2.3 WATER

This section describes the physical and hydrological characteristics of the VCSNS site and surrounding region that could affect or be affected by the construction and operation of VCSNS Units 2 and 3. The potential construction and operational impacts of the project on near- and far-field water resources are discussed in Chapters 4 and 5, respectively.

Units 2 and 3 would be located in Fairfield County, South Carolina, approximately 1 mile east of the Broad River and 2 miles northeast of the Parr Shoals Dam. The site would be situated on a hilltop with a plant grade elevation of 400 feet NAVD88[a] (or 400.7 feet NGVD29), about 150 feet above the Broad River floodplain. The site is located near the Monticello Reservoir, which serves as the upper pool of the Fairfield Pumped Storage Facility and the source of cooling and makeup water for Unit 1.

2.3.1 HYDROLOGY

This subsection describes the surface water bodies and groundwater aquifers that could affect the plant water supply and effluent disposal or that could be affected by the construction or operation of Units 2 and 3.

2.3.1.1 Surface Water

Figure 2.3-1 shows the major hydrologic features within a 50-mile zone around the site. Figure 2.3-2 shows the topography at and around the site based on data from a recent aerial photogrammetric survey. Figure 2.3-3 shows in more detail the major hydrologic features within a 6-mile zone around the site.

2.3.1.1.1 Rivers and Streams

The Broad River flows in a northwest-to-southeast direction approximately 1 mile west of the proposed site of Units 2 and 3. The reach of the river near the site is impounded by the Parr Shoals Dam forming the Parr Reservoir. At the Parr Reservoir, the river is approximately 2,000 feet wide, with depths ranging from a few feet to approximately 15 feet. Although the width of the Broad River varies substantially along the length of the Parr Reservoir, 2,000 feet is a typical width. In addition, the overflow section of Parr Shoals Dam is approximately 2,000 feet long. The gradient of the Broad River near the site is about 0.0007. This is approximately the average gradient in the stretch of the Broad River between the confluence of the Enoree River, upstream of the site, and the Richtex U.S. Geological Survey (USGS) station, downstream of the site, as shown in Figure 2.3-4. The Broad River originates on the eastern slope of the Blue Ridge Mountains near Lake Lure in North Carolina, and drains an area of approximately

a. At the VCSNS site, the difference between the NGVD29 datum and the NAVD88 is -0.696 feet. For example, EL 425 feet NGVD29 is equivalent to EL 424.304 feet NAVD88.

4,750 square miles upstream of Parr Shoals Dam. The drainage area of the Broad River is located between two southeast-northwest trending ridges stretching from Columbia, South Carolina, to the headwaters of the river approximately 100 miles northwest in North Carolina. Figure 2.3-4 shows the Broad River watershed upstream of the site. For most of its length in South Carolina, the Broad River flows through agricultural and forested land, including the Sumter National Forest, which bounds the river for some 30 miles above the Parr Reservoir. Many streams and creeks carry runoff and groundwater drainage to the Broad River. Rivers draining into the Broad River include the Enoree, the Tyger, and the Pacolet Rivers. Downstream of Parr Shoals Dam, the Broad River joins the Saluda River near Columbia, South Carolina, to form the Congaree River.

The average annual precipitation over the watershed of the Broad River upstream of Parr Shoals Dam is 45 inches with a runoff of approximately 17.8 inches, equivalent to a runoff volume over the entire watershed of 4.3 million acre-feet per year. It should be noted that this estimate is spatially averaged over a 4,750 square mile area, and therefore it is not expected to be the same as the mean point rainfall measured at any particular rain gauge. For comparison, the average annual precipitation at the Parr rain gauge, which is the closest station to the VCSNS site, is 45.75 inches (Table 2.7-3).

The USGS operates, or has operated, various stream flow gauging stations on the Broad River upstream and downstream of the Parr Reservoir. The three nearest stations to the site are located at Alston, Richtex, and Carlisle. Data from these three stations were used for the hydrologic evaluation of the Broad River near the site. Table 2.3-1 lists the key hydrologic data for the Alston, Richtex, and Carlisle gauging stations (Cooney et al. 2006, USGS 2006a). Figure 2.3-4 shows the location of these stations.

The nearest downstream active stream flow gauging station on the Broad River is at Alston (USGS station 2161000), approximately 1.2 miles downstream of Parr Shoals Dam (USGS 2006b). The Alston station has a contributing drainage area of approximately 4,790 square miles (Cooney et al. 2006), which is about 5.2% greater than the drainage area of the Broad River at its closest point to the site. It has operated for 31 years. Stream flow measurements at this station began in October 1896; they were discontinued in December 1907, and started again in October 1980. The Alston station continues to operate to this date. The mean annual daily flow at Alston based on all available data from water years 1897–1907 and 1981–2005 is 6,302 cubic feet per second (cfs) (Cooney et al. 2006, p.224). The mean annual daily flow based on recorded flows from 1980 to 2003 is approximately 5,726 cfs. The highest annual mean flow on record was 11,750 cfs in 1903 and the lowest annual mean flow was 2,153 cfs in 2002. The annual seven-day minimum flow is 200 cfs recorded in August 2002. The maximum recorded mean daily flow was 130,000 cfs and the maximum peak flow was 140,000 cfs, both measured on June 7, 1903 (Cooney et al. 2006, p. 224).

The next nearest downstream gauging station on the Broad River is at Richtex (USGS station 2161500), located approximately 10.2 miles downstream of the Parr Shoals Dam (USGS 1974). This station was discontinued in 1983. The

Richtex station had a contributing drainage area of approximately 4,850 square miles (USGS 2006a). The drainage area of the Richtex gauging station is about 6.7% greater than the drainage area of the Broad River at its closest point to the site. Stream flow data collected at this station exist from October 1925 to September 1928 and from October 1930 to September 1983. The mean annual daily flow for this period was approximately 6,155 cfs. The highest flood of record at Richtex had a peak discharge of 228,000 cfs, which occurred on October 3, 1929 (USGS 2006a).

The nearest active stream flow gauging station on the Broad River upstream of the site is near Carlisle (USGS 2156500), located approximately 24.6 miles upstream of the site (USGS 2006b). The Carlisle station has a contributing drainage area of approximately 2,790 square miles (Cooney et al. 2006, USGS 2006a). It is located upstream of the confluence of the Tyger and Enoree Rivers with the Broad River. Its drainage area is approximately 39% smaller than the 4,550 square mile drainage area of the Broad River near the site. Historical data from this station cover a period of 68 years. Stream flow measurements at this station began in 1938 and continue to this date. The mean annual daily flow at this station from 1938 to 2005 was 3,880 cfs. The highest annual mean flow was 5,977 cfs in 1965 and the lowest annual mean flow was 1,255 cfs in 2002. The annual seven-day minimum flow was 220 cfs, recorded in August 2002. The maximum recorded mean daily flow was 114,000 cfs and the maximum peak flow was approximately 123,000 cfs, both measured on October 7, 1976 (Cooney et al. 2006).

Tables 2.3-2, 2.3-3, and 2.3-4 give the mean daily flows for each day of the year at Richtex, Alston, and Carlisle, respectively, based on the available flow data record at each station. Tables 2.3-5, 2.3-6, and 2.3-7 give the mean monthly flow at Richtex, Alston, and Carlisle, respectively, for all the years of record.

2.3.1.1.2 Historical Flooding and Peak Flows

The historical flow data indicate two flood seasons—one from January to April and the other from July to October. Floods during the latter period are generally associated with hurricanes and have usually been of greater magnitude than those occurring from January to April. Table 2.3-8 lists the major historic floods at Richtex and Alston gauging stations, their peak discharge rates and maximum water surface elevations, as well as estimates of the corresponding discharges and water levels at the Parr Shoals Dam. Discharges at the Parr Shoals Dam were estimated by multiplying the recorded flow values at Richtex and Alston stations by the ratio of the respective drainage areas.

Figure 2.3-5 shows the flood inundated areas delineated by the Federal Emergency Management Agency in the area near the VCSNS site (FEMA 1982). The map shows different flood-prone areas indicated as zones A, B, and C for flood insurance purposes. Zone A indicates areas of special flood hazard corresponding to the 100-year floodplain; zone B includes areas of moderate flood hazards, mainly representing the limits between 100-year flood and 500-year flood; and zone C areas of minimal flood hazards.

Figure 2.3-6 shows the flood frequency curve for the Broad River at the Parr Shoals Dam that was developed based on annual maximum flow data recorded at Richtex (1926 to 1983) and Alston (1984 to 2006) USGS gauging stations, with drainage area adjustments as mentioned above. Table 2.3-9 also presents the estimated flood frequency values at the Parr Shoals Dam for return periods of up to the 500-year event.

The peak probable maximum flood discharge for the Broad River watershed at the Parr Reservoir, with a drainage area of 4,750 square miles, was estimated to be equal to 1,109,520 cfs. The corresponding peak flood stage was calculated to be 25.5 feet above the top of the gates of Parr Shoals Dam, which is at an elevation of 266 feet NGVD29 (or 265.3 feet NAVD88). The maximum probable maximum flood level is 265.3 + 25.5 = 290.8 feet NAVD88 (or 291.5 NGVD29).

2.3.1.1.3 Low Flows

Information on historic low flows is available at the Richtex (October 1925 to September 1983) and Alston (October 1980 to September 2003) gauging stations. The lowest observed daily mean flow at Richtex was 149 cfs on October 13, 1935, and on September 2, 1957. The lowest daily mean flow at Alston was 48 cfs on September 12, 2002. However, this value is not considered representative of natural river flows because it was influenced by the upstream flow diversion from the Parr Reservoir to Fairfield Pumped Storage Facility. Therefore, this value was not included in the low flow analysis. The next lowest flow at Alston was 156 cfs on August 13, 2002.

