering and construction activities have been suspended. The plant systems and structures are maintained through an active layup and preservation program initiated in 1988. The program is described briefly in Section 3.2.5.3, including brief descriptions of the existing structures. Detailed descriptions of the site, buildings, structures, systems, and operations are provided in the following licensing and environmental documentation for the plant:

- Atomic Energy Commission, *Final Environmental Statement Related to Construction of the Bellefonte Nuclear Plant Units 1 and 2* (AEC 1974).
- Tennessee Valley Authority, *Final Environmental Impact Statement for the Bellefonte Conversion Project*, (TVA 1997f).
- Tennessee Valley Authority, *Bellefonte Nuclear Plant, Final Safety Analysis Report, through Amendment 30,* Chattanooga, Tennessee, (TVA 1991).

The following sections describe the affected environment at the Bellefonte site for land resources, noise, air quality, water resources, geology and soils, ecological resources, cultural resources, and socioeconomics. In addition, the radiation and hazardous chemical environment, waste management, and spent nuclear fuel considerations are described.

4.2.3.1 Land Resources

Land Use

Located in Jackson County, Alabama, the Bellefonte Nuclear Plant site occupies approximately 607 hectares (1,500 acres) of land on a peninsula at Tennessee River Mile 392, on the west shore of Guntersville Lake, about 11.3 kilometers (7 miles) east-northeast of Scottsboro, Alabama. This land has already been dedicated as the site for Bellefonte 1 and 2. No additional land is needed to complete construction of either unit or to accommodate tritium production. The location of the Bellefonte site is shown in **Figure 4–13.** The Bellefonte site is shown in greater detail in **Figure 4–14**.

Greater than 90 percent of the land within the three-county area surrounding the site is characterized by forest and agricultural use or is undeveloped. The remaining land is used for residential, commercial, industrial, infrastructure, social, cultural, or governmental purposes. The nearest town, Hollywood, Alabama, is approximately 4.8 kilometers (3 miles) from the site.

Completion of the units for industrial purposes (including contracted irradiation services) would conform with the proposed urban and industrial development land use for the site and its vicinity as designated by the local governmental plans, policies, and controls.

Industry

Industrial development is largely concentrated along the Scottsboro-Stevenson-Bridgeport corridor and is mainly influenced by the availability of transportation and urban services.

Agriculture

The total area of Jackson County, Alabama, is approximately 277,000 hectares (684,500 acres), of which about 30 percent or 82,800 hectares (204,600 acres) is used for agriculture (GISP 1998b).

Forest

Sixty-three percent of the area of Jackson County, Alabama, is forested, amounting to 174,200 hectares (430,500 acres). Oak-hickory hardwood forests make up 78 percent of the forested area. The balance includes loblolly and short-leaf pine and oak-pine forests (DOA 1998b, DOA 1998c).

Recreation

Hunting, fishing, and pleasure boating are among the more popular activities in the Bellefonte site area. Guntersville Lake supports a variety of water-based recreation activities. Most of this activity occurs during the spring, summer, and early fall periods of the year.

Nature Reserves

A wildlife management area includes Mud Creek and Crow Creek embayments and their shoreline lands. The Coon Gulf Habitat Protection Area on the eastern shore of Guntersville Reservoir is a state-managed reserve.

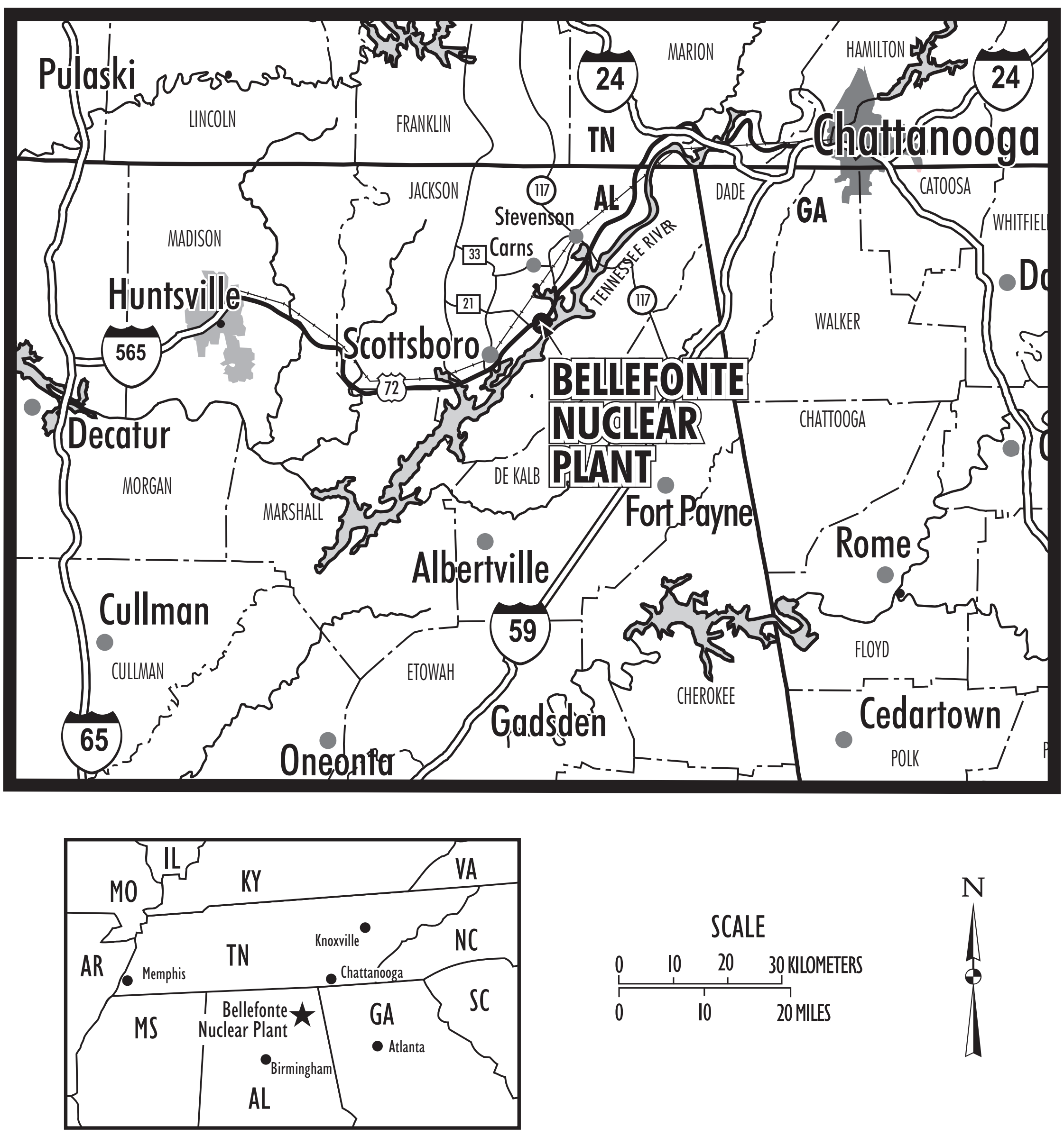

Figure 4–13 Location of the Bellefonte Nuclear Plant Site

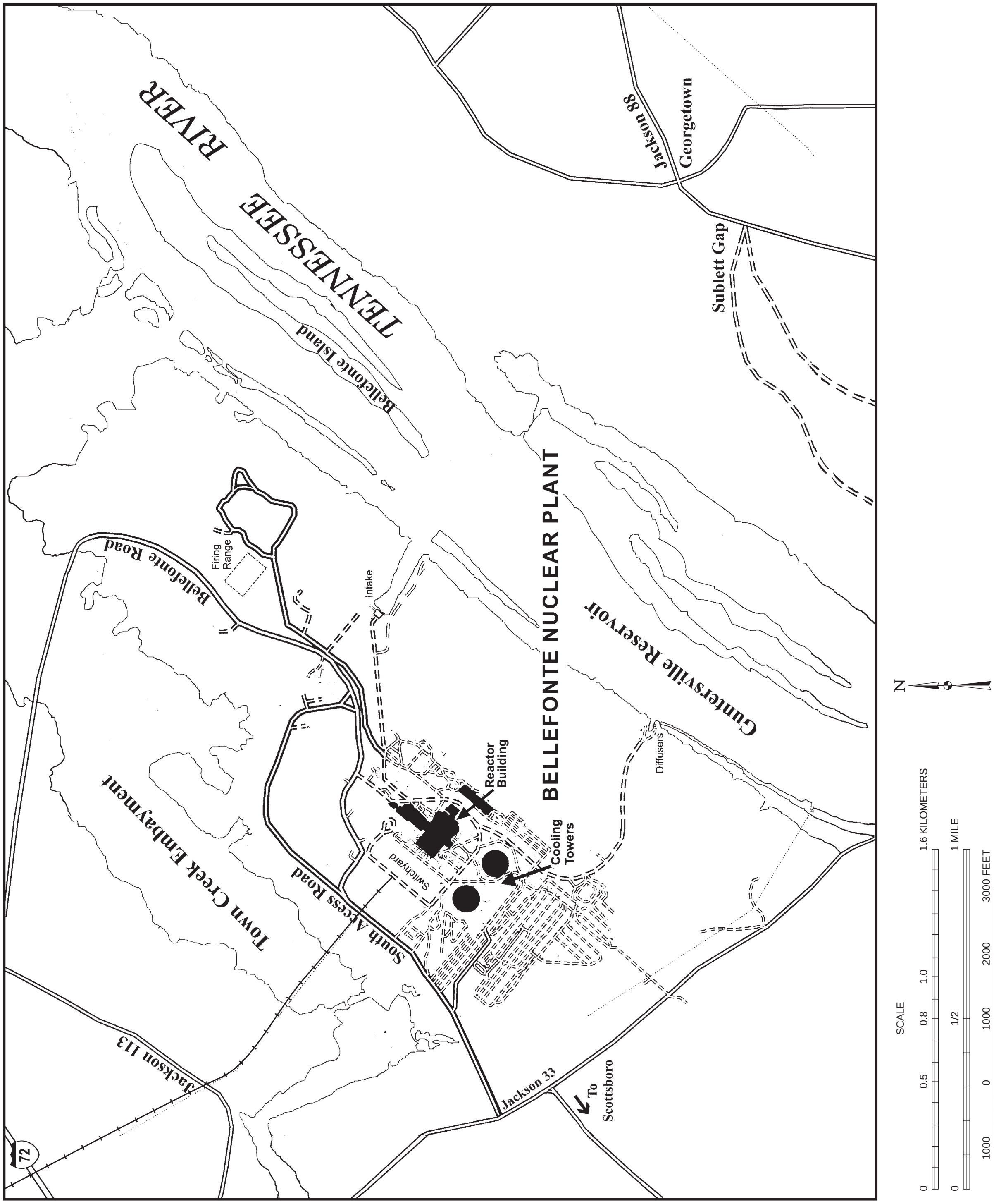

Figure 4–14 Bellefonte Nuclear Plant Site

Visual Resources

The visual landscape of the Bellefonte Nuclear Plant site is characterized by a flat valley adjacent to a reservoir and a river. The visual landscape of the site reflects that of an industrialized facility. The viewshed includes hilly land with urban-industrial nodes surrounded by low density development scattered among agricultural uses and forest lands.

The major visual elements of the plant already exist, including the cooling towers, containment structures, turbine building, and transmission lines. Views of the Bellefonte site from passing river traffic on the Tennessee River are partially screened by the ridge lines close to the shoreline. The plant is overlooked by a few residences on Sand Mountain on the east side of the river. Distant glimpses of the plant site can be had from the coves and hollows along the Sand Mountain rim, from State Roads 35 and 40 as they traverse Sand Mountain, and from Comber Bridge, which crosses Guntersville Lake (TVA 1997f). The plant can be seen from various locations along U.S. Highway 72 to the northwest and from residences on the northern shore of Town Creek Embayment.

A visual resource inventory is composed of three factors: Visual Resource Management classification, distance zones, and sensitivity levels. Distance zones for each viewpoint are determined as foreground-middleground, background, or seldom-seen. Based on the Bureau of Land Management Visual Resource Management method, the existing landscape at the site would be classified as Visual Resource Management Class 3 or 4. Class 3 includes areas where there has been a moderate change in the landscape and these changes may attract attention, but do not dominate the view of the casual observer. Class 4 includes areas where major modifications to the character of the landscape have occurred. These changes may be dominant features of the view and the major focus of viewer attention (DOI 1986a). Due to the location of the site adjacent to the Tennessee River, the area is subject to high user volumes associated with recreational uses. Because of the proximity to urban development and recreational areas, the facilities are visible from viewpoints with low to moderate sensitivity levels (DOI 1986a).

4.2.3.2 Noise

The most common measure of environmental noise impact is the day-night average sound level. The day-night average sound level is a 24-hour sound level with a 10 dBA penalty added to sound levels between 10:00 p.m. and 7:00 a.m to account for increased annoyance due to noise during nighttime hours. The EPA has developed noise level guidelines for different land-use classifications based on day-night average sound levels and equivalent sound levels. The U.S. Department of Housing and Urban Development has established noise impact guidelines for residential areas based on day-night average sound levels. Some states and localities have established noise control regulations or zoning ordinances that specify acceptable noise levels by land-use category. The State of Alabama has not developed a noise regulation that specifies the numerical community noise levels that are acceptable.

For the purpose of this document, noise impacts are assessed using a day-night average sound level of 65 dBA as the level below which noise levels would be considered acceptable for residential land uses and outdoor recreational uses, and an increase of 2 dBA as an indicator of "substantial" increases in noise. This approach is based on the TVA noise analysis for the Bellefonte Conversion Project (TVA 1997f).

The day-night average sound levels at locations near the site are typical of a quiet rural community. The daytime and nighttime equivalent sound level values ranged from 41 to 51 dBA. The maximum day-night average sound level, 55 dBA, falls well within the Department of Housing and Urban Development guidelines limit. The EPA considers the typical day-night average sound level noise range for a rural location where noise sources include wind, insect activity, aircraft, and agricultural activity to be 35 to 50 dBA. Offsite noise levels below 65 dBA are considered acceptable.

4.2.3.3 Air Quality

The Bellefonte Nuclear Plant site is in the Tennessee River Valley, Alabama-Cumberland Mountains, Tennessee, Interstate Air Quality Control Region. Ambient concentrations of criteria pollutants in the vicinity of the Bellefonte Nuclear Plant that were determined by monitoring at a station on Sand Mountain are presented in **Table 4–25**. This station is about 3.8 kilometers (2.4 miles) east of the plant site. During the period from February 1, 1990, through January 31, 1991, six criteria pollutants were monitored at the station. Monitoring data for 1996 and 1997 from Scottsboro and Huntsville are used to supplement this data.

The ambient concentrations of criteria pollutants are compared with the most stringent regulation or guideline. Alabama Ambient Air Quality Standards are the same as the National Ambient Air Quality Standards for all criteria pollutants.

The area surrounding the Bellefonte Nuclear Plant site is designated by the EPA as an attainment area with respect to National Ambient Air Quality Standards for criteria pollutants (40 CFR 81). The nearest Prevention of Significant Deterioration Class I areas to the Bellefonte Nuclear Plant site are the Cohutta National Wildlife Area in north-central Georgia and the Sipsey National Wildlife Area in northeastern Alabama. Both sites are more than 100 kilometers (62 miles) from the Bellefonte Nuclear Plant site.

Sources of criteria pollutant emissions found at the Bellefonte Nuclear Plant site include the occasional operation of diesel-powered emergency generators and fire protection pumps; the backup security generator; the environmental data station generator; site, trade, and employee vehicles; and auxiliary boilers. Small quantities of toxic chemicals and metals are emitted from the testing and operation of the diesel-fueled equipment, resulting in contributions to offsite concentrations of less than 0.0001 percent of the threshold limit value of any of these pollutants.

The calculated concentrations of carbon monoxide, nitrogen dioxide, particulate matter, and sulfur dioxide from operation of the auxiliary steam boilers, diesel generators, lube oil system, and diesel fire pumps are two or more orders of magnitude below the ambient standards. Compliance with the new $PM_{2.5}$ standards was not evaluated since current emission data for $PM_{2.5}$ are not available. When the calculated concentrations from onsite sources are combined with concentrations from offsite sources, the ambient air quality standards for carbon monoxide, nitrogen oxide compounds, particulate matter, and sulfur dioxide continue to be met.

Gaseous Radioactive Emissions

Bellefonte 1 and 2 are not completed and are not operating. Therefore, there are no gaseous radioactive emissions.

Meteorology and Climatology

The regional and local climatology and meteorology of the Bellefonte Nuclear Plant site described in the Atomic Energy Commission's 1974 *Final Environmental Statement Related to Construction of Bellefonte Nuclear Plant Units 1 and 2* (AEC 1974) were re-evaluated in 1997 (TVA 1997f), with consideration of additional data accumulated in the intervening years. It was determined that the records used for the 1974 Final Environmental Statement provide an adequate representation of regional climatic conditions. This information has been updated with more recent data for Huntsville and Chattanooga.

Regional Climate

The Bellefonte site is located in an area dominated by prominent valley ridge topographical features, generally aligned from northeast to southwest. Local prevailing wind patterns of the Tennessee River Valley are down-valley (north through northeast) and up-valley (south through southwest).

Table 4–25 Comparison of Baseline Bellefonte 1 and 2 Ambient Air Concentrations With the Most Stringent Applicable Regulations and Guidelines

Criteria Pollutant	*Averaging Time*	*Most Stringent Regulation or Guideline[a] (μg/m³)*	*Baseline Concentrations μg/m³*
Carbon monoxide	8-hour 1-hour	10,000 40,000	4,104[b] 5,472[b]
Lead	Calendar quarter	1.5	0.03[c]
Nitrogen dioxide	Annual	100	24.1[b]
Ozone	8-hour (4th highest averaged over 3-years)	157[d]	e
Particulate matter	PM_{10} Annual 24-hour (interim) 24-hour (99th percentile 3-year average) $PM_{2.5}$ Annual (3-year average) 24-hour (98th percentile averaged over 3-years)	 50[d] 150[d] 150[d] 15[f] 65[f]	 24[c] 46[c] 46[c] g g
Sulfur dioxide	Annual 24-hour 3-hour	80 365 1,300	13.1[c] 73.4[h] 210[c]

μg/m³ = micrograms per cubic meter

PM_n = particulate matter size less than or equal to *n* micrometers.

[a] The Alabama Department of Environmental Management, Air Division, has incorporated all National Primary Air Quality Standards and all National Secondary Ambient Air Quality Standards by reference in Chapter 335-3-1, General Provisions, Paragraph 335-3-1-.03. Therefore, only National Ambient Air Quality Standards are provided. The standards, other than those for ozone, particulate matter, lead, and those based on annual averages, are not to be exceeded more than once per year. The 1-hour ozone standard is attained when the expected number of days per year with maximum hourly average concentrations above the standard is ≤ 1. The 1-hour ozone standard applies only to nonattainment areas. The 8-hour ozone standard is attained when the 3-year average of the annual fourth-highest daily maximum 8-hour average concentration is less than or equal to 157 μg/m³. The interim 24-hour PM_{10} standard is attained when the expected number of days with a 24-hour average concentration above the standard is ≤ 1. The annual arithmetic mean particulate matter standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard.

[b] Madison County - Huntsville. Carbon monoxide - 1997, nitrogen dioxide - 1993.

[c] Sand Mountain, 1990-1991.

[d] EPA recently revised the ambient air quality standards for particulate matter and ozone. The new standards, finalized on July 18, 1997, change the ozone primary and secondary standards from a 1-hour concentration of 235 μg/m³ (0.12 parts per million) to an 8-hour concentration of 157 μg/m³ (0.08 parts per million). During a transition period while states are developing state implementation plan revisions for attaining and maintaining these standards the 1-hour ozone standard would continue to apply in nonattainment areas (62 FR 38855-38894). For particulate matter, the current PM_{10} (particulate matter size less than or equal to 10 micrometers) annual standard is retained and two $PM_{2.5}$ (particulate matter size less than or equal to 2.5 micrometers) standards are added. These standards are set at 15 μg/m³ 3-year annual average arithmetic mean based on community-oriented monitors and 65 μg/m³ 3-year average of the 98th percentile of 24-hour concentrations at population-oriented monitors. The current 24-hour PM_{10} standard is revised to be based on the 3-year average of the 99th percentile of 24-hour concentrations. The existing PM_{10} standards would continue to apply in the interim period (62 FR 38652).

[e] There is insufficient data to compare to the 8-hour standard for ozone.

[f] Federal standard.

[g] Compliance with the new $PM_{2.5}$ standards was not evaluated since current emissions data for $PM_{2.5}$ are not available.

[h] Sulfur dioxide - Jackson County, 1996.

Source: TVA 1998a.

Severe Weather

The site is vulnerable to severe weather, including heavy general rainstorms; thunderstorms that can be accompanied by heavy downpours, strong winds, hail, lightning, or tornadoes; and snow and ice storms.

The probability of a tornado occurring at any point within a radius of 55 kilometers (34.2 miles) of the plant site is 1.15×10^{-4} (TVA 1997f) or once in 8,700 years. For straight winds, the fastest wind measured 10 meters (33 feet) above ground and about 145 kilometers per hour (90 miles per hour), and is expected once in a 100-year period (TVA 1997f).

Local Meteorological Conditions

Data collected over a 30-year period (1961–1990) indicate that at Huntsville the annual average temperature is 15.7°C (60.3°F); the average daily minimum temperature in January is –1.6°C (29.2°F); and the average daily maximum temperature in July is 31.7°C (89.0°F) (TVA 1998e). The average annual precipitation is approximately 145.2 centimeters (57.18 inches). Prevailing winds are from the east-southeast. The average annual wind speed is 3.6 meters per second (8 miles per hour) (NOAA 1997b).

4.2.3.4 Water Resources

Surface Water

The Bellefonte site is located at Tennessee River Mile 391.5, about 68.8 kilometers (43 miles) upstream of the Guntersville Dam, on a peninsula formed between the Town Creek Embayment and the Guntersville Reservoir, on the western shore of Guntersville Reservoir. The surface area of the reservoir is 275 square kilometers (106 square miles).

The average daily flow volume at the Bellefonte site is 1,100 cubic meters per second (38,850 cubic feet per second). Seasonal averages derived from records for 1950 to 1987 are 895 cubic meters per second (31,600 cubic feet per second) during summer and 1,400 cubic meters per second (49,500 cubic feet per second) during winter (TVA 1997f, TVA 1998e). Hourly flows at the site may vary considerably from daily average flows, depending on turbine operations at the Nickajack and Guntersville Hydro Plants. Hourly flows may be zero or may be in an upstream direction for up to six hours per day (TVA 1998e).

Surface Water Quality

Guntersville Reservoir is classified for uses of public water supply, fish and wildlife, and swimming and other whole body water-contact sports (TVA 1997f). Monitoring data from the EPA Storage and Retrieval of Parametric Data base (STORET) for 1974 to 1990 showed that dissolved oxygen concentrations routinely drop below 5 milligrams per liter during the summer months at lower depths of the lake. No concentrations less than 4 milligrams per liter were measured. Mild dissolved oxygen stratification was found to occur occasionally in the main channel areas. Strong stratification occurred fairly frequently in the shallower overbank and embayment areas. All pH (acidity) measurements were above the minimum Alabama criterion of 6.0. In areas of high biological activity, pH values above the maximum Alabama criterion of 8.5 were observed (TVA 1997f). Surface water quality monitoring data are presented in **Table 4–26**.