The *n*-day low flow for a stream is the average flow measured during the *n* consecutive days of lowest flow during any given year. Table 2.3-10 shows the 3-day, 7-day, 10-day, 30-day, 60-day, 90-day, 183-day, and 365-day average low flows for each year of record at Parr Shoals Dam.

The seven-day average low flow for the period 1929–2002 in the Broad River at Parr Shoals Dam was estimated to be 190 cfs on August 11-17, 2002. A low flow frequency analysis was performed on daily mean flows estimated at Parr Shoals Dam by plotting a best-fit curve through the annual low daily mean flows, which was extrapolated to obtain the 100-year daily mean low flow in the Broad River. This analysis showed that the 100-year daily mean low flow is about 125 cfs. A similar analysis performed on the annual minimum seven-day average flows produced the 100-year seven-day average low flow, estimated equal to 430 cfs.

An often used statistical measure of low flows is the 7Q10 low flow, defined as the lowest stream flow for seven consecutive days that occurs on average once every ten years. The USGS (USGS 2007) using the combined data at Richtex and at Alston, determined that the 7Q10 low flow at Alston is equal to 853 cfs.

2.3.1.1.4 Dams and Reservoirs

The nearest bodies of water to the site are the Parr Reservoir and the Monticello Reservoir, which serve as the lower and the upper pools, respectively, of the Fairfield Pumped Storage Facility.

The Parr Reservoir, located approximately 1 mile west of the proposed site for Units 2 and 3 on the Broad River, was created in 1914 by the construction of a dam on the Broad River at Parr Shoals, approximately 26 miles upstream of the confluence of the Broad and Saluda Rivers. The purpose of the dam was hydroelectric energy generation. Parr Hydro is a 15 MW run-of-the-river hydroelectric facility (SCE&G 2002a, p.2-3). In 1977, the level of the Parr Reservoir was raised by 9 feet with the construction of spillway crest gates mounted on top of the concrete portion of the dam, with a crest elevation of 266 feet NGVD29. This increased its surface area from 1,850 acres to approximately 4,400 acres. At EL 266 feet NGVD29, the Parr Reservoir extends approximately 13 miles upstream and has a usable storage capacity of 29,000 acre-feet. This modification was made as part of the development of the Fairfield Pumped Storage Facility, which was built on Frees Creek, a small tributary to the Broad River. Figure 2.3-7 gives the elevation-area-capacity curves for the Parr Reservoir.

The retention time of the Parr Reservoir is about three days. This is based on a mean flow at Parr Shoals Dam of 5,334 cfs, estimated from flow data from the Alston station for the period October 1980 through September 2005, and adjusted by the ratio of the drainage areas at Parr Shoals Dam and Alston. The retention time varies with flow conditions in the Broad River. The range of this variability is 0.8 to 29.3 days, which was estimated based on maximum and minimum monthly flow values of 18,732 cfs and 541 cfs, respectively.

Average evaporation loss rate from the Parr Reservoir was estimated to be 50 acre-feet/day (25 cfs) based on pan evaporation data obtained from the South Carolina Department of Natural Resources (SCE&G 2007b). On a mean annual basis, most of the evaporation loss is offset by precipitation. Seepage loss at Parr Shoals Dam is considered to be insignificant due to a relatively small hydraulic head across the dam.

Water flows out of the Parr Reservoir through the spillway and the turbines of the Parr Shoals Hydroelectric Project. The gated concrete gravity ogee spillway is approximately 2,000 feet long and 37 feet high and spans the Broad River between the non-overflow section on the east (left) and the earthen embankment on the west (right) ends of the dam. Ten bottom-hinged, bascule-type crest gates were added to the crest of the spillway to raise the Parr Reservoir approximately 9 feet, from EL 257.0 feet NGVD29 (or 256.3 feet NAVD88) to EL 266.0 feet NGVD29 (or 265.3 feet NAVD88). The spillway gates are operated by low-pressure hydraulic cylinders mounted on the downstream side of the spillway (SCE&G 2006a).

The Parr Shoals Hydroelectric Project originally had six sluice gates located in the east section of the dam adjacent to the powerhouse. Two of the gate slots have been filled with concrete, the remaining four are not usable because of the level of siltation in the reservoir. The four unusable sluice gates are 9 x 9 feet with centerline EL 222.5 feet NGVD29 (or 221.8 feet NAVD88). There are no draft tube gates. The powerhouse has eight turbine bays. Six of the turbine bays have Francis-type turbines installed with a total authorized generation capacity of 14.88 MW, and the other two bays are empty with the original head gates being replaced with reinforced concrete arch walls. The intake passages of the six main units are 13 feet high and 25 feet wide with their centerline at EL 242.1 feet NGVD29 (or 241.4 feet NAVD88). The powerhouse also has two exciter turbine passages. The corresponding intake passages are 9.5 feet wide and 5 feet high, with their centerline at elevation approximately 250 NGVD29 (or 249.3 feet NAVD88) (SCE&G 2006a).

The hydrodynamic circulation in the Parr Reservoir is controlled by the incoming flow of the Broad River and the operation of the Fairfield Pumped Storage Facility. Under low flow conditions in the Broad River, the flow in part of the Parr Reservoir between Parr Shoals Dam and the Fairfield Pumped Storage Facility may be in the upstream direction during the night when the Fairfield Pumped Storage Facility pumps water from the Parr to the Monticello Reservoir. This flow pattern is reversed during the day when water from the Monticello Reservoir is released to generate power. No current measurements exist.

The Monticello Reservoir has a drainage area of approximately 17.4 square miles. It was formed by the Frees Creek dams, which include a main dam, referred to as Dam B, and three smaller saddle dams, referred to as Dams A, C, and D. These dams were constructed at the same time as Unit 1 and FPSF to create the Monticello Reservoir, which serves as the source of cooling water for Unit 1 and as the upper reservoir for the FPSF. The Monticello Reservoir is approximately six miles long, and has a surface area of approximately 6,800 acres and a storage volume of approximately 400,000 acre-feet at normal maximum water surface EL 425 feet NGVD29 (or 424.3 feet NAVD88). Figure 2.3-8 gives the elevation-area-capacity curves for the Monticello Reservoir. The average depth of the reservoir is 59 feet and its maximum depth is approximately 126 feet (SCDHEC, 1998). A part of the Monticello Reservoir, covering an area of approximately 300 acres, is used for recreational purposes. The maximum daily withdrawal for power generating purposes is 29,000 acre-feet, lowering the reservoir to EL 420.5 feet NGVD29 (or 419.8 feet NAVD88) and reducing the reservoir surface area to approximately 6,500 acres. Pumping during periods of off-peak power demand refills the reservoir. Operations vary, depending on the season and system needs. In the summer, the Fairfield Pumped Storage Facility generally pumps water from the Parr Reservoir to the Monticello Reservoir between the hours of 11 p.m. and 8 a.m. and generates power (by releasing water) between the hours of 10 a.m. and 11 p.m. In the winter, the Fairfield Pumped Storage Facility generally pumps water from the Parr Reservoir to the Monticello Reservoir between 11 p.m. and 6 a.m. and generates between the hours of 6 a.m. and 1 p.m. The level of generation varies from one generator up to the maximum output of eight generators, depending on demand. Maximum output may not be necessary on all days.

Pumping is normally done at maximum capacity. The Fairfield Pumped Storage Facility normally operates seven days a week.

Average ambient evaporation from the Monticello Reservoir was estimated to be about 65 acre-feet/day (33 cfs) with an additional 44 acre-feet/day (22 cfs) latent evaporation from condenser water. The total evaporation rate of 55 cfs corresponds to an average daily evaporation loss of 109 acre-feet. On a mean annual basis, most of the evaporation loss from the Monticello Reservoir is offset by precipitation. There is no evidence of significant seepage from the Monticello Reservoir.

The main outlet of the Monticello Reservoir is the intake of the Fairfield Pumped Storage Facility. The approach channel of the intake is a flared, open concrete-lined channel 300 feet long with a maximum width of 260 feet and a minimum width of 132 feet. The intake structure is 265 feet long with a maximum width of 132 feet and a minimum width of 115 feet with an invert at 360 feet NGVD29 (or 359.3 feet NAVD 88). It has four 225-foot long water passages tapering in width from 30 feet wide by 50 feet high at the trash racks down to 17 feet 8 inches wide by 30 feet high at the gate sections. An enclosed 40-foot long section comprised of four 26-foot diameter concrete channels transitions to 26-foot diameter, 800-foot-long steel exposed surface penstocks. (SCE&G 2006a)

As a result of the Fairfield Pumped Storage Facility operations, the Parr Reservoir is subject to daily fluctuations in water level of as much as 10 feet, but the daily average is approximately 4 feet. These water level fluctuations can expose and then inundate again up to 2,550 acres of the Parr Reservoir with each cycle of pumping and generation (release of water). The amount of water pumped from and returned to the Parr Reservoir daily represents as much as 88% of its total volume. Similarly, Fairfield Pumped Storage Facility operations can cause water levels in the Monticello Reservoir to fluctuate as much as 4.5 feet daily, from 420.5 feet to 425.0 feet NGVD29 (419.8 feet to 424.3 feet NAVD88). Daily elevation changes vary, depending on system needs.

No systematic current measurements exist for the Monticello Reservoir. Near the Fairfield Pumped Storage Facility, intake flows are influenced by the operation of the storage facility, as water is discharged into the Monticello Reservoir during the night and withdrawn during the day. In the vicinity of Unit 1, flows are influenced by the operation of the cooling water intake and outfall.