Table 4–26 Summary of Surface Water Quality Monitoring in the Vicinity of the Bellefonte Nuclear Plant Site

Parameter	*Unit of Measure*	*Water Quality Criteria*	*Average Water Body Concentration*
Radiological			
Alpha (gross)	picocuries per liter	15[a]	3.25
Beta (gross)	picocuries per liter	50[b]	2.4
Tritium	picocuries per liter	20,000[a]	<300[c]
Nonradiological			
Aluminum	milligrams per liter	0.2[d]	0.43
Ammonia	milligrams per liter	30[e]	0.03
Arsenic	milligrams per liter	0.05[a]	0.0002
Barium	milligrams per liter	2.0[a]	0.05
Beryllium	milligrams per liter	0.004[a]	0.001
Boron	milligrams per liter	0.9[e]	0.15
Cadmium	milligrams per liter	0.005[a]	0.0005
Chlorides	milligrams per liter	250[d]	7.6
Chromium	milligrams per liter	0.1[a]	0.003
Copper	milligrams per liter	1.3[f]	0.011
Iron	milligrams per liter	0.3[d]	0.53
Lead	milligrams per liter	0.015[a]	0.006
Manganese	milligrams per liter	0.05[d]	Not available
Mercury	milligrams per liter	0.002[a]	0.0009
Molybdenum	milligrams per liter	0.01[e]	0.02
Nickel	milligrams per liter	0.1[a]	0.0017
pH (acidity/alkalinity)	pH units	6.5–8.5[d]	7.4
Silver	milligrams per liter	0.2[e]	0.01
Sodium	milligrams per liter	20[e]	6.83
Sulfate	milligrams per liter	250[d]	15.4
Total Dissolved Solids	milligrams per liter	500[d]	100
Zinc	milligrams per liter	3[e]	0.11

[a] Alabama Drinking Water Standards.
[b] Proposed National Primary Drinking Water Regulations.
[c] Below Lower Limit of Detection of 300 picocuries per liter.
[d] National Secondary Drinking Water Regulations (40 CFR 143).
[e] EPA health advisory.
[f] EPA primary drinking water standard goal.
Source: Alabama 1998, ADEM 1998a, ADEM 1998b, EPA 1996b, TVA 1997f.

Surface Water Use and Rights

The Bellefonte Nuclear Plant currently draws water from the Guntersville Reservoir for fire protection and some cooling needs. There are eight municipal water supplies that use water from Guntersville Reservoir downstream of the Bellefonte intake at distances of 6.3 kilometers (3.9 miles) for Fort Payne to 62.6 kilometers (38.9 miles) for Guntersville. Guntersville State Park, 47.2 kilometers (29.3 miles) downstream, uses Guntersville Reservoir water for irrigation. Water intakes near Bellefonte are shown in **Table 4-27.** The nearest intake to the Bellefonte diffuser discharge at Tennessee River Mile 390.3 is Fort Payne, 4.3 kilometers (2.7 miles) downstream (TVA 1999).

Table 4–27 Public and Industrial Surface Water Supplies From the Tennessee River Near Bellefonte

Plant Name	*Use (million liters per day)*	*Location (Tennessee River Mile and Bank)*	*Approximate Distance From Site (kilometers)*	*Type of Supply*
South Pittsburg	4.16	TRM 418.0 R	42.6	Municipal
Bridgeport	2.69	TRM 413.6 R	35.6	Municipal
TVA Widows Creek Fossil Plant	4084	TRM 407.7 R	26.1	Industrial
Mead Corporation	16.7	TRM 405.2 R	22.0	Industrial
TVA Bellefonte Nuclear Plant	unknown[a]	TRM 391.5 R	0.0	Industrial
Fort Payne	37.9	TRM 387.6 L	6.3	Municipal
Scottsboro Water System[b]	18.9	TRM 385.8 R TRM 377.4 R	9.2 22.7	Municipal
Section, Alabama Water Board	7.6	TRM 382.0 L	15.3	Municipal
Christian Youth Camp	unknown	TRM 367.9 R	38.0	Municipal
Guntersville State Park	unmetered[c]	TRM 362.2 L	47.2	Irrigation
Albertville	34.1	TRM 361.0 L Short Creek 2.0	49.1	Municipal
Guntersville	10.7	TRM 358.0 L TRM 352.6 L	53.9 62.6	Municipal
Arab	11.9	TRM 356.0 L	57.1	Municipal

L = Left bank.
R = Right bank.
[a] River water usage currently limited to fire protection needs.
[b] Also supplies water to Jackson County.
[c] Water usage is not metered.
Source: TVA 1997f.

Surface water rights concerning the Guntersville Reservoir and the Town Creek Embayment near the Bellefonte site involve nonimpairment of designated uses. In addition, constructing intake structures for withdrawing water from available supplies requires U.S. Army Corps of Engineers and TVA permits.

Liquid Chemical and Radioactive Effluents

The Bellefonte Nuclear Plant uses a small amount of chemicals for maintenance and layup. There is no liquid radioactive effluent at the partially completed plant.

Other effluent streams from the Bellefonte Nuclear Plant site leave through pathways, all of which are regulated by an NPDES Permit issued by the Alabama Department of Environmental Management. Three process discharge streams are routed to the Guntersville Reservoir. Nine stormwater discharge streams are routed to the Town Creek Embayment and the Guntersville Reservoir. Sanitary wastewater is discharged to the Hollywood Waste Water Treatment Facility, which is operated by the city of Hollywood. A small quantity of sanitary wastewater from the simulator building, training facility, and environmental data station is treated on site by sand filters and a septic system.

Floodplains and Flood Risk

The Bellefonte Nuclear Plant is situated on a peninsula formed between the Town Creek Embayment and the Guntersville Reservoir in Jackson County, Alabama.

The 100-year floodplain for the Guntersville Reservoir varies from elevation 183.0 meters (600.5 feet) above mean sea level at Tennessee River Mile 390.4 to elevation 183.2 meters (601.1 feet) at Tennessee River Mile 392.3. The TVA Flood Risk Profile elevations on the Guntersville Reservoir vary from elevation 183.4 meters (601.8 feet) at Tennessee River Mile 390.4 to elevation 183.7 meters (602.7 feet) at Tennessee River Mile 392.3. For Town Creek, the 100-year floodplain is the area lying below elevation 183.7 meters (602.7 feet). The Flood Risk Profile elevation is 183.8 meters (603.1 feet). The Flood Risk Profile is used to control flood damageable development for TVA projects. At this location, the Flood Risk Profile elevations are equal to the 500-year flood elevations. The safety-related facilities, systems, and equipment are housed in structures that provide protection from flooding for all flood conditions up to an elevation of 191.2 meters (627.3 feet) (TVA 1978).

Jackson County, Alabama, has adopted the 100-year flood as the basis for its floodplain regulations, and all development would be consistent with these regulations. There are no floodways published for this area.

Groundwater

The near-surface aquifer beneath the Bellefonte site occurs under unconfined conditions. Typical aquifer material is highly weathered sedimentary bedrock overlying slightly fractured bedrock. Groundwater movement through the Chickamauga Reservoir underlying the site is via fractures that have been subjected to solution activity.

Groundwater Quality

The groundwater quality of the near-surface aquifer beneath the site ranges from good to fair. Sampling of groundwater for prereactor ambient condition information was initiated at the site in 1973. During the period from 1977 through 1983, monthly groundwater samples were collected from six onsite bedrock wells to establish the background radionuclide levels at the site (TVA 1997f).

Groundwater sampling also has been conducted for organics and indicator parameters associated with known or potential subsurface releases at the site. Very few constituents exceeded the EPA Maximum Contaminant Levels specified in the Primary and Secondary Drinking Water Standards (TVA 1997f). Metals that appeared at levels consistently higher than the Maximum Contaminant Levels include iron, manganese, and aluminum. These may be related to the natural mineralogy of the area.

Groundwater Availability, Use, and Rights

Most of the potable water for nearby users is surface water taken from the Guntersville Reservoir near the site. There are, however, both private and public uses of groundwater in the vicinity of the site, including water supply wells for the cities of Stevenson, Scottsboro, and Hollywood, Alabama. The closest active municipal groundwater supply using the shallow (Chickamauga) aquifer is the city of Scottsboro, 11.3 kilometers (7.0 miles) from the plant site. The Bellefonte Nuclear Plant does not currently withdraw any groundwater. The aquifer is designated Class II, indicating it is currently being used for, or is a potential source of, drinking water. The city of Hollywood, 4 kilometers (2.5 miles) northwest of the site, pumps 416,000 liters per day (110,000 gallons per day) from two deep wells. These wells, along with surface water from Guntersville Reservoir, provide the water supply for the city of Hollywood and potable water for the Bellefonte site.

Groundwater rights concerning the aquifers near the site are associated with the Reasonable Use Doctrine. Under this doctrine, landowners can withdraw water to the extent that they must exercise their rights in accordance with the similar rights of others. The location of Bellefonte on a peninsula also tends to hydrologically isolate Bellefonte from the neighborhood residential wells on the other side of Town Creek.

4.2.3.5 Geology and Soils

Geology

The Bellefonte Nuclear Plant site is located in the Southern Appalachian Tectonic Province, in a 241-kilometer (150-mile) long anticlinal valley known as the Brown-Sequatchie Valley. This valley is representative of the valley and ridge topography and structure. The valley was formed by erosion of the Sequatchie anticline. When erosion breached the arch of thick sandstone and exposed the limestone and dolomite, an axial valley developed.

The controlling feature of the geologic structure is the Sequatchie thrust fault some 4 kilometers (2.5 miles) northwest of the site. The Sequatchie fault and resultant anticline developed more than 200 million years ago. The fault has been inactive for many millions of years.

Seismology

The known seismic history of the southeastern United States since 1776 indicates the site is located in an area of low seismic risk. The maximum historic intensities affecting the site were the result of earthquakes centered at distant points. Nevertheless, the Bellefonte Nuclear Plant design is based on the largest historic earthquake to occur in the Southern Appalachian Tectonic Province—the 1897 Giles County, Virginia, earthquake (intensity: Modified Mercalli VIII and Richter magnitude 6 to 7). The safe-shutdown earthquake for the plant was established at a maximum horizontal acceleration of 0.18 g (g = acceleration due to gravity) and a simultaneous maximum vertical acceleration of 0.18 g. The safe-shutdown earthquake is defined as the earthquake that produces the maximum ground vibration for which: (1) the reactor coolant pressure boundary, (2) the capability to shut down the reactor and maintain it in the shutdown mode, and (3) the capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposures comparable to the guideline exposures are designed to remain functional (10 CFR 100, Appendix A).

Soils

Extensive evaluation was made of the soil and bedrock on the Bellefonte Nuclear Plant site. All major Seismic Category I structures important to the safe operation of Bellefonte 1 and 2 are founded on competent bedrock. Physical testing has shown that the bedrock is capable of supporting loads in excess of those imposed by the plant structures.

The effects of amplications of ground motions through soil columns should be considered in the seismic design of structures not founded on rock. The potential for liquefaction beneath any new structure, pipeline, or conduit not founded on rock should be evaluated in areas that are not investigated as part of the original *Bellefonte Nuclear Plant Final Safety Analysis Report, as Amended* (TVA 1991).

4.2.3.6 Ecological Resources

Terrestrial Resources

The Bellefonte Nuclear Plant site is located within the Ridge and Valley Physiographic Province. This province lies between the Blue Ridge Mountains and the Cumberland Plateau and is characterized by prominent, northwest-trending ridges and adjacent valleys. The Tennessee River flows through this province, roughly paralleling the alignment of the valleys. The area surrounding the Bellefonte site is characterized by forests that have been continuously disturbed by timbering and agricultural practices.

The forest region that constitutes the Bellefonte Nuclear Plant site is characterized by numerous tree species (rather than domination by one or only a few species) sharing the canopy. Site vegetation has been continuously disturbed by decades of timbering and agriculture. Five categories of vegetative communities present on the site are mixed hardwoods, lawns and grassy fields, scrub-shrub thickets (including fencerows), bottomland riparian hardwoods, and pine-hardwood forests. Parking lots, roads, buildings, cooling towers, and other structures associated with the partially completed nuclear facility occupy 20 percent of the site. Mixed hardwood communities, most commonly located on the ridges and knobs, comprise 40 percent of the site. Ten percent of the site is planted in lawns and grassy fields. Fifteen percent of the site is occupied by scrub-shrub communities occurring in areas that were previously managed as open land, but which have been left undisturbed for the past 2 to 25 years. Five percent of the site is occupied by bottomland hardwood and riparian forests associated with streams and the shoreline margins of Guntersville Lake. The remainder of the site area, approximately 10 percent, is occupied by pine-hardwood forests (TVA 1997f).

Terrestrial Wildlife

Although disturbed areas in the immediate vicinity of the Bellefonte plant provide little habitat for wildlife, the remaining portions of the site are suitable for a wide variety of animals. Mixed-hardwood and pine-hardwood forests provide habitat for mammals such as white-tailed deer, gray squirrels, and flying squirrels. Common birds in these habitats include red-bellied woodpeckers, blue jays, wood thrush, Kentucky warblers, and Carolina wrens. Reptiles and amphibians commonly found in these forested habitats include ring-necked snakes, ground skinks, slimy salamanders, and Fowler's toads.

Lawns and grassy fields provide habitat for mammals such as eastern cottontail rabbits, woodchuck, hispid cotton rats, and least shrews. A variety of birds may be seen in this habitat including ground-nesting species such as meadowlarks and field sparrows. Gray rat snakes, eastern garter snakes, and American toads are a few of the reptiles and amphibians commonly found in lawns and grassy fields.

Scrub-shrub communities are one of the most abundant habitat types occurring on the site. Such communities provide important nesting and foraging areas, as well as travel corridors for birds and small mammals. Mammals present in this habitat type include southeastern shrews, eastern cottontail rabbits, and gray squirrels. Birds utilizing scrub-shrub communities include gray catbirds, rufous-sided towhees, and mockingbirds.

Bottomland hardwood and riparian forests are located along streams and the Guntersville Reservoir and support a highly diverse wildlife population. Mammals found in these forests include beaver, mink, muskrat, and gray squirrels. Great blue herons, great egrets, wood ducks, screech owls, and prothonotary warblers are a few of the many birds that may be found in bottomland hardwood and riparian forests. Several species of amphibians and reptiles are commonly found in these forests. These include rough green snakes, midland water snakes, bullfrogs, and gray treefrogs (TVA 1997f).

Wetlands

There are many wetland areas in and around the Bellefonte Nuclear Plant site, most of them located along the 20-kilometer (12.5-mile) shoreline that borders much of the site (TVA 1997f). **Figure 4–15** indicates the location of wetlands located near the plant site. Included are 9 hectares (52 acres) of islands along the old river channel. The wetlands on these islands are classified as palustrine, bottomland hardwood, deciduous, and temporarily flooded. Aquatic bed wetlands that separate the islands from the mainland are classified as lacustrine, aquatic bed, or rooted vascular submerged permanently flooded wetlands. Fringe wetlands are

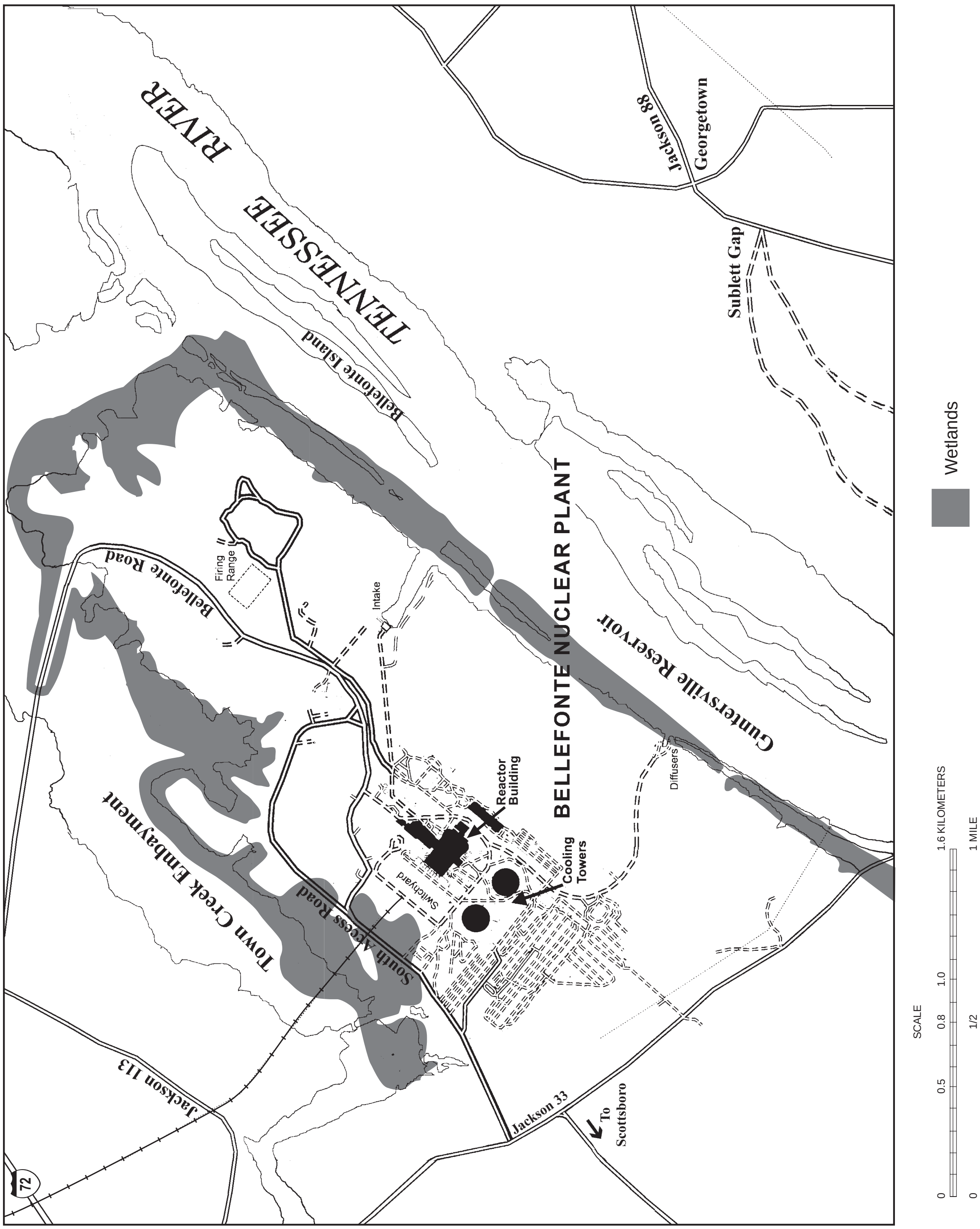

Figure 4–15 Wetlands Map of the Bellefonte Nuclear Plant Site Vicinity

characterized by the presence of emergent and scrub-shrub plant communities and forested shoreline. These are shallow overbank areas adjacent to the old river channel (TVA 1997f).

Plant species found in the fringe wetlands include:

Common cattail *(Typha latifolia)*	Black willow *(Salix nigra)*
Giant cutgrass *(Zizaniopsis miliacae)*	River birch *(Betula nigra)*
Bulrush *(Scirpus americanus)*	Sycamore *(Platanus occidentalis)*
Soft rush *(Juncus effusus)*	Willow oak *(Quercus phellos)*
Button Bush *(Cephalanthus occidentalis)*	Water oak *(Quercus nigra)*
	Red maple *(Acer rubrum)*.

Aquatic bed wetlands are formed by floating mats of Eurasian milfoil, *Myriophyllum heterophyllum*; American pondweed, *Potamogeton pectinatus*; and spiny-leafed naiad, *Najas minor*.

Wetlands have also developed in three ponds that were constructed in the 1970s during the initial phase of development of the Bellefonte project. The dikes of two ponds were breached in 1989, and 2.4 hectares (6 acres) of palustrine, emergent, persistent, intermittently flooded wetlands have developed. The third 5-hectare (12-acre) pond is used to filter stormwater runoff and is classified as palustrine, scrub-shrub, permanently flooded wetlands.

TVA fulfills its mandate to protect wetlands as directed by Executive Order 11990. Other wetlands have developed in areas where ponds were constructed for previous construction activities.

Aquatic Resources

The Bellefonte site is located on a peninsula bounded to the north by Town Creek Embayment and to the south by the Tennessee River (Guntersville Reservoir). The site, with its narrow backwater sloughs and embayments protected from the wave and current action of the main river by strip islands and bars, supports diverse aquatic flora and fauna. Beyond the strip islands and bars, the original channel of the Tennessee River also contains a diverse aquatic community that is affected by the river current. The Town Creek Embayment is more isolated from river currents than the shallow overbank aquatic habitat along the river proper.

Plankton

Assessments show phytoplankton to be quite variable among sample stations, months, and years, making the determination of spatial and temporal trends difficult. The exception is the trend for greatest phytoplankton abundance and blue-green algae dominance during parts of the year at shallow overbank habitats and at downstream sampling locations. This trend can be anticipated based on the increased hydraulic retention time during the transition from fast-flowing (lotic) to slow-flowing (lentic) conditions (TVA 1997f).

Fish Communities

Guntersville Reservoir supports an abundant and diverse fish community, including both a sport and commercial fishery. Eighty-two species of fish have been collected in TVA field investigations. Two study programs are compared: 1949 to 1984 and 1984 to 1994. Comparisons show that, of 61 species collected in both studies, only 13 species found prior to 1985 were not collected in the 1984–1994 samples. Eight new species were found after 1985. All species that are unique to either of the studies, with the exception of the introduced grass carp, are typically rare individuals.

Fish present within the Guntersville Reservoir may be placed into one of three major groups: game, rough, and forage. Game fish include bluegill, redear sunfish, warmouth, and yellow bass. Rough fish include freshwater drum, yellow bullhead, spotted gar, skipjack herring, and grass carp. Forage fish include gizzard shad and threadfin shad. Prior to 1975, forage fish were the predominant group in terms of numbers of individuals, while after 1975 game fish were the predominant group. This shift in fish numbers coincided with the onset of nonnative aquatic macrophytes in the reservoir and illustrates the impact of aquatic macrophytes on the fishery community (TVA 1997f).

The health of the fish community in the vicinity of the Bellefonte site was rated "fair" from 1993 to 1996 (Reservoir Fish Assemblage Index scores ranging from 35 to 38). This assessment included sampling the inflow region of Guntersville Reservoir (upstream from the plant site), the transition region (downstream from the plant site), and the forebay region (farfield downstream from the plant site). Aspects that appear to be limiting the fish community quality in the transition zone are the low number of sucker species, the high percentage of individuals of tolerant species, the numerical dominance by a single species, and the high percentage of omnivores in the community. Sport Fish Index scores for the upper Guntersville Reservoir reveal that this portion of the reservoir maintained a good sauger, channel catfish, and largemouth and spotted bass fishery during 1996. Smallmouth bass and crappie fisheries rated low. Commercial species taken in the reservoir include catfish, buffalo fish, and paddlefish (TVA 1997f).

Grass carp, or white amur, is a herbivorous fish native to eastern Asia. As many as 120,000 individuals were introduced into the Guntersville Reservoir from 1988 to 1990 to control aquatic vegetation; specifically, to control hydrilla and spinyleaf naiad. The decline in these aquatic macrophytes can be attributed at least in part to feeding by grass carp. Since nearly all grass carp introduced into the reservoir have been sterile, they have not reproduced. Thus, the influence of this species on the existing environment of the reservoir should decline with time.