In addition to the Parr and Monticello Reservoirs, a number of small reservoirs exist upstream and downstream of the site on the Broad River and its tributaries. These reservoirs are generally small, low-head dams for hydroelectric power generation and water supply. Most of these dams were constructed in the late 1800s and early 1900s.

The Monticello Reservoir will serve as the water supply for Units 2 and 3 (Figure 2.1-1). An intake structure will be constructed at the south end of the reservoir. The water outfall structure of Units 2 and 3 will be placed in the Parr Reservoir. Bathymetric surveys were conducted in 2006 in both reservoirs. Two areas were surveyed, a 1,000 by 1,000 feet area in the Monticello Reservoir in the vicinity of the water intake, and a 1,250 by 2,500 feet area in the vicinity of the outfall in the Parr Reservoir. Using a combination of hydrographic and topographic surveying techniques and procedures, three-dimensional data were acquired along transects spaced at 25 ft intervals in the intake area and at 50 ft intervals in the outfall area. Figure 2.3-9 shows the surveyed areas. The areas covered by the bathymetric survey near the intake structure are shown in Figure 2.3-9. The bathymetric contours for these two areas developed from the data collected during the surveys are presented in Figures 2.3-10 and 2.3-11.

2.3.1.1.5 Water Temperatures

The Monticello Reservoir serves as the cooling reservoir for Unit 1. Monthly water temperature profiles of Monticello Reservoir have been performed since 1991. Continuous temperature recording was conducted during the warmest months (July, August, and September) for the reservoir, in the area of the circulating water intake from 1992 through 1994 (SCE&G 1994). Table 2.3-11 presents the daily water temperature data versus depths obtained near the plant circulating water intake during the summer months of 1994. The monitoring data collected in the summer of 1994 was compared with data from 1992 and 1993 to evaluate year-to-year reservoir conditions regarding vertical water temperature profiles. The result of comparison suggests that the same pattern persisted throughout the monitoring program. In the area of the circulating water intake, the reservoir maintained a uniform temperature distribution from the surface to approximately 60 feet as a result of pumped storage activity (SCE&G 1994).

Since 1995, water quality (temperature, pH, conductivity, and dissolved oxygen) profiles were measured monthly at three locations in the Monticello Reservoir. As shown in Figure 2.3-12, these locations are designated as “Uplake 16,” “Intake 2,” and “Discharge 6.” Monthly water quality monitoring data from the years 1995, 1996, and 2006 were used to create Tables 2.3-12 to 2.3-14 and Figures 2.3-13 to 2.3-14 (SCE&G 1995, SCE&G 1996, SCE&G 2007a). These stations cover three major portions of the Monticello Reservoir:

- “Intake 2” – the area near the circulating water intake for Unit 1 that is influenced by pump back and generation operations of the Fairfield Pumped Storage Facility.
- “Discharge 6” – the area near the discharge canal that is influenced by the Unit 1 thermal discharge.
- “Uplake 16” – the northern end of the reservoir that is less influenced, in terms of water quality, by the operation of the Fairfield Pumped Storage Facility or Unit 1.

Tables 2.3-12 through 2.3-14 presents the monthly water temperature data versus depth at these three stations in the Monticello Reservoir for the years 1995, 1996, and 2006, respectively. Figures 2.3-13 and 2.3-14 show the vertical profile of water temperature for the coldest month—January—and the hottest month—August—for the year 2006, respectively.

Water temperature data recorded at three USGS stations, Richtex (02161500), Alston (02161000), and Carlisle (02156500) on the Broad River are presented in Figure 2.3-15. These data cover the river reach nearest to Units 2 and 3, including Parr Shoals Dam. Periodic water temperature data were collected from these stations. For the Richtex station (02161500), the available water temperature data are for the period from October 1959 to September 1960 and July 1972 to July 1973. For the Alston station (02161000), the water temperature was recorded from November 1971 to July 1972. For the Carlisle station (02156500), the water temperature record extends from year 1962 to 1975 except for the period of year 1965 to 1968. As shown in Figure 2.3-15, within this river reach, the minimum and the maximum recorded water temperatures were 38.3°F and 86°F, respectively, during the period from October 1959 to December 1975. Even though the data presented in the figure do not represent continuous daily records, they are indicative of water temperature patterns in the river.

2.3.1.1.6 Erosion and Sedimentation

Sedimentation and erosion in the Broad River near Units 2 and 3 are functions of the sediment supply relative to the transport capacity of the river (Julien 1998, p. 204). While detailed measurements of the transport capacity of the Broad River have not been conducted, the potential for sedimentation and erosion near Units 2 and 3 may be assessed using previous reports, aerial imagery, and sediment samples from the Parr Reservoir. Most of the Broad River basin is located in the Southern Piedmont region, where hillside erosion increased dramatically in the 19th and early 20th centuries because of agricultural activities (Trimble 1994). However, erosion trends started reversing around 1920, and by 1967, erosion levels in the Southeastern Piedmont were only one-fifth to one-third of their peak levels (Trimble 1974). Data presented in the Broad Basinwide Water Quality Management Plan prepared in 1998 by the North Carolina Division of Water Quality Statistics suggest that there was a statewide decline in erosion from 1982 to 1992 (NCDWQ 1998).

With respect to the availability of sediment supply, Table 2.3-15 lists the stations where sediment and other related water quality data are available from South Carolina Department of Health and Environmental Control (SCDHEC) Water Quality Monitoring Stations along the Broad River (U.S. EPA 2006). Figure 2.3-4 shows the locations of these water quality monitoring stations, as well as the locations of the USGS stream flow gauging stations. There is no information on bed load measurements at any of the six SCDHEC station locations or at any USGS gauges on the Broad River. Only two of the SCDHEC water quality monitoring stations have data on total suspended solids (mg/L) that could be used to calculate suspended load (tons/day): B-047, which is located approximately 12 miles upstream of the Parr Shoals Dam, and B-046, which is located approximately 9 miles further upstream. An order-of-magnitude estimate of bed load can be obtained using the globally averaged ratio of suspended load to bed load sediment flux for rivers of 9:1, which was reported by Syvitski, et al. (2003).

While data for water quality monitoring stations B-046 and B-047 includes entries from 1963 to present, between 1999 and 2005 only 74 records at B-046 and 26 records at B-047 of total suspended solids are reported. These data are listed in Table 2.3-16 and Table 2.3-17 for B-046 and B-047, respectively. Daily flow values from the Carlisle gauge (USGS 02156500) and the Alston gauge (USGS 02161000) are also presented in Table 2.3-16 and 2.3-17, respectively. The Carlisle gauge is about at the same river mile as station B-046 (Figure 2.3-4). The Alston gauge is about 13 miles downstream from station B-047. As shown in Tables 2.3-16 and 2.3-17, the suspended load is calculated as the product of the discharge and the total suspended sediments concentration. The relationship between the suspended load and the flow rate is plotted in Figure 2.3-16.

The combination of a relatively large watershed at the Parr Shoals Dam (*i.e.*, about 4,790 square miles), high local rainfall (*i.e.*, about 45 inches per year), and hillslopes with a moderate erodibility factor (*i.e.*, 0.24) (SCDHEC, 2007) has led to relatively high suspended solids loads in the Broad River (Figure 2.3-16). The high turbidity of the Broad River has been noted in several recent water quality reports (*e.g.*, NCDWQ 1998, SCDHEC 2001). In addition, data collected in the Upper Broad River (B-042 and B-044) has shown increasing turbidity (SCDHEC 2001, p. 15), suggesting the sediment supply may be in a state of disequilibrium (*i.e.*, changing with time).

With respect to the transport capacity of the Broad River, aerial imagery of the Broad River (Figure 2.3-17) upstream of Units 2 and 3 indicates the local geomorphology is comprised of anabranching islands (locations where primary and secondary channels separate and subsequently reconnect) and localized depositional bars along the channel banks (Schumm 1985). The river channel has relatively little meandering indicating a relatively stable plan form. The Broad River near VCSNS is a predominantly aggradational regime (*i.e.*, sediment supply exceeds transport capacity) due to the presence of the Parr Shoals Dam. As noted in Parker (2007, p. 7), “the installation of a dam on a river typically blocks the downstream delivery of all but the finest sediment, creating a pattern of bed aggradation upstream. The dam raises base level, *i.e.*, the downstream water surface elevation to which the river upstream must adjust, forcing upstream-migrating deposition. This deposition is most intense near the delta at the upstream end of the reservoir. As a result, the effect is to intensify the upward concavity of the long profile of the bed upstream of the dam. The more sharply declining bed slope intensifies selective transport of fine material, setting up strong local downstream fining.” As a result, “the river bed often aggrades upstream of the dam and degrades downstream” (Parker 2007, p. 3). The backwater effects of the Parr Reservoir extend upstream by about 13 miles (Figure 2.3-17).

Several boring samples in the Parr Reservoir were taken by SCE&G in January 2007 for the possibility of dredging the reservoir (Figure 2.3-18). The sediment gradations are summarized in Table 2.3-18, and are predominantly comprised of (1) clay and clay-silt fractions and (2) sand and sand-silt fractions (*i.e.*, $0.002<D_{50}<0.409$ mm; where D_{50} is the median grain size of the sample) (Figure 2.3-19). Two of the 16 samples included gravel fractions. While these gradations are relatively fine relative to the transport capacity of the river, the high sediment load suggests future dredging will be necessary in the Parr Reservoir to preserve the longitudinal profile.

No bed load sediment transport measurements have been reported for any reach of the Broad River. Bed load in the Broad River near the site cannot be easily estimated as a fraction of the suspended load because the portion of sediment that moves as bed load varies widely between rivers and on the same river over time (Keyes and Radcliffe 2002).

2.3.1.1.7 Wetlands

Wetlands within approximately a mile and a half of Units 2 and 3 site are associated with several small streams draining to the Broad River. The mapped wetlands are shown in Figure 2.3-20. Riparian wetlands have been identified along the two unnamed creeks to the north and to the south of Units 2 and 3, as well as along other small streams. Most of these streams are dry part of the year.

With the exception of a few beaver ponds and the water bodies discussed in Subsection 2.3.1.1.4, there are no natural or man-made ponds at the site or within a mile and a half of Units 2 and 3.

2.3.1.2 Groundwater Resources

2.3.1.2.1 Regional Hydrogeology

The region within 200 miles around the Units 2 and 3 site encompasses parts of four physiographic provinces. These include, from west to east, the Valley and Ridge, Blue Ridge, Piedmont and Coastal Plain physiographic provinces. These provinces are defined on the basis of physical geography and geology. Figure 2.3-21 shows the aquifer systems associated with these provinces. Figure 2.3-22 is a schematic cross section view of these provinces. Although Figure 2.3-22 includes the Appalachian Plateau province, groundwater conditions in this province will not be addressed because of its distance from, and lack of influence on, the site. This figure shows a sharp change in topographic slope that defines the boundary between the Blue Ridge and Piedmont provinces. These provinces, however, exhibit essentially the same aquifer system characteristics and are considered together in the description provided below. Groundwater occurrence is of significance to the site of Units 2 and 3 only within the Piedmont physiographic province. However, brief discussions of groundwater within the other provinces within 200 miles of the site are presented below to provide a more complete picture of regional hydrogeologic conditions.

The Valley and Ridge aquifer system lies within the Valley and Ridge physiographic province about 190 miles west of the site (Figure 2.3-21). This aquifer is composed of Paleozoic-age folded and faulted sedimentary rock. Carbonate and sandstone layers form the principal aquifers in the system. The carbonate rocks, mainly limestone, generally form most of the more productive aquifers and underlie valleys within the province. Most of the groundwater flow is in the fractures and dissolution features in the folded and faulted strata. Typical well yields are from 10 gpm in sandstone formations to 10 to 50 gpm within the limestone units. Locally high yields are possible within highly fractured strata or solution cavities (Miller 1990).

The Piedmont and Blue Ridge physiographic provinces exhibit essentially the same aquifer system characteristics. The aquifer system associated with these provinces is combined and referred to as the Piedmont and Blue Ridge aquifer system. This system lies beneath the site and to the north and west of the site. The Piedmont and Blue Ridge provinces are composed of metamorphic rocks with igneous intrusions and overlying saprolite or residual soil with alluvial deposits along stream valleys. Groundwater occurs in the fractured portions of the bedrock and within the saprolite and alluvium. Well yields are generally low within this aquifer system (6 to 28 gpm) and mainly depend on the local fracture density of the bedrock. Localized large yielding wells are possible and are dependent on the geologic unit present and the surrounding geologic structure. Large yields of groundwater can be found in carbonate strata due to dissolution by the groundwater, which creates larger openings that allow greater flow and/or storage. (Miller 1990)

The Southeastern Coastal Plain aquifer system is the aquifer system associated with the Coastal Plain physiographic province (sometimes referred to as the Atlantic Coastal Plain physiographic province). This province lies approximately 15 miles south and east of the site. The divide between the Piedmont and Coastal Plain physiographic provinces is defined as the Fall Line. The Coastal Plain province is further divided into the Upper and Lower Coastal Plain as shown on Figure 2.3-21. The geology of the Coastal Plain province is characterized by aquifers developed in layers of sands, silts or high-permeability limestone confined by units of clay and silts or low-permeability limestone (Childress and Butler 2006).

Most of South Carolina’s groundwater resources are within the Coastal Plain. In general, reliance on groundwater for irrigation, industrial uses, and public water supply increases dramatically east of the Fall Line (Figure 2.3-21) (Childress and Butler 2006).

Within South Carolina, the aquifers that make up the Southeastern Coastal Plain aquifer system include the Surficial Aquifer, Tertiary Sand/Limestone Aquifer, the Black Mingo Aquifer, the Black Creek Aquifer, the Middendorf Aquifer and the Cape Fear Aquifer as indicated in Figure 2.3-23 (Miller 1990).

2.3.1.2.2 Local Hydrogeology

The area within 6 miles of the site lies within the Piedmont and Blue Ridge Aquifer system within the Piedmont Physiographic Province (Figure 2.3-24). The bedrock underlying the site area principally consists of Paleozoic crystalline metamorphic and igneous intrusives of the Carolina Zone.

The metamorphic and igneous rocks weather to overburden soils of clayey, silty, and sandy composition. The character of the overburden is related to the type of bedrock and degree of weathering. The overburden thickness is up to 100 feet or more, but varies considerably from place to place (Miller 1990).

Groundwater in the site area occurs in two types of formations: (1) jointed and fractured crystalline bedrock, and (2) lower zones in the residual soil overburden (Figure 2.3-25). Recharge to these formations is principally by infiltration of precipitation falling on the upland areas (Figure 2.3-25). Some of the water infiltrating the surface soil evaporates, transpires from plants, or reemerges at the surface downslope at short distances from points of infiltration. A small portion of the water percolates to perched water zones, or deeper into the water table in the lower soils and the underlying jointed bedrock. The groundwater table, in general, follows the land surface but with more subdued relief. Groundwater discharges as visible seeps and springs and/or percolates through the ground into creeks and streams. Some groundwater is discharged via wells, but the amount pumped is very small because the formations generally are not pervious enough to sustain well yields greater than a few gallons per minute.

2.3.1.2.3 Site Hydrogeology

The hydrogeology of the site of Units 2 and 3 is consistent with the hydrogeology of the Piedmont Physiographic Province. Based on the interpretation of the data from the field investigation (MACTEC 2007), it was determined that the hydrogeologic profile consists of two hydrogeologic zones. These zones are the saprolite/shallow bedrock hydrostratigraphic zone, which is primarily a water table aquifer, and the deep bedrock hydrostratigraphic zone, where groundwater occurs within fractures in the bedrock. Recharge to the saprolite/shallow bedrock zone occurs locally from surface deep infiltration. There are no studies of groundwater recharge rates in the vicinity of the Units 2 and 3 site. However, there are multiple studies of groundwater recharge rates for the Savannah River Site, located about 75 miles to the south-southwest of VCSNS. Even though the Savannah River Site is located in the Coastal Plain physiographic province, while VCSNS is in the Piedmont, there are similarities between the two sites in terms of precipitation, ground surface relief and slope, vegetation types, and other features. Mean annual precipitation at the Savannah River Site is 49 inches compared with 45 inches at Parr Hydro. Recharge estimates at the Savannah River Site are in the range of 8 to 17 inches per year (Geotrans 1997; Fogle and Brewer 2001; Brewer and Sochor 2002; INTERA 2003). The higher end of these recharge estimates is for lower lying flat areas and the lower end corresponds to sloping areas. Recharge rates at the VCSNS are expected to be of the same order.

The deep bedrock zone is recharged by infiltration from the saprolite/shallow bedrock zone. The deep bedrock zone flows westward off the site toward the Broad River. The Monticello Reservoir is located approximately 1 mile to the north of the Units 2 and 3 site.

2.3.1.2.3.1 Observation Well Installation and Testing Program

Thirty-one observation wells were installed at the site of Units 2 and 3 as part of a geotechnical subsurface investigation program for the FSAR (Figures 2.3-26 and 2.3-27). These wells were screened either in the saprolite/shallow bedrock zone (Figure 2.3-26) or the deep bedrock zone (Figure 2.3-27). Of the 31 observation wells installed on the site, 22 are completed in the saprolite/shallow bedrock zone and 9 are completed in the deep bedrock zone.

The wells were located to provide adequate distribution with which to determine site groundwater levels and subsurface flow directions and gradients beneath the site. Five well pairs were installed to determine if the saprolite/shallow bedrock and deep bedrock zones were hydraulically connected. Table 2.3-19 provides the well construction details for each well, including the material type in which each well was screened.

Field hydraulic conductivity testing was conducted in each observation well following the slug test procedures in ASTM D4044. In addition, field hydraulic conductivities were determined in selected deep bedrock zone boreholes based on the packer test method, as described in ASTM D4630.

Groundwater level measurements in the observation wells were taken monthly for one year from June 2006 through June 2007 (Table 2.3-20). Figure 2.3-28 shows hydrographs for all of the saprolite/shallow bedrock zone wells over the monitoring period. Observation well OW-312 was intended to be a saprolite/shallow bedrock zone well; however, during drilling, rock was encountered at a depth of 36.5 feet (EL 388.6 NAVD88) and drilling at this location could not progress deeper. A well was set at the total depth of the well; however, the total depth of the well is at a higher elevation than the groundwater table at this location, thus, the well never encountered groundwater. Figure 2.3-29 shows hydrographs for all of the deep bedrock zone wells over the monitoring period. In general, the piezometric levels do not change much over the one year of readings. This would indicate these wells have completed their recovery of groundwater levels due to well installation and that there is minimal seasonal variation in piezometric levels at the site. The exceptions to this include OW-624 in the saprolite/shallow bedrock zone and OW-233 and OW-627a within the deep bedrock zone. For both OW-624 and OW-233, the groundwater level rose quickly over the first four or five months and then stabilized. This is interpreted to be due to low permeability within the screened material causing a slow recovery to original piezometric levels within the aquifer. For OW-627a, the hydrograph indicates that piezometric levels rose between June 2006 and July 2006, and then dropped quickly at the time of the August 2006 reading. This rapid drop between July and August was due to the groundwater sampling of this well. Since August 2006, the piezometric level in OW-627a has been steadily rising, indicating that the well is still recovering to the original piezometric level.