Mussel and Clam Communities

The most permanent (long-lived) members of the benthic macroinvertebrate community are the freshwater mussels, *Unionidae*. These organisms, which require a fish host to complete their life cycle, were at one time a dominant and diverse part of the benthic community of the Tennessee River. Major declines in the numbers and diversity of these organisms have occurred during the past 30 years. A recent investigation in August 1995 identified 14 species of mussels. The greatest abundance for one of the samples (a single transect) was at Tennessee River Mile 391.1, just downstream from the Bellefonte underwater diffuser. This sample contained 65 mussels of 8 species with a population of 1.3 per square meter.

The three most abundant mussels, *Megalonaias nervosa*, *Potamilus alatus*, and *Pleurobema cordatum*, made up 84 percent of the total. While some mussels species found near Bellefonte are harvested by the commercial mussel industry (e.g., *Megalonaias nervosa*), the low average density found (0.3) indicates this area does not support a valuable commercial mussel resource (TVA 1997f).

Two introduced species, the Asiatic clam, *Corbicula fluminea*, and the zebra mussel, *Dreissena polymorpha*, are known to occur in the part of Guntersville Reservoir that is adjacent to the Bellefonte site. The Asiatic clam has been present in this part of the Tennessee River for at least 30 years, but the zebra mussel was first found here in 1995. Both species have the potential to clog power plant water systems (TVA 1997f).

Aquatic Macrophytes

The greatest abundance of aquatic macrophytes in the TVA system is in the Guntersville Reservoir (TVA 1997f). Over the past decade, coverage of aquatic macrophytes has varied from about 8,100 hectares (20,000 acres) in 1988 (about 29 percent of the water surface area) to about 2,024 hectares (5,000 acres) in 1991. The peak coverage in 1988 occurred at the end of a record drought period (1984–1988) in the Tennessee Valley. Although several native submersed species such as southern naiad, coontail, American pondweed, small pondweed, and muskgrass colonize portions of the lake, the most abundant plants are the introduced or nonnative species.

The most widespread and abundant submersed macrophyte is Eurasian watermilfoil, *Myriophyllum spicatum*. This nonnative species was introduced into the TVA system in the 1950s, and established colonies were observed on the Guntersville Reservoir in 1963. By the late 1960s there were several thousand acres of Eurasian watermilfoil growing in embayments and overbank areas of the Guntersville Reservoir. Coverage of Eurasian watermilfoil on the Guntersville Reservoir over the past decade ranged from about 1,214 hectares (3,000 acres) in 1991 to about 6,070 hectares (15,000 acres) in 1988. Abundance and coverage of Eurasian watermilfoil and other submersed macrophytes can be expected to fluctuate in response to such factors as flow and water clarity, and should be most abundant in years with the low flows and clear water commonly associated with drought conditions.

Eurasian watermilfoil typically grows at water depths of a few inches up to about 3 meters (10 feet) and can form dense colonies that can interfere with small craft navigation and recreational activities, provide habitat for mosquitoes, and clog water intakes. Eurasian watermilfoil is abundant in shallow embayments near Bellefonte and along the overbank adjacent to the river channel. However, because of the riverine nature of the Guntersville Reservoir in the vicinity of the site, the overbank habitat is not as extensive as it is in portions of the reservoir farther downstream. Extensive colonization of Town Creek Embayment by aquatic macrophytes has little potential for clogging the facility intake structure; however, they have some potential for increasing mosquitoes at the facility.

Spinyleaf naiad, *Najas minor*, and hydrilla, *Hydrilla verticillata*, are two other introduced species of submersed aquatic macrophytes that have established themselves on the Guntersville Reservoir. Like Eurasian watermilfoil, these two species also can colonize shallow water habitats and have the potential to cause similar problems. Spinyleaf naiad was introduced into the TVA system in the 1940s. During the mid- to late 1980s, spinyleaf naiad colonized as much as 607 to 810 hectares (1,500 to 2,000 acres). These levels have declined to a few hundred acres in the 1990s. Hydrilla has the potential to be an even more problematic plant than Eurasian watermilfoil because of its ability to colonize in deeper water and because it forms a continuous plant mass through the water column. Hydrilla, which was first discovered on the Guntersville Reservoir in 1982, increased to about 1,215 hectares (3,000 acres) in 1988. Although scattered hydrilla currently is present throughout the mid-portion of the reservoir, visible colonies occupy less than 4 hectares (10 acres).

The establishment and rapid spread of hydrilla were the primary reasons for the stocking of 100,000 sterile grass carp in the Guntersville Reservoir in 1990. The dramatic decline in hydrilla and spinyleaf naiad and the suppression of these species can be partially attributed to feeding by the grass carp. Like Eurasian watermilfoil, the abundance of these species can be expected to fluctuate with reservoir conditions (e.g., flow and water clarity), and also can be expected to increase as populations of the grass carp decline and feeding pressure becomes less.

Threatened and Endangered Species

Federally listed and per or state-listed threatened and endangered species occurring in the vicinity of the Bellefonte site were described in the 1974 Final Environmental Statement (TVA 1974b), and more recently in the Bellefonte Conversion Project Final EIS (TVA 1997f). At least two Federally listed animals occur regularly on the Bellefonte site, and several other Federally or state-listed species are likely to use areas of suitable habitat on or near the site occasionally (**Table 4–28**).

Table 4–28 Federally and State-Listed Threatened or Endangered Species On or Near the Bellefonte Nuclear Plant Site

Common Name	*Scientific Name*	*Federal*	*State*
Plants			
Snow-wreath	*Neviusia alabamensis*	Not listed	Endangered
Smoketree	*Cotinus obovatus*	Not listed	Species of Concern
Yellow Honeysuckle	*Lonicera flava*	Not listed	Species of Concern
Mollusk			
Orange-footed Pearlymussel	*Plethobasus cooperianus*	Endangered	Endangered
Pink Mucket	*Lampsilis abrupta (=L. orbiculata)*	Endangered	Endangered
Anthony's Riversnail	*Athearnia anthonyi*	Endangered	Endangered
Fish			
Snail Darter	*Percina tanasi*	Threatened	Threatened
Reptiles			
Box turtle	*Terrapene carolina*	Not listed	Species of Concern
Birds			
Bald Eagle	*Haliaeetus leucocephalus*	Threatened	Threatened
Osprey	*Pandion haliaetus*	Not listed	Threatened
Cooper's Hawk	*Accipiter cooperii*	Not listed	Species of Concern
Willow Flycatcher	*Empidonax traillii*	Not listed	Status Undetermined
Warbling Vireo	*Vireo gilvus*	Not listed	Status Undetermined
Mammals			
Gray Bat	*Myotis grisescens*	Endangered	Endangered
Indiana Bat	*Myotis sodalis*	Endangered	Endangered
Meadow Jumping Mouse	*Zapus hudsonius*	Not listed	Species of Concern

Source: Tennessee 1994, TVA 1997f, TVA 1998a, TVA 1999.

Plants

No Federally listed threatened or endangered species are known to occur on or in close proximity to the site. However, two plants Federally listed as endangered occur in Jackson County. American hart's-tongue fern, *Phyllitis scolopendrium var. americana,* occurs in a cave mouth about 32 kilometers (20 miles) west of the site. No suitable habitat for this species occurs on the Bellefonte Nuclear Plant site, and it has not been found in nearby caves or sinkholes. The green pitcher plant, *Sarracenia oreophila*, occurs in wet woods and streambanks on Sand Mountain. Suitable habitat is absent from the Bellefonte site, and the species has not been found on or in the immediate vicinity of the site.

The snow-wreath, listed as endangered in Alabama, and smoketree and yellow honeysuckle, both listed as of special concern in Alabama, are found across the Tennessee River from the plant site. Although habitat similar to that preferred by these species exists within the Bellefonte Nuclear Plant site boundary, these species have not been found there during extensive field surveys (TVA 1998e).

Terrestrial Animals

Two Federally listed terrestrial animals, the bald eagle and gray bat, have been seen at the Bellefonte site. The bald eagle is a fairly common winter resident and an uncommon summer resident on Guntersville Reservoir. The nearest nest sites are at the Raccoon Creek, and Crow Creek embayments, 14 kilometers (9 miles) and 16 kilometers (10 miles), respectively, upstream of the Bellefonte Nuclear Plant site. Wintering eagles on Guntersville Reservoir concentrate at a few nocturnal roost sites and disperse over much of the reservoir during the day. They regularly use the wooded shoreline of the Bellefonte site along both the main stem of the Tennessee River and the intake canal for perching and foraging. Additional information on the biology and status of bald eagles in the southeastern United States is contained in the Biological Assessment included in the 1995 NRC *Final Environmental Statement Related to the Operation of Watts Bar Nuclear Plant* (NRC 1995b).

The gray bat roosts in caves year-round and forages over water on insects. At least two caves used as summer roosting sites, Blowing Wind Cave and Nitre Cave, occur within 15 kilometers (9 miles) of the Bellefonte site. The reservoir adjacent to the Bellefonte site provides suitable foraging habitat, and gray bats frequently travel 20 or more kilometers (12 or more miles) from summer roost caves to foraging sites. It is likely, therefore, that gray bats regularly occur along the shoreline of the Bellefonte site. Best, et al., (1995) provide additional details on gray bat movements and foraging ecology at Guntersville Reservoir.

The Indiana bat roosts in hollow trees during summer months and hibernates in caves during the winter. This species typically forages in wooded areas adjacent to streams and other water courses. Because Indiana bats have been observed hibernating in caves within 15 kilometers (9 miles) of the Bellefonte site, it is likely they at least occasionally forage within forested riparian areas on the Bellefonte site during the summer.

The habitat requirements and local status of the meadow jumping mouse, osprey, Cooper's hawk, willow flycatcher, warbling vireo, and box turtle have been described by TVA. In general, suitable habitat for these species occurs at Bellefonte; however, the extent of their use (if any) of the site is not known (TVA 1997f).

Aquatic Species

In recent years, no aquatic species on the Federal or State of Alabama lists of endangered or threatened wildlife have been found in the Tennessee River in the vicinity of the Bellefonte site. Recent fish community assessments and a mussel survey in Guntersville Reservoir near the Bellefonte site do not indicate the presence of listed or candidate endangered or threatened species (TVA 1997f). A few listed aquatic species have been found in both the upstream part of Guntersville Reservoir and in Wheeler Reservoir just downstream from Guntersville Dam.

The endangered pink mucket and the threatened snail darter occur in suitable gravel and cobble habitats in several Tennessee River reaches, including both the Nickajack and Guntersville Dam tailwaters. The orange-footed pearlymussel also occurs in gravel and cobble habitats within the main stem of the Tennessee River. In recent years it has been found in the Guntersville Dam tailwater and not in the Nickajack Dam tailwater. Anthony's riversnail, the only endangered snail in this group, occurs in the lower Sequatchie River and at a few locations in the Nickajack Dam tailwater about 24 kilometers (15 miles) upstream of the Bellefonte site. It has not been found in surveys near the Bellefonte site or at any other location on Guntersville Reservoir or in the Guntersville Dam tailwater (TVA 1998a). Additional information on the biology, distribution, and recovery objectives for this species is presented in the U.S. Fish and Wildlife Service recovery plan (DOI 1997).