2.3.1.2.3.2 Groundwater Levels and Flow directions

2.3.1.2.3.2.1 Horizontal Groundwater Flow

The groundwater level data for the Units 2 and 3 locations were used to determine groundwater flow patterns across the site. Piezometric level contour maps were created for the saprolite/shallow bedrock zone and the deep bedrock zone. One contour map for each zone was created for each quarter using a representative month of piezometric levels.

Figure 2.3-30 shows piezometric level contours for the saprolite/shallow bedrock zone. Figure 2.3-31 shows the piezometric level contours for the deep bedrock zone. Groundwater data collected in June 2007 were used to create these piezometric level contour maps.The piezometric contours for the saprolite/shallow bedrock zone are clipped on the west side of the power block to indicate the saprolite/shallow bedrock zone is unsaturated in this area.

Contour maps were created for each of the four quarters of the first year of piezometric level measurements. The piezometric contour maps of the saprolite/ shallow bedrock zone are very similar for all four quarters. In other words, no seasonal changes were observed within the saprolite/shallow bedrock zone. The piezometric contour maps of the deep bedrock zone did change over time; however, this was because observation well OW-233 had not completed its recovery. The contours based on the June 2007 data are considered most representative of long-term conditions because they are not influenced significantly by the effect of the well development on the groundwater levels.

The piezometric level elevation contour map of the saprolite/shallow bedrock zone indicates that groundwater flows from ridgetops toward drainage swales, with the piezometric surface mimicking the topography. The drainage swales at the site all lead eventually to the west toward the Broad River. The ridge to the north of the Units 2 and 3 power block area (PBA) circle in the vicinity of OW-622 appears to be hydraulically connected to the area of Unit 1, which is connected to the Monticello Reservoir. Contour maps of the deep bedrock zone indicate groundwater flow westward within the bedrock from the PBA circle off the site toward the Broad River.

The groundwater gradient in the saprolite/shallow bedrock zone ranges from 0.001 to 0.003 foot/foot on top of the ridge and it is steeper (0.037 to 0.05 foot/ foot) on the ridge flanks.

The groundwater gradient in the deep bedrock zone ranges from 0.0085 to 0.0094 foot/foot on top of the ridge and it is steeper (0.022 to 0.11 foot/foot) on the ridge flanks.

This groundwater flow regime is consistent with the regional conditions described in Subsection 2.3.1.2.2 and illustrated in Figure 2.3-25.

2.3.1.2.3.2.2 Vertical Groundwater Flow

Five well pairs were installed as part of the subsurface investigation to assess whether the saprolite/shallow bedrock and the deep bedrock zones are hydraulically connected. The well pairs are OW-205(a&b), OW-305(a&b), OW-401(a&b), OW-621(a&b), and OW-627(a&b). These well pairs indicate that the saprolite/shallow bedrock and the deep bedrock zones are hydraulically connected.

At ridgetops, the water levels within the two aquifers are very nearly the same [OW-305(a&b) and OW-401(a&b)], indicating that the two are directly connected. Moving away from the ridgetop toward the ridge flanks, the water levels within the two aquifers begin to diverge indicating a downward gradient, as illustrated in Figure 2.3-32. The average vertical gradient calculated at OW-205(a&b) is 0.17 feet/feet indicating a downward gradient. Closer to drainage swales, the difference between the water levels within the two aquifers becomes even greater [OW-621(a&b) and OW-627(a&b)]. The average vertical gradient calculated at each of these locations is 1.54 feet/feet and 1.74 feet/feet, respectively, indicating a larger downward vertical gradient.

2.3.1.2.3.3 Hydraulic Properties

Hydraulic conductivities of the site subsurface materials were determined in the observation wells using the slug test method and in selected geotechnical borings using the packer test method. The results of the slug tests are presented in Table 2.3-21.

Slug tests were conducted in 29 of the 31 observation wells; two wells—OW-312 and OW-501—were not tested. OW-312 was dry, and OW-501 was screened in fill and residual soil.

Of the 29 wells that were tested, 8 were assessed as providing invalid or unreliable test results because of the large ratio of theoretical head change over the submerged screen length, failure to approach asymptote, and/or erratic data.

The remaining 21 slug test results were analyzed and low, high, and geometric mean values were calculated for each of the hydrostratigraphic zones. The saprolite/shallow bedrock hydrostratigraphic zone tests were completed in saprolite, partially weathered rock, or a combination of both. Based on 16 slug tests, the range of hydraulic conductivity values for this zone is from 0.0017 feet/day to 18 feet/day with a geometric mean for this zone of 0.62 feet/day. The deep bedrock hydrostratigraphic zone tests were completed in sound rock. Based on five slug tests, the range of hydraulic conductivity values for the deep bedrock zone is from 0.0088 feet/day to 0.38 feet/day with a geometric mean for this zone of 0.07 feet/day.

Table 2.3-22 gives the results of packer tests conducted in selected geotechnical borings. These tests were conducted in the deep bedrock hydrostratigraphic zone. The range of hydraulic conductivity values for the deep bedrock zone from the packer tests is 0 to 1.14 feet/day, with the non-zero packer tests having a geometric mean value of 0.166 feet/day. Some hydraulic conductivity values are listed as zero. This is a result of a test conducted in a zone that did not take any water. This geometric mean hydraulic conductivity value of the packer tests is higher than the 0.07 feet/day geometric mean hydraulic conductivity value indicated by the slug test results. When comparing the two sets of data, it can be seen that the difference in values measured by the two tests was a result of the depths at which the tests were taken. The packer tests were generally conducted at shallower depths than the slug tests. At shallower depths, the hydraulic conductivity of the deep bedrock zone increases. When compared with just the shallow slug test results, the packer test values and the slug test values are in much closer agreement.

Table 2.3-23 presents porosity values derived from laboratory test results for grain size, moisture content, and specific gravity on residual soil and saprolite. The range in porosity values calculated for the residual soil is from 0.465 to 0.631 with an arithmetic mean porosity value of 0.527. The range in porosity values calculated for the saprolite material is from 0.401 to 0.632 with an arithmetic mean porosity value of 0.49. This is based on seven samples of residual soil and 23 samples of saprolite. The saprolite value is considered to be representative of the porosity value for the saprolite/shallow bedrock zone. The residual soil porosity values are considered to be representative of the unsaturated zone above the aquifer. There are no direct estimates of the specific yield at the site of Units 2 and 3. Considering the composition of the overburden soils (clayey, silty, and sandy materials), it is reasonable to expect the specific yield to be of the order of 20% to 25%. Reported average specific yield values in the literature are 18% for silt, 21% for fine sand, 26% for medium sand, and 27% for coarse sand (Fetter 1988). The specific yield of the saprolite should be similar to these values.

Soil samples were collected from geotechnical borings at the VCSNS site for grain size analyses (MACTEC 2007). The coarser materials (sands and gravels) are assumed to be representative of the subsurface material along potential contaminant transport pathways. The median (D_{50}) grain size of the samples classified as sand or gravel under the Unified Soil Classification System is 0.15 mm. This value is assumed to be the representative grain size of the saprolite/shallow bedrock zone. An effective porosity of 0.27 is estimated using a grain size of 0.15 mm and Figure 2.17 of de Marsily (1986) (Figure 2.3-33). A study by Stephens et. al. (1998) suggests that effective porosities derived from grain size data tend to be biased high. Therefore, the grain size data-derived effective porosity (0.27) was reduced by 33% for added conservatism to obtain an estimated saprolite/shallow bedrock zone effective porosity of 0.18.

The total porosity of the deep bedrock is assumed to be 0.05 (Harned and Daniel, 1989). This value is the mean of four measured porosity values in the bedrock ranging from approximately 0.03 to 0.06 at an approximate depth of 70 feet elsewhere in the Piedmont, the physiographic region where the VCSNS site is located. The effective porosity of the deep bedrock is assumed to be 0.04, approximately 80% of the total porosity.

Hydraulic properties of the unsaturated zone were not measured because accidental release of liquid effluents would be through the saturated zone.

2.3.1.2.3.4 Subsurface Pathways

The Units 2 and 3 site is located on a ridgetop. Piezometric contour maps developed from piezometric levels measured for one year from June 2006 through June 2007 indicate that groundwater flows in all directions from the ridgetop. Drainage swales are present to the northwest, southwest, and east of the site as can be seen from the topographic map in Figure 2.3-2. These swales drain to tributaries that eventually lead to the Broad River. The Broad River is located approximately 1 mile to the west of the site. The surface groundwater flow regime roughly mimics the topography and flows through the saprolite/shallow bedrock hydrostratigraphic zone. Groundwater from the saprolite/shallow bedrock zone recharges the deep bedrock hydrostratigraphic zone. Piezometric-level contour maps developed for the deep bedrock zone indicate a flow path that leads directly toward the Broad River.

The primary and most plausible groundwater pathway from the Units 2 and 3 auxiliary building is through the saprolite/shallow bedrock zone to the nearby unnamed creeks, one to the north-northwest of Unit 2 and the other to the south-southwest of Unit 3.

In the following discussion, the term "pathway" is used to describe travel through a specific geologic medium (e.g. saprolite/shallow bedrock or deep bedrock) and in a general direction (e.g. east or west). The term "pathline" is used to describe a specific course followed from the initial to terminal point.

Figure 2.3-34 shows the expected pathways in plan view. Cross sections were developed roughly along these groundwater pathways as shown in Figures 2.3-36, 2.3-37, and 2.3-38. The subsurface pathways from Unit 2 and 3 to the nearest groundwater discharge point are shown in Figures 2.3-37 and 2.3-38, respectively. The travel time in the saprolite/shallow bedrock zone, analyzed between the Units 2 and 3 auxiliary buildings and the nearest creek where groundwater discharges, has been conservatively determined below, and is based on site-specific data.

For the unnamed creek to the north-northwest of the site, the average advective velocity (v) is calculated using the following parameters:

hydraulic conductivity K = 1.7 feet/day (75th percentile hydraulic conductivity value from the slug test data in the saprolite/shallow bedrock zone)

effective porosity n_e = 0.18

horizontal hydraulic gradient $\frac{dh}{dx}$ = - 0.032 ft/ft. (Table 2.3-25)

Substituting these values in the following equation yields:

$$v = \frac{K}{n_e}\frac{dh}{dx} = \frac{1.7\ ft/day}{0.18}\left(-0.032\ ft/ft\right) = 0.30\ ft/day \cong 110\ ft/yr$$

The straight-line distance from the auxiliary building of Unit 2 to the nearest unnamed creek to the north-northwest is about L=850 feet, which results in an estimated groundwater travel time of:

$$t = \frac{L}{v} = \frac{850\ ft}{110\ ft/yr} \cong 7.7\ yrs$$

This same methodology was used for calculating the groundwater travel time from Unit 3. At Unit 3, the horizontal hydraulic gradient was calculated to be 0.038 ft/ft (Table 2.3-25) and the straight-line distance from the auxiliary building of Unit 3 to the nearest unnamed creek to the south-southwest is about L=1727 feet. The estimated travel time from Unit 3 to the unnamed creek is 13.3 years. Calculated travel times are summarized in Table 2.3-25.

2.3.1.2.3.5 Alternate Subsurface Pathways

As discussed in the preceding subsection, the western pathway through the saprolite/shallow bedrock zone to the nearby unnamed creeks is the most plausible groundwater pathway from Units 2 and 3. Units 2 and 3 are close to a groundwater high point under the ridge where Units 2 and 3 are located. In the event that the groundwater high should shift laterally to the west as a result of plant construction, the groundwater pathway from Units 2 and 3 auxiliary buildings could potentially be to the east. To account for this possibility as well as the potential for groundwater pathways in the deep bedrock, several alternate, less likely groundwater pathways were also analyzed. The alternate pathways are:

1. Saprolite/shallow bedrock zone pathway to the east discharging in Mayo Creek (see Figure 2.3-39)

2. Deep bedrock pathway to the west discharging in the Broad River (see Figure 2.3-40)

3. Deep bedrock pathway to the east discharging in Mayo Creek (see Figure 2.3-39)

4. Deep bedrock pathway to the east continuing beyond Mayo Creek and intercepted by a postulated receptor well at the nearest SCE&G property boundary (see Figure 2.3-40)

2.3.1.2.3.5.1 Saprolite/Shallow Bedrock Zone Pathway to Mayo Creek

In the event that the groundwater high point under Units 2 and 3 shifts laterally to the west, the groundwater flow direction from the auxiliary building in the saprolite/shallow bedrock zone could potentially be to the east, discharging in Mayo Creek. Groundwater travel times were calculated using the same methods and hydraulic properties of the saprolite/shallow bedrock as previously described. The groundwater travel times along the pathlines from Units 2 and 3 to Mayo Creek in the saprolite/shallow bedrock are estimated as 38.4 and 37.7 years, respectively as presented in Table 2.3-25.

2.3.1.2.3.5.2 Deep Bedrock Pathway to the Broad River

Groundwater travel times from Units 2 and 3 were calculated assuming the groundwater pathway is in the deep bedrock and discharges to the Broad River. A deep bedrock pathway is assumed to be less likely than a saprolite/shallow bedrock pathway due to the higher hydraulic conductivity of the overlying saprolite/shallow bedrock. The deep bedrock is assumed to have a hydraulic conductivity of 0.4 feet/day (the highest value measured in the deep bedrock from slug tests) and an effective porosity of 0.04. The groundwater travel times along the pathlines from Units 2 and 3 to the Broad River in the deep bedrock are estimated as 56.4 and 48.6 years, respectively as presented in Table 2.3-25.

2.3.1.2.3.5.3 Deep Bedrock Pathway to Mayo Creek

As discussed in Subsection 2.3.1.2.3.5.1, a shift in the groundwater high under Units 2 and 3 could result in an eastern groundwater flow path discharging in Mayo Creek. Groundwater travel times from Units 2 and 3 were calculated assuming the groundwater pathway is in the deep bedrock and discharges to Mayo Creek. Groundwater travel times were calculated using the same hydraulic properties of the deep bedrock as described in the previous section. The groundwater travel times along the pathlines from Units 2 and 3 to Mayo Creek in the deep bedrock are estimated as 42.1 and 35.1 years, respectively as presented in Table 2.3-25.

2.3.1.2.3.5.4 Deep Bedrock Pathway to Hypothetical Private Well at Property Boundary

A deep bedrock pathway to the east continuing beyond Mayo Creek to a hypothetical well at the SCE&G property boundary is considered implausible. Groundwater levels in water table aquifer systems generally mimic the topography, but with subdued relief. As shown in Figure 2.3-40, the ground surface elevation increases substantially to the east of Mayo Creek. Therefore, it is expected that the water table and piezometric levels in the deep bedrock also increase to the east of Mayo Creek. This would result in a reversal of the hydraulic gradient with the flow of groundwater east of Mayo Creek being toward the creek. There is no evidence of any geologic feature (e.g. confining unit) precluding groundwater discharge from the deep bedrock aquifer to Mayo Creek.

Although it is considered implausible, groundwater travel times were calculated using the previously described hydraulic properties of the deep bedrock and the hydraulic gradients used for the deep bedrock to Mayo Creek calculations. The groundwater travel times along the pathlines from Units 2 and 3 to a hypothetical well at the SCE&G property boundary in the deep bedrock are estimated as 69.2 and 56.4 years, respectively as presented in Table 2.3-25.

2.3.1.2.4 Summary

The VCSNS site lies within the Piedmont Physiographic Province. Geologic conditions beneath the site consist of a weathering profile of Paleozoic crystalline rock. Groundwater at the site occurs in two zones—the saprolite/shallow bedrock zone and the deeper bedrock zone. Recharge to the saprolite/shallow bedrock zone occurs by infiltration of precipitation. Discharge is to localized drainage and stream incisions. Recharge to the bedrock zone is from the overlying saprolite/shallow bedrock zone.

Observation wells completed in the saprolite/shallow bedrock zone and deep bedrock zones were used to develop piezometric contour maps and hydraulic gradients. Hydrogeologic properties of these aquifers were determined by laboratory testing of soil samples and by in situ testing.

The U.S. EPA defines a sole-source aquifer as an underground water source that supplies at least 50% of the drinking water consumed in the area overlying the aquifer. These areas can have no alternative drinking water source(s) that could physically, legally, and economically supply all those who depend on the aquifer for drinking water. No sole-source aquifers have been designated by the EPA within the VCSNS site region (U.S. EPA 2007).

2.3.2 WATER USE

Construction or operation of Units 2 and 3 could affect availability of surface water and groundwater near the site. This subsection describes the current uses of those water resources, including the types, locations, and quantities of the consumptive and nonconsumptive water uses.

2.3.2.1 Groundwater Use

2.3.2.1.1 Regional Groundwater Use

Groundwater use as reported to SCDHEC by each county within 50 miles is shown in Table 2.3-26. Public water supply systems are the largest users (47.7% of the total) of groundwater in the 50-mile region, followed by agricultural users (21.7%), and industrial users (14.4%) (SCDHEC 2005). Smaller amounts of groundwater are used by mining operations, thermoelectric (nuclear and fossil-fueled) power plants, golf courses, and aquaculture facilities.

Groundwater within 20 miles of the site is primarily used for individual households and for livestock. Within 2 to 20 miles of VCSNS, there are approximately 100 sites that have at least one groundwater well that has been reported for municipal, industrial, or domestic purposes.

2.3.2.1.2 Local Groundwater Use

Three counties lie within 6 miles of the proposed site: Fairfield County, Newberry County, and Richland County (Figure 2.1-3). Reported permitted groundwater uses for these counties are included in Table 2.3-26. The largest user of groundwater is Richland County, with Newberry and Fairfield following, respectively. In Richland County, industry is the largest consumer of groundwater, followed by public water suppliers. Newberry County's groundwater use is primarily for irrigation of crops and public water supply. Fairfield County's groundwater use is primarily for public water supply. (SCDHEC 2005)

Groundwater within 2 miles of the site is primarily used for domestic purposes. The nearest groundwater well is approximately 1 mile east of the VCSNS site, just outside the site boundary and the nearest large groups of wells are located approximately 1.5 miles east of the site along SC 215 and in Jenkinsville approximately 2.5 miles southeast of the site. These wells serve private residences and stores. The Jenkinsville Water Company has nine wells, three of which are located within approximately 2 miles of the site. These wells are located to the north and are separated from the VCSNS site by the Monticello Reservoir. SCDHEC projects that the population of Fairfield County will increase from the year 2000 population of 23,454 to a year 2025 population of 27,280 (SCDHEC 2005). However, the resident population within the direct vicinity of the site (2 miles) is expected to remain fairly constant through the year 2019 (see population projections in Table 2.5-1), resulting in a reasonably consistent demand for domestic groundwater in that area.

The Monticello Reservoir is the source of process and domestic water for Unit 1. However, groundwater is pumped from two wells in the protected area to lower the water table and reduce the amount of seepage from the Monticello Reservoir into below-grade portions of the buildings. The pumped water is discharged to permitted National Pollutant Discharge Elimination System (NPDES) outfalls at a total rate of approximately 26 gpm (SCE&G 2002a).