4.2.3.7 Archaeological and Historic Resources

An initial archaeological reconnaissance of the 607 hectares (1,500 acres) of the Bellefonte Nuclear Plant site was conducted in 1972 (TVA 1997f). This reconnaissance resulted in the verification and discovery of five sites, with three of the sites containing Archaic, Woodland, or Mississippian components. One of the sites was subjected to data recovery in 1973-1974 resulting from mitigation of adverse impacts related to the proposed construction of the Bellefonte Nuclear Plant. Another of the sites consists of a woodland component on the northeast edge of the peninsula near the confluence of Town Creek and the Tennessee River that is potentially eligible for inclusion in the National Register of Historic Places. None of the other sites are eligible for inclusion. An archival record search, an initial field check, and discussions with the Alabama Historical Commission determined that the only historical site of significance within the project locality is the original town site of Bellefonte. Bellefonte was incorporated in 1821 and served as the first county seat of Jackson County; it has been determined eligible for inclusion in the National Register of Historic Places. At the time of the survey, two antebellum structures were still standing: the Daniel Martin Inn/Tavern and a one-room cabin with a more recent lean-to addition. The major street layout of Bellefonte was still discernible, as were the limestone foundations of two antebellum brick structures and an associated cistern. Brick remnants of the former jail and the chimney and doorstep foundations of a cabin were also present. Since the 1972 survey, all structures associated with the original town site of Bellefonte were removed by subsequent landowners (TVA 1997f, TVA 1998e).

4.2.3.8 Socioeconomics

The social, economic, and community characteristics of the affected environment are described at three levels of increasing size: (1) the city of Scottsboro, (2) Jackson County, and (3) the region of influence, defined as the area within a 80-kilometer (50-mile) radius of the Bellefonte Nuclear Plant that includes the city of Scottsboro and Jackson County. Completion of Bellefonte 1 would have the greatest effect on the socioeconomic characteristics of Jackson County.

The Bellefonte Nuclear Plant site is near Hollywood, Jackson County, Alabama. Its exact location is latitude 34°42'32" north and longitude 85°55'36" west (NRC 1998d). Scottsboro, a city of approximately 14,000 persons, is about 11.3 kilometers (7 miles) from the Bellefonte Nuclear Plant and is the largest city in the county. Scottsboro is located on the banks of the Tennessee River's Guntersville Reservoir, Jackson County, Alabama. Jackson County is in the northeast corner of Alabama, adjacent to Marion County, Tennessee, to the north; DeKalb County, Alabama, to the east; Madison County, Alabama, to the west; and Marshall County, Alabama, to the south.

The affected environment section describes only those socioeconomic factors that most likely would be affected if the Bellefonte Nuclear Plant were selected for tritium production. School-related issues and tax related issues are expected to be among the important socioeconomic factors.

Regional Economic Characteristics

This section presents data on the current and recent economic conditions in Scottsboro and Jackson County, including unemployment rate, workforce occupations, per capita and household income, and main businesses.

Employment

The most recent unemployment rate for Jackson County is 8.2 percent for the period January through October, 1997 (Jackson County 1998). **Table 4–29** shows the unemployment rate for the county from 1991 to 1997. As indicated in Table 4–29, the 1997 figure is considerably lower than the annual averages from 1991 through 1996. There are no comparable figures available for the city of Scottsboro.

Table 4–29 Unemployment Percentages in Jackson County (1991–1997)

1991	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*
10.0	10.2	9.6	9.1	10.0	9.5	8.2

Source: Jackson County 1998.

Income

Total personal income in Jackson County increased from $876 million in 1995 to $931 million in 1996 (DOC 1998b). The per capita personal income went from $17,539 in 1995 to $18,366 in 1996. In 1996, the county ranked eighteenth in Alabama in per capita income. **Table 4–30** shows the per capita and household income figures for Scottsboro and Jackson County for 1997.

Table 4–30 Per Capita and Household Income in the City of Scottsboro and Jackson County (Estimates for 1997)

Income Measure	*City of Scottsboro*	*Jackson County*
Estimated per capita income	$15,552	$13,525
Estimated average household income	Not Available	$35,264
Estimated median household income	$27,856	$26,492

Source: Jackson County 1998.

In terms of occupations, manufacturing is the most important, accounting for about 31 percent of the workforce (5,064 workers) in Jackson County. This is followed by services, with about 27 percent of the workforce (4,377 workers), and by retail trade, with about 19 percent (3,151 workers). Less important occupations include government (almost 8 percent), finance/insurance/real estate (4.7 percent), construction (3.8 percent), and wholesale trade (2.9 percent). **Table 4–31** reflects the distribution of industrial occupations in Jackson County compared with the overall figures for Alabama and the United States (as percentages of total employment only for 1996).

Table 4–31 Industrial Occupation Distribution for Jackson County, Alabama, and the United States (1996 Main Occupations as a Percentage of Total Employment Only)

Type of Occupation	*Jackson County (Estimated for 1997)*	*Alabama (1993)*	*United States (1993)*
Manufacturing	29.7	17.4	12.6
Services	15.4	24.6	30.4
Retail trade	15.7	17.1	16.9
Government	16.6	16.8	14.2
Finance-Insurance-Real Estate	3.3	4.8	7.4
Construction	6.0	6.2	5.3
Wholesale trade	2.7	4.4	4.6
Agriculture	0.9	1.1	1.2

Source: DOC 1998b.

Businesses

The businesses of greatest economic significance in the region of influence are Akzo Nobel, CommScope, Mead Containerboard, Maples Industries, Patrick Lumber Company, Shaw Industries, U.S. Gypsum, and Wenzel Metal Spinning (Scottsboro 1998). Jackson County businesses employ a total of 16,264 workers. The average number of employees per business in the county is 10.2 (Jackson County 1998).

Population

The population of Hollywood has remained essentially flat over this decade. According to Census Bureau data, it was 916 and 914 in 1990 and 1996, respectively (DOC 1998c). The population of Scottsboro increased from 13,786 in 1990 to 14,133 in 1996 (estimated), an increase of 2.5 percent. Scottsboro ranks thirty-third in Alabama in terms of population. The nearest metropolitan city to the Bellefonte Nuclear Plant site is Huntsville, which grew from 159,880 in 1990 to 170,424 in 1996 (estimated), an increase of 6.6 percent.

According to the 1990 U.S. Census, the total population of Jackson County was 47,796 (DOC 1998c). The estimated county population in 1997 was 50,532, and the projection for 2002 is 51,132 (Jackson County 1998). The estimated number of households in the county in 1997 was 19,315; this number is projected to decrease to 19,177 by 2002.

The total population for the Bellefonte Nuclear Plant region of influence was estimated at 883,553 in 1990 (DOC 1992). For the same year, the number of households was estimated at 336,109. About 25 percent (220,967) of the region of influence's population were under 18 years of age; about 53 percent (468,407) were 18 through 54; and about 22 percent were 55 or older.

Demographic characteristics of the region of influence and Jackson County for 1990 are shown in **Table 4–32**. For the same year, **Table 4–33** shows the ethnic breakdown by race and Hispanic origin for the population of the county, the region of influence, and the United States (for comparison).

Table 4–32 General Demographic Characteristics of the Bellefonte Nuclear Plant Site Region of Influence and Jackson County (1990 Census)

Demographic Measure	*Jackson County*	*Region of Influence*
Total population	47,796	883,553
Families	14,143	252,374
Households	18,099	336,109
Male	23,146	427,549
Female	24,650	456,004

Sources: DOC 1998c.

The racial and ethnic composition of the region of influence projected for the year 2025 is shown in **Figure 4–16**. Low-income households based on 1990 Census data are presented in **Figure 4–17**. Low-income households are those with incomes of 80 percent or less than the median income of the counties. As indicated in this figure, approximately 44 percent of total households are low-income households (see Appendix G).

Table 4–33 Population Distribution by Race and Hispanic Origin in Jackson County, the Bellefonte Nuclear Plant Site Region of Influence, and the United States[a]

Ethnic Group or Subgroup (U.S. Census Definitions)	*United States*	*Jackson County*		*Bellefonte Site Region of Influence*	
	Percentage of Total Population	*Population*	*Percentage of Total Population*	*Population*	*Percentage of Total Population*
White not of Hispanic origin	75.60	44,531	93.17	825,149	85.11
Black not of Hispanic origin	11.80	1,957	4.09	126,093	13.01
American Indian, Aleut, or Eskimo not of Hispanic origin	0.70	1,008	2.11	4,934	0.51
Asian or Pacific Islander not of Hispanic origin	2.80	89	0.19	6,958	0.72
Other race not of Hispanic origin	Not Available	3	0.01	125	0.01
White of Hispanic origin	4.63	165	0.35	4,115	0.42
Black of Hispanic origin	0.31	11	0.02	594	0.06
American Indian, Aleut, or Eskimo of Hispanic origin	0.07	12	0.03	41	0.00
Asian or Pacific Islander of Hispanic origin	0.12	1	0.00	160	0.02
Other race of Hispanic origin	3.83	19	0.04	1,346	0.14
Hispanic total	9.10	208	0.44	6,256	0.65
Total population (all ethnic groups)	100.00	47,796	100.00	969,515	100.00

[a]Shown as a percentage of total population for comparison purposes.
Note 1: Region of Influence is defined as the area within a 50-mile radius of the Bellefonte site.
Note 2: The sum of the items may not add up to the population total due to rounding error.
Sources: DOC 1992.

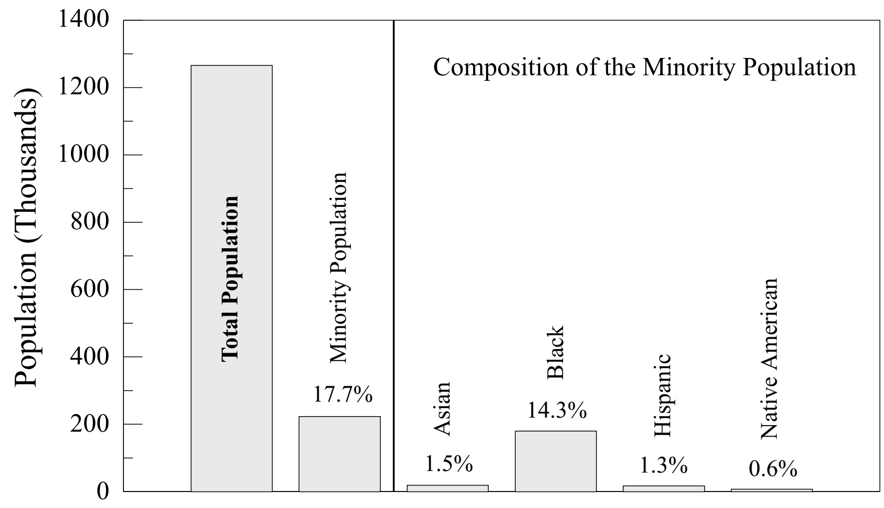

Figure 4–16 Racial and Ethnic Composition of the Minority Population Residing in Counties Within 80 Kilometers (50 Miles) of the Bellefonte Nuclear Plant Projected for the Year 2025

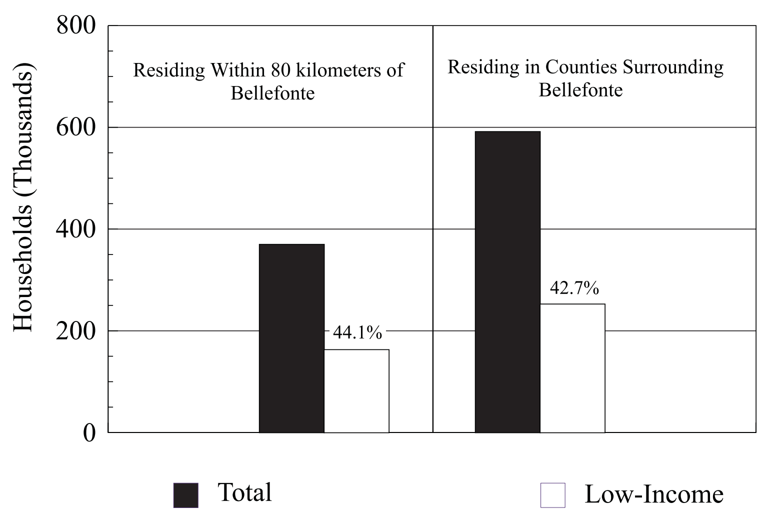

Figure 4–17 Low-Income Households Residing Within 80 Kilometers (50 Miles) of the Bellefonte Nuclear Plant (1990)

Housing

Temporary housing in Jackson County consists of 7 hotels and motels, about 10 trailer parks, and 13 apartment complexes. The hotels and motels are the Budget Inn, Comfort Inn, Days Inn, Goose Pond Colony Cottage Rentals, Hampton Inn, Scottish Inn Motel, and Scottsboro Hotel. The three largest trailer parks together have about 380 camper and mobile home lots, while the other 10 have about 30 each. Camper lots cover an area half the size of mobile homes and are ideal for workers who commute from nearby counties or neighboring states and drive back home on weekends. Thus, a trailer park designed for campers can accommodate twice as many tenants as one designed for mobile homes (Scottsboro 1998). An additional park adjacent to the Bellefonte Nuclear Plant site is planned for construction in the fall of 1998; it will feature about 125 lots, with the option for expansion to about 250. The estimated number of camper and mobile home lots in the county, which was about 590 as of May 1998, is expected to increase to about 674 in 1999. Trailer parks take about four months to build. As of spring 1998, all trailer parks in the area were at or near capacity.