2.3.2.2 Surface Water Use

2.3.2.2.1 Regional Surface Water Use

Major hydrologic features within the 50-mile radius zone are shown in Figure 2.3-1. Permitted surface water uses within the counties located within 50 miles of the site are indicated in Table 2.3-27. With the exception of Lee, Orangeburg, and Sumter Counties, all other counties within 50 miles of the proposed site rely far more heavily on surface water than on groundwater to meet water demands. Permitted uses of surface water include hydroelectric, thermoelectric, aquaculture, golf course irrigation, industry, agricultural irrigation, mining, and public water supply. Water in the Broad River is used to generate hydroelectric power at seven hydroelectric facilities within South Carolina.

Owner	Facility
SCE&G	Neal Shoals Parr Shoals
Duke Power	Gaston Shoals Ninety-Nine Islands
Cherokee Falls Associates	Cherokee Falls
Lockhart Power	Lockhart
City of Columbia	Columbia Canal

Source: Bettinger et al. 2003

Gaston Shoals, Cherokee Falls, Ninety-Nine Islands, Lockhart, and Neal Shoals are located upstream of the proposed site. Columbia Hydro is adjacent to Columbia Canal and is downstream of the proposed site. SCE&G also operates the Fairfield Pumped Storage Facility, which is discussed in detail in Subsection 2.3.1.

Downstream of the site, surface water is withdrawn by a number of municipalities and industries. The closest large downstream surface water user is the city of Columbia, approximately 28 miles from the site.

There are numerous reservoirs and streams within 50 miles that are used for fishing, swimming, and boating (see Figure 2.1-2). More notable locations include Lake Murray to the south, Lake Greenwood to the west, and Wateree Lake to the east.

Table 2.3-28 provides a summary of other significant downstream surface water users, their location, average daily use, and source of supply.

2.3.2.2.2 Local Surface Water Use

Portions of Fairfield County, Newberry County, and Richland County all lie within 6 miles of the proposed site (Figure 2.1-3). Reported permitted surface water uses for these counties are included in Table 2.3-27. The largest user of surface water is Fairfield County, with Richland and Newberry following, respectively. In both Fairfield and Richland counties, the largest users of surface water are the hydroelectric and thermoelectric power industries, respectively. Newberry County's surface water is primarily used for public water supplies. (SCDHEC 2005)

In Fairfield County, surface water is used as a potable water supply by the town of Winnsboro and by Unit 1. Unit 1 obtains potable water from the Monticello Reservoir. The Unit 1 average daily use is 27,800 gpd and the maximum daily capacity is 1,296,000 gpd (SCE&G 2002a). The town of Winnsboro provides water to approximately 8,303 people (Devlin 2006) and gets its surface water from Sand Creek and a 192-acre reservoir located west of the town in the Jackson Mill Creek watershed (SCDHEC 2003). The reservoir contains approximately 600 million gallons of water (Fairfield County 1997).

The city of Columbia is a public water supplier in Richland County that also withdraws surface water for public use. The city pumps an average of 65 million gpd. Approximately half of the municipal water comes from the Broad River from the Columbia Canal while the other half comes from Lake Murray, a reservoir on the Saluda River (SCDNR 2005). The latter source serves approximately 263,066 people (U.S. EPA 2005).

Two public water suppliers in Newberry County are the city of Newberry and the town of Whitmire. The city of Newberry removes water from the Saluda River (SCDHEC 2003) to serve a population of approximately 10,145 (Devlin 2006). The town of Whitmire uses water from Duncan Creek and from the Enoree River (SCDHEC 2003). These sources provide water to approximately 2,755 people (SCDHEC 2003).

As shown on Figure 2.3-35, the Parr Reservoir provides a source of water for Parr Hydro and serves as a lower pool for the Fairfield Pumped Storage Facility. Monticello Reservoir, which serves as the upper pool for Fairfield Pumped Storage Facility, also provides a source of domestic, process, and cooling water for Unit 1. Currently, the Federal Energy Regulatory Commission license for the Parr project (FPC 1974) limits withdrawal of water from the Monticello Reservoir just to the activities associated with operations of Unit 1; thus, additional withdrawal of water for the proposed action will require a license amendment. Water use associated with Unit 1 also includes the evaporative losses associated with condenser cooling water system operation. Estimates for the amount of water lost to evaporation range from approximately 13 cfs (5,800 gpm) based on a withdrawal rate of 1,180 cfs (530,000 gpm) from the Monticello Reservoir (U.S. NRC 1981) to a theoretical maximum of 22 cfs (9,900 gpm) based on a withdrawal rate of 1,308 cfs (SCE&G 2002a). These estimated evaporative losses represent approximately 8.7% to 15% of the licensed minimum flow of 150 cfs (67,300 gpm) (FPC 1974) and approximately 0.23% to 0.38% of the mean annual flow of 5,726 cfs (2,570,000 gpm) of the Broad River at Alston, South Carolina (Subsection 2.3.1).

The Monticello Reservoir has an ambient evaporation rate of 33 cfs (14,810 gpm). This represents the evaporation rate for the reservoir without the discharge of cooling water from Unit 1.

As described in Subsection 2.3.1, the lowest daily mean flow reading on record at Alston was 48 cfs (22,000 gpm) on September 12, 2002 (Cooney et al. 2006) during drought conditions in South Carolina. During this period, SCE&G's Parr

Hydro facility operations were minimal, requiring only a small flow of water through the dam. This flow was further reduced because water was being pumped to the Monticello Reservoir by the Fairfield Pumped Storage Facility. The decrease in reservoir pool level lowered the head on the dam, limiting downstream river flow. When the pumping station began releasing water to Parr Reservoir, the low flow situation was corrected by increasing the head at the dam and, thus, increasing discharge from the Parr Reservoir to the river. This low flow value is not considered representative of natural river flows because it was influenced by the upstream flow diversion. The state of South Carolina uses the 7Q10 value to determine potential impacts. Based on a review of USGS data, the nearest downstream gauging station on the Broad River is the Alston station located 1.2 miles downstream of Parr Shoals Dam. The 7Q10 value at the Alston station is 853 cfs (382,800 gpm) (USGS 2007).

Locally, portions of the Monticello and Parr reservoirs and the Broad River below Parr Shoals Dam are used for fishing and boating. The Federal Energy Regulatory Commission license for the Parr project (FPC 1974) required development of recreational facilities on the Monticello Reservoir and a boat launching area adjacent to the crossing of Heller's Creek by County Road 28 on the Parr Reservoir. A park provides access to a 300-acre sub-impoundment at the north corner of the Monticello Reservoir for fishing and swimming. A boat ramp is located just north of the park. The Federal Energy Regulatory Commission license stipulates minimum flows from the Parr Shoals Dam into the Broad River. The flow is to be maintained at 1,000 cfs or at the average daily natural inflow into Parr Reservoir (less evaporative losses from the Parr and Monticello reservoirs) during the striped bass spawning season in March, April, and May to protect the fishery of the Broad River. During the rest of the year, the minimum daily average flow below the dam is to be maintained at 800 cfs or at the average daily natural inflow into Parr Reservoir (minus evaporation). In accordance with the FERC license requirements, should the Broad River flow from the Parr Shoals Dam be less than the stipulated minimum flow, daily operation of the Fairfield Pumped Storage Facility would cease or be limited. The supply of water required to support normal operations at VCSNS is maintained by the inventory available in the Monticello Reservoir. With the unavailability of the Fairfield Pumped Storage Facility to provide makeup to the Monticello Reservoir, inflow would only be from natural runoff or precipitation.

2.3.3 WATER QUALITY

This subsection describes the physical and chemical characteristics of surface water bodies and groundwater aquifers that could be affected by construction, operation, or decommissioning of new units at the VCSNS site. Subsections 4.2.3 and 5.2.3 discuss the impacts of construction and operation on water quality.

2.3.3.1 Surface Water

The surface water bodies of primary interest include the Broad River, Parr Reservoir (located on the Broad River), Monticello Reservoir (created by the damming of Frees Creek), and Mayo Creek (which flows into the Broad River just south of the Parr Shoals Dam). These water bodies are important because Units 2 and 3 would withdraw makeup water from Monticello Reservoir through a new intake structure located west of the circulating water intake structure for Unit 1. The Monticello Reservoir would also supply a new water treatment plant to serve Units 2 and 3. All cooling system discharges from the new units, including cooling tower blowdown, would be discharged to the Parr Reservoir as well as discharges from the radwaste treatment facility. A small effluent stream from the water treatment plant would be discharged to the Monticello Reservoir. Mayo Creek currently has NPDES outfalls from Unit 1 and the New Nuclear Deployment Building and could receive the discharge from the temporary package sewage treatment plant during construction of the new units. Mayo Creek will intercept surface runoff from a portion of the proposed site. Storm water from the proposed site will also flow directly to the Broad River along unnamed intermittent stream channels.