Currently, most apartment complexes have low vacancy rates at or near 0 percent. Vacancy rates are subject to seasonal variation and range from 0 to 12 percent (Jackson County 1998). Monthly rents range from the low $200s to mid $300s for one-bedroom apartments, the high $200s to high $300s for two-bedroom apartments, and the high $300s to low $400s for three-bedroom apartments (Jackson County 1998). There are 12 apartment complexes in operation and one under construction in Jackson County (Scottsboro 1998). They range in size from 20 to 100 units and include one complex for the elderly and one for low-income tenants (Jackson County 1998). The estimated number of rental apartment units is 650. There were also 36 homes for rent in Jackson County as of May 1998 (Scottsboro 1998). The home rental market is considered limited by local realtors.

In terms of permanent housing, from 1980 to 1990 a total of 621 electrical utility permits were issued to new single-family homes, equal to a less than 0.5 percent increase per year (Scottsboro 1998). The number of occupied housing units in Jackson County was 18,020 in 1990, of which 13,827 (77 percent) were owner-occupied and 4,193 (23 percent) were rentals (Jackson County 1998). The average number of persons per housing unit in 1990 was 2.6, which is slightly higher than the average for Alabama (2.32) and the United States (2.29) (Jackson County 1998). There were 147 homes listed for sale in Jackson County as of April 21, 1998 (Scottsboro 1998). Of these, 82 were in Scottsboro. The average number of days to sell a home was 126 as of April 21, 1998.

The average home sale price in 1997 was $72,000. Property taxes, insurance costs, and utility rates are about 88 percent of the national average (Scottsboro 1998).

Community Services

General Education

A total of 152 students are enrolled in Hollywood Junior High School, part of the Jackson County School System (Jackson County 1998). The city of Scottsboro has four public elementary schools, one junior high school, and one high school. Total public school enrollment in Scottsboro is 2,967, of which 1,664 attend primary schools and 1,303 attend secondary schools (Scottsboro 1998). Scottsboro has one private elementary school (the North Alabama Christian School, a new private elementary school opened for the current academic year) and eight private preschool and kindergarten schools. The Scottsboro School System has 207 certified teachers and can absorb 725 additional students next year with the construction of a new high school. The old high school is being converted into an elementary school (Scottsboro 1998). The current student-to-teacher ratio for the system is 14:1. Presented as **Table 4–34** are the student enrollment breakdown by year and the number of staff for 1997–1998 in the Scottsboro School System.

Table 4–34 Scottsboro School System Breakdown by Academic Year (1991–1998)

School and Location	*Grade Levels*	*Total Enrollment (by School Year)*							*Total Faculty (1997–1998)*			*Student to Faculty Ratio (1997–1998)*
		1991–1992	*1992–1993*	*1993–1994*	*1994–1995*	*1995–1996*	*1996–1997*	*1997–1998*	*Certified Teachers*	*Support*	*Other*	
Brownwood Elementary	K–4	381	364	365	367	416	431	437	32	6	6	14:1
Caldwell Elementary	K–4	501	543	469	449	429	445	428	34	9	7	13:1
Nelson Elementary	K–4	264	239	297	297	338	355	364	27	6	4	13:1
Page Elementary	5–6	492	498	462	436	420	420	435	29	8	5	15:1
Total primary	K–6	1,638	1,644	1,593	1,549	1,603	1,651	1,664	122	29	22	14:1
Scottsboro Junior High School	7–8	454	461	486	480	458	451	453	29	7	7	16:1
Scottsboro High School	9–12	881	868	825	812	842	800	850	56	12	9	15:1
Total secondary	7–12	1,335	1,329	1,311	1,292	1,300	1,251	1,303	85	19	16	15:1
Total system	K–12	2,973	2,973	2,904	2,841	2,903	2,902	2,967	207	48	38	14:1

K = Kindergarten.
Source: Scottsboro 1998.

The system's transportation services can accommodate up to 4,080 students transported by 34 buses on a dual-route basis, or 2,040 on a single route (Armstrong 1998). Thus, the system's transportation services can accommodate an additional 1,113 students, given a dual-route system.

The Scottsboro School System's budget for Fiscal Year 1998 (October 1, 1997, through September 30, 1998) was $18,368,433 (Scottsboro 1998). The system obtains revenue from the county, state, and Federal governments. For Fiscal Year 1997, Jackson County paid the school system $204,690 from tax revenues (Jackson County 1998). In addition, $672,657 were allocated to the school system for Fiscal Year 1998 by the Jackson County Commission from funds provided by TVA in lieu of taxes (Jackson County 1998). The budget per student was $5,120 for the 1995–1996 academic year.

Overall student enrollment in the Jackson County School System is 6,257, of which 713 are in elementary schools, 566 in middle schools, 1,273 in junior high schools, and 3,705 in high schools (Jackson County 1998). The Jackson County School System has 437 certified teachers and 35 administrators. The current student-to-teacher ratio for the system is 14:3. The system could absorb about 740 additional students without significant disruption. Eighteen new classrooms are being added system-wide. There are two private Christian academies in the county (one in Scottsboro, as mentioned above). The Jackson County School System has 100 school buses and, at an average of 66 students per bus, an overall transportation capacity of 6,600 on a single-route basis or 13,200 on a dual-route basis. This means that the system could accommodate an additional 343 students on a single-route basis and 6,943 on a dual-route basis. The Jackson County Board of Education is considering plans to consolidate three high schools: Woodville, Skyline, and Paint Rock Valley. The proposed consolidated school would be for 432 high school students. Forty-four percent of those students are currently enrolled at Skyline, 33 percent at Woodville, and 23 percent at Paint Rock (Alabama A&M 1998).

The system's budget was $42,418,000 for the 1997–1998 academic year, of which $35,765,012 were spent directly on students (about $5,716 per student, up from $4,240 for the 1995–1996 academic year) and $6,652,988 on general student services (Armstrong 1998, Jackson County 1998). The estimated budget for 1998-1999 is $43 million (Jackson County 1998). There are three revenue components to the budget: Federal, state, and county government funds. For Fiscal Year 1997, Jackson County's share was $374,403 (Jackson County 1998). In addition, $1,448,021 were allocated to the school system for Fiscal Year 1998 by the Jackson County Commission out of funds provided by TVA in lieu of taxes (Jackson County 1998).

Public Safety

This section describes public safety—specifically, fire protection and police protection—in the region of influence, including Jackson County and Scottsboro.

Fire protection in Scottsboro is provided by the Scottsboro Fire Department. There are 30 full-time firefighters and 14 volunteers (Scottsboro 1998). Jackson County has 490 volunteer firefighters. **Table 4–35** shows full-time and volunteer firefighters in the region of influence. There are 27 fire departments within the region of influence; 24 of these are in Jackson County, as noted above. The total number of firefighters for the region of influence (including all of Jackson County) is approximately 535.

Table 4–35 Fire Protection Services Available in the City of Scottsboro, Jackson County, and the Bellefonte Nuclear Plant Site Region of Influence (April 1998)

Level of Analysis	*Number of Stations (Fire Departments)*	*Number of Firefighters*		*Vehicles*		
		Full-Time	*Volunteer*	*Pumps and Tankers*	*Ladders*	*Rescue*
City of Scottsboro	3 (1)	30	14	4	1	1
Jackson County[a]	Not available (24)	31	490	24	1	21
Region of Influence[b]	Not available (27)	31	535[c]	31	1	21

[a] Including the Scottsboro Fire Department.
[b] Including the Scottsboro Fire Department, all of Jackson County's volunteer departments, and three of DeKalb County's fire departments (Henager, Sylvannia, and Powell).
[c] Minimum estimate.
Sources: Scottsboro 1998, Jackson County 1998.

Police protection in the vicinity of the Bellefonte site is provided by the Scottsboro Police Department, the Hollywood Police Department, and the Jackson County Sheriff's Office. The county has eight police departments (Scottsboro, Stevenson, Bridgeport, Hollywood, Woodville, Skyline, Section, and Pisgah). Scottsboro has 37 full-time officers, about 10 civilian dispatchers, 6 jailers, 2 clerks, and 1 maintenance employee. The Hollywood Police Department has three officers. The Sheriff's Office has 27 sworn deputies, including the Sheriff, who is based in Scottsboro (Jackson County 1998).

There are two hospitals in Jackson County. Jackson County Hospital has 170 beds and a staff of 465, including 40 physicians (Jackson County 1998). North Jackson Hospital has 40 beds and a staff of about 270, including 6 physicians.

Local Transportation

The nearest major interstate highway is Interstate Highway 59, approximately 47 kilometers (29 miles) southeast of the Bellefonte site. U.S. Highway 72, which connects Chattanooga, Tennessee, and Huntsville, Alabama, is 3.2 kilometers (2 miles) northwest of the site. Bellefonte Road is a two-lane road extending from the north across Town Creek Embayment to U.S. Highway 72. Site access from the south is provided by South Access Road, connecting to Jackson County Road 33. The CSX Railway main line between Chattanooga and Huntsville passes about 4.8 kilometers (3 miles) northwest of the Bellefonte site. The Tennessee River is navigable past the Bellefonte site; a minimum 2.7-meter (9-foot) channel depth is maintained for commercial or recreational vessels. The barge traffic in this portion of the Tennessee River navigation system is considered moderate (TVA 1997f). These transportation routes are shown in **Figure 4–18.**

Tax Revenues

Jackson County Tax Revenues

Jackson County collects tax revenues from real estate, sales taxes, and motor vehicle tags. The net assessed real estate value for Fiscal Year 1997 was $169,486,219 (Jackson County 1998). Total tax collections in Fiscal Year 1997 were $9,353,939, up from $8,618,488 in Fiscal Year 1995. **Figure 4–19** shows the total distributions by recipient for Fiscal Year 1997. **Table 4–36** shows Jackson County's tax and fee revenue distributions by recipient and by source for Fiscal Year 1997.

The Jackson County Commission also receives monthly payments from TVA of about $469,629.06, amounting to $5,635,548.72 for Fiscal Year 1998 (Jackson County 1998).

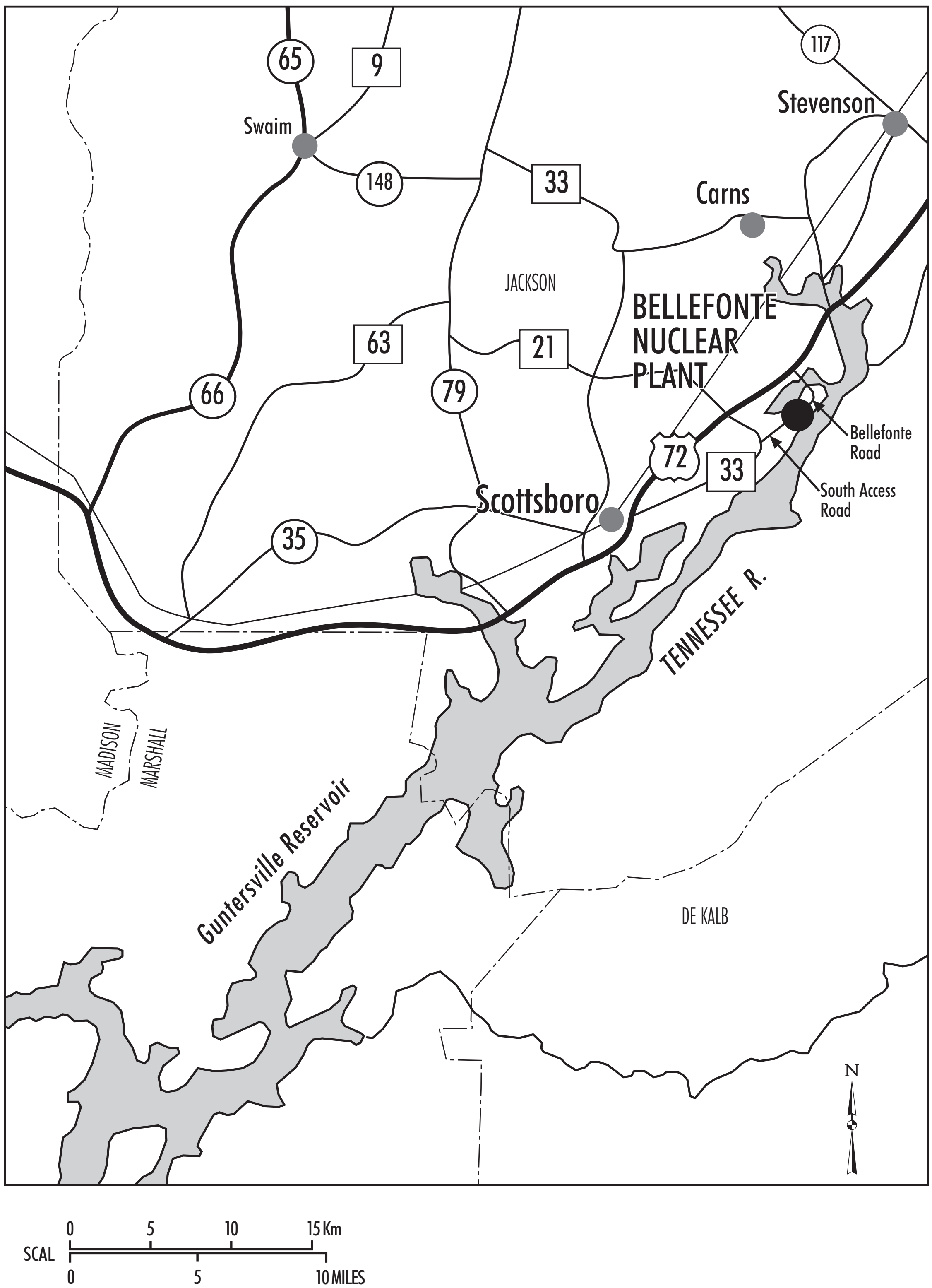

Figure 4–18 Transportation Routes in the Vicinity of the Bellefonte Nuclear Plant Site

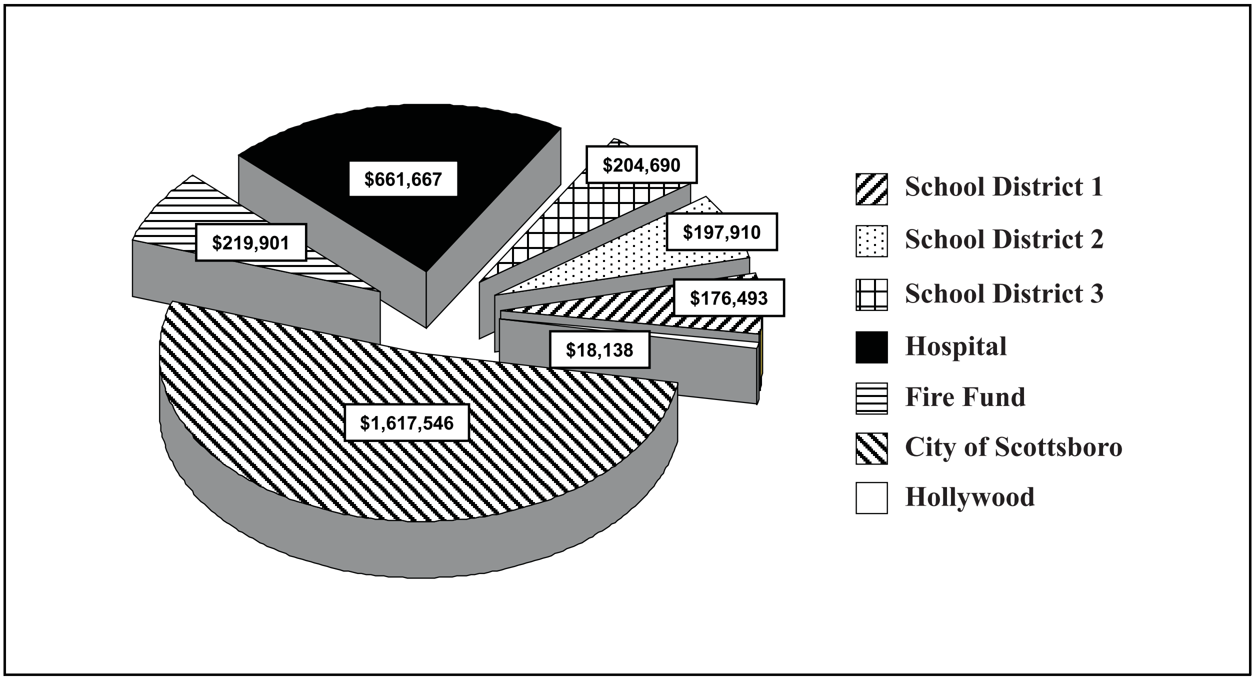

Figure 4–19 Jackson County Tax Revenue Distributions by Recipient FY 1997

Source: Jackson County 1998.

Tobacco Tax Revenues

Scottsboro City received $86,538 in tobacco tax revenues in 1997. Assuming an average $12 carton price, 30 cents would be allocated to the city, 50 cents to the county, $1.65 to the state, $2.48 to the Federal Government, and an additional 44 cents to state and local governments as sales taxes (Scottsboro 1998). Tax revenues are allocated to the city's general fund for operations. Jackson County's tobacco tax share amounts to approximately $300,000 per year (Scottsboro 1998).

Table 4–36 Jackson County Revenue Distributions by Recipient (Selected Recipients Only) and Tax and Fee Revenue Sources, Fiscal Year 1997 (October 1996 Through September 1997)

	County School Districts						
Tax or Fee Revenue Source	***District 1 (Jackson County)***	***District 2 (Jackson County)***	***District 3 (Scottsboro)***	***County Hospitals***	***Fire Fund***	***Scottsboro***	***Hollywood***
Real estate	$146,614	$158,878	$175,368	$548,437	$219,901	$1,302,747	$9,837
Motor vehicle ownership	$23,680	$35,918	$25,050	$113,230	$0	$185,722	$2,171
Motor vehicle sales	$0	$0	$0	$0	$0	$88,985	$3,596
Mobile home ownership [a]	$5,345	$485	$2,337	$0	$0	$2,337	$154
Motor vehicle tags	$855	$2,629	$1,935	$0	$0	$37,755	$2,380
Totals	$176,493	$197,910	$204,690	$661,667	$219,901	$1,617,546	$18,138

[a] Only when the land is not owned.
Source: Jackson County 1998.

4.2.3.9 Public and Occupational Health and Safety

Radiation Environment

Construction on Bellefonte 1 and 2 has not been completed. Therefore, no radiation has been released to the environment.

Background radiation exposure of individuals in the vicinity of the Bellefonte site is expected to be the same as for the Watts Bar site. The background radiation exposure at the Bellefonte site is presented in **Table 4–37**.

Table 4–37 Sources of Radiation Exposure to Individuals in the Vicinity of the Bellefonte Nuclear Plant Site[a]

Source	***Total** Effective Dose Equivalent (millirem per year)*
Natural Background Radiation	
Cosmic and cosmogenic radiation	28
External terrestrial radiation	28
In the body	39
Radon in homes (inhaled)	200
Total	295
Other Sources of Radiation	
Release of radioactive material in natural gas, mining, ore processing, etc.	5
Diagnostic x-rays and nuclear medicine	53
Nuclear energy	0.28
Consumer and industrial products	0.03
Total	355

[a] Values are based on average national data, not measured values at the Bellefonte site.
Source: TVA 1998b.

Chemical Environment

Since construction of the Bellefonte Nuclear Plant has not been completed, only small amounts of hazardous chemicals are used at the site for maintenance and layup (TVA 1997f).

The Bellefonte Nuclear Plant is in compliance with the discharge requirements of the NPDES Permit issued by the Alabama Department of Environmental Management (TVA 1997f). Historical data (from 1974 to 1991) on stormwater discharges indicate that all primary pollutants (list of major health-related contaminants) were below the Method Detection Limits, except for some metals. Two specified examples of these metals are dissolved iron and manganese (TVA 1997f). The background samples from intake water were also above the Method Detection Limits for the same metals. Section 4.2.3.3, Table 4–25, and Section 4.2.3.4, Table 4–26 contain data on quantities of concentrated chemical concentrations in ambient air and surface water in the vicinity of Bellefonte.

4.2.3.10 Waste Management

Small quantities of nonradioactive wastes are generated at the Bellefonte site. Current operations include actions necessary to maintain plant systems such as the turbines.

Ongoing maintenance activities at the Bellefonte Nuclear Plant generate a small amount of solid waste. Typical solid waste is routinely put in dumpsters on site and subsequently disposed of off site by contractors. Asbestos and special wastes are sent to the local sanitary landfill after approval by the Alabama Department of Environmental Management. In 1995, the Bellefonte Nuclear Plant generated more than 2.8 cubic meters (100 cubic feet) of asbestos wastes, including insulation board, roofing material, tiles, gaskets, and filters. Special wastes generated by Bellefonte include activated alumina, grease, oil-contaminated rags, oil filters, sandblast grit, cement, and surplus chemicals. Bellefonte's special waste disposal for 1995 included 55 drums (each containing 55 gallons) of oil-contaminated materials, grease and surplus chemicals, several hundred pounds of waste cement, and lesser amounts of other wastes.

The Bellefonte site currently qualifies as an EPA Small Quantity Generator, in accordance with 40 CFR 121.5 (i.e., the site generates more than 100 kilograms, but less than 1,000 kilograms of hazardous waste in any one calendar month per year). Hazardous wastes generated by the Bellefonte Nuclear Plant include waste oil, lead wastes, nickel-cadmium batteries, acetic acid wastes, hydrazine, polyvinylchloride glue, tar, and solvents.

Some polychlorinated biphenyls wastes (e.g., lighting ballasts, small capacitors), which are regulated by the Toxic Substances Control Act, are also generated. Hazardous wastes are shipped to the TVA Hazardous Waste Storage Facility in Muscle Shoals, Alabama, which makes arrangements for disposal at a permitted disposal facility (TVA 1997f).

4.2.3.11 Spent Fuel Management

There is no spent fuel at the Bellefonte Nuclear Plant site.

Storage Capacity

Spent fuel storage has been provided for Bellefonte 1 and 2. There are two separate spent fuel pools, one for each unit. Each pool has a storage capacity of 1,058 spent fuel assemblies.