One important goal of SCDHEC, as well as the U.S. EPA through the Clean Water Act, is to maintain the quality of surface waters to provide for the survival and propagation of a balanced indigenous aquatic community of flora and fauna. The degree aquatic life is protected (Aquatic Life Use Support) is assessed by comparing important water quality characteristics and the concentrations of potentially toxic pollutants with numeric criteria. For aquatic life uses, the goal of the standards is the protection of a balanced indigenous aquatic community. Therefore, biological data is the ultimate deciding factor, regardless of chemical conditions. If biological data shows a healthy, balanced community, the use is considered supported even if chemical parameters do not meet the applicable criteria. Recreational Use Support is attained based on the frequency of fecal coliform bacteria excursions, meaning bacteria concentrations greater than 400 organisms per 100 milliliters for all surface water classes. (SCDHEC 2006a)

SCDHEC’s List of Impaired Waters for 2004 includes one sample location on the main stem of the Broad River. The remaining locations listed are associated with the river’s extensive tributary system. Generally, impacts along the Broad River tributaries to recreational use and to aquatic life standards were associated with fecal coliform. In these cases, recreation is not fully supported. The aquatic life use standards are also not fully supported in other locations primarily due to the lack of diversity of macroinvertebrates. The Broad River main sample location listed is at US 176 in Columbia (Richland County) where the waters were impacted by fecal coliform. The Monticello Reservoir, between the large islands (sample location B-327), was also on the 2004 list due to aquatic life standards not being fully supported due to a varying pH (SCDHEC 2004).

The 2006 List of Impaired Waters does not include the Broad River at the US 176 location in Columbia, but does include the Broad River at SC 72/215/121 near the town of Carlisle in Chester County. This location was included because of the presence of copper and its potential degradation of aquatic life use standards. The Broad River at the rail trestle just south of SC 213 is also included on the list because of the potential degradation of aquatic life use standards. The Monticello Reservoir (sample location B-327) was again included on the 2006 draft list because of potential impact to aquatic life use standards because of pH variation.

The Parr Reservoir is included on the 2006 draft list due to sampling results at two locations. One is in the forebay area near the dam at sample location B-345. Sample results indicate potential impacts to aquatic life use standards because of the presence of copper. The second location is 4.8 miles upstream of the dam (sample location B-346), upstream of the effluent from the Monticello Reservoir. The results indicate a potential impact to aquatic life use standards from total phosphorus. (SCDHEC 2006b)

The following paragraphs discuss water quality data in more detail for the water bodies of interest for the proposed site for the new units.

2.3.3.1.1 Mayo Creek

Water quality parameters (temperature, pH, dissolved oxygen, specific conductance, and turbidity) were measured at three locations (Stations 1, 2, and 3) on Mayo Creek in July 2006 as part of a Mayo Creek aquatic survey undertaken by SCE&G. Follow-up sampling/monitoring was performed in November 2006 at Stations 2 and 3. Station 4, not previously sampled/monitored, was sampled in November 2006. Mayo Creek is a small tributary of the Broad River. Its drainage area extends through the wooded eastern portion of the proposed construction area for Units 2 and 3 and into the vicinity of Unit 1's facilities. Data was collected during morning to early afternoon hours. Station 1 is located at the confluence of Mayo Creek and Broad River. Station 2 is located 100 meters upgradient of the bridge on Parr Road. Station 3 is located 300 meters upgradient of the bridge on Parr Road. Station 4 is located approximately 1,100 meters upstream of the Parr Road Bridge. Mayo Creek is a groundwater–fed stream. The stream contains many riffles and is shaded throughout most of its length. The results of the field monitoring, included in Table 2.3-29, are typical to creeks located in the Piedmont of South Carolina. The results are also typical of data collected for the Broad River drainage.

2.3.3.1.2 Unnamed Tributary to Parr Reservoir

Water quality parameters (temperature, pH, dissolved oxygen, specific conductance, and turbidity) were measured at a single location, Station 5, in an unnamed tributary to the Parr Reservoir during the November 2006 follow-up monitoring event of Mayo Creek. The results of the monitoring indicated the water temperature was 14.3°C (57.7°F), the dissolved oxygen was 3.3 mg/L, the specific conductivity was 125 micromhos per centimeter, and the pH was 6.1. Turbidity measurements were not collected.

2.3.3.1.3 Broad River

The Broad River water quality data collected from the fall of 2000 through spring of 2002 by the South Carolina Department of Natural Resources (SCDNR) determined that the water quality parameters monitored were consistent with those expected for a river located in the Piedmont of South Carolina. Dissolved oxygen ranged from 6.1 to 9.9 milligrams per liter, pH values ranged from 6.3 to 8.5, specific conductance values ranged from 85 to 262 micromhos per centimeter, and turbidity ranged from 3.2 to 24.4 nephelometric turbidity units. No seasonal or longitudinal differences in these water quality parameters were observed during the evaluation. Water temperature ranged from 11.6°C (52.9°F) to 29.6°C (85.28°F) (Bettinger et al. 2003). In 2001, SCDHEC reported the results of a study that characterized surface water quality of the Broad River Basin at 11 sites including nine assessment sites on the main stem of the river. At all but one of the sites aquatic life was fully supported. Aquatic life was not fully supported in the Columbia Water Plant diversion canal southeast and downstream of the site because of the occurrence of copper in excess of the acute aquatic life standards. Variances from aquatic life standards for dissolved oxygen and pH were less than or equal to 10%, and aquatic life standards for toxins were not exceeded (SCDHEC 2001).

Water quality collected from the Broad River at SC 34, the closest upstream sampling location to the proposed site, indicated the aquatic life uses were fully supported; however, there is an increasing trend in turbidity. South Carolina has classified the river here as freshwater. Recreational uses are only partially supported in this area because of fecal coliform bacteria excursions (SCDHEC 2001). Water quality field parameters collected by the USGS from the Broad River near Jenkinsville (just downstream of the Parr Reservoir) for 2005 indicates that temperature ranged from 5.4°C (41.7°F) to 31.2°C (88.2°F). The range of pH was from 6.3 to 7.6. Dissolved oxygen ranged from 3.8 to 12.9 milligrams per liter. Conductivity ranged from 42 to 103 micromhos per centimeter (Cooney et al. 2006). This data is consistent with stream data in the Piedmont.

2.3.3.1.4 Parr Reservoir

The Parr Reservoir water quality data was also reported in the 2001 study of the Broad River basin. Parr Reservoir is classified by South Carolina as freshwater. Aquatic life use and recreational use were fully supported (SCDHEC 2001). SCDHEC also reports water quality data annually from two locations on the Parr Reservoir—Cannon's Creek Landing Road (Sample location B-345) and within the reservoir approximately 4.8 kilometers north of the reservoir dam (Sample location B-346). The most recent complete data available for these locations is for 2004. The results of 2004 data analysis and partial data (Sample Location B-345) for 2005 for these locations are shown in Tables 2.3-30 and 2.3-31, respectively.

2.3.3.1.5 Monticello Reservoir

The Monticello Reservoir provides once-through cooling water to Unit 1 and acts as the upper reservoir for the Fairfield Pumped Storage Facility. The Parr Reservoir, created by the damming of the Broad River, serves as the lower reservoir for the Fairfield Pumped Storage Facility. Makeup water for the Monticello Reservoir is supplied from the Parr Reservoir. As part of the Fairfield Pumped Storage Facility operations, water is released from the Monticello Reservoir through the Fairfield Pumped Storage Facility to the Parr Reservoir to generate electricity during peak demand periods. Water is then pumped during off-peak demand periods from the Parr Reservoir to the Monticello Reservoir to maintain the level of the upper reservoir. Over time, the water quality of the

Monticello Reservoir, because of the constant cycling and mixing of water, is expected to be basically that of the Broad River (U.S. NRC 1981).

Water quality monitoring data indicates that the Monticello Reservoir waters are relatively low in concentrations of common ions, low in hardness, and low in dissolved solids and conductivity. Groundwater in the vicinity of the site is highly mineralized because of prolonged contact with, and solution of, rock minerals and, as a result, is generally higher than local surface waters in hardness, dissolved solids, and conductivity. There is no indication that evaporative losses associated with operation of Unit 1 have increased concentrations of common ions, minerals, or solids in the Monticello Reservoir water, and no indication that groundwater quality in the area has been affected (SCE&G 2002a). The Monticello Reservoir is characterized by SCDHEC as freshwater (SCDHEC 2001).

SCE&G monitors water temperature and other parameters at three locations on the Monticello Reservoir—an “uplake” location (near the northern end of the Monticello Reservoir), a location near the circulating water intake, and a location just outside of the northern end of the discharge canal—as part of the Unit 1 water quality monitoring program. Measurements were taken during 2000 through 2003 and 2005 at these locations monthly during early to late-morning hours (SCE&G 2001, 2002b, 2003a, 2004a, 2006b).

Temperature readings from the Monticello Reservoir surface water at the cooling water discharge location, Discharge 6, at the southern end of the reservoir was higher than the temperature found at the other two sampling reservoir locations. The temperature at the Discharge 6 sample location ranged from 7.5°C (45.5°F) to 37.9°C (100.3°F) throughout the year, with the highest temperatures occurring in August. A thermal plume at the Discharge 6 sampling location is evident during operation of Unit 1 year-round at depths of 2 to 3 meters. During the winter months, the temperature profiles for Uplake 16 and the Intake 2 locations were similar, with temperature ranging from 7.2°C (45°F) to 14.4°C (58°F). During the August 2003 monitoring event, a thermocline was evident at the Uplake 16 location between 8 and 9 meters. During the fall months, thermal stratification breaks down, allowing a mixing of the layers (SCE&G 2001, 2002b, 2003a, 2004a, 2006b).

Dissolved oxygen in the Monticello Reservoir is relatively high throughout the year except for the deeper waters in the late summer. These deep waters, because of their lower temperatures and higher densities, do not mix with the upper layers of water and become oxygen depleted. A general decrease in oxygen occurs with depth during the summer months. During winter conditions, thorough mixing of water layers occurs, distributing oxygen from the surface to the bottom. The only exception is near Discharge 6 where the levels indicate the presence of the thermal plume from the Unit 1 discharge. The Uplake 16 sample location shows the greatest decline in oxygen with depth in winter or summer. More mixing appears to occur at the Intake 2 location due to the influence of pump-back by FPSF (SCE&G 2001, 2002b, 2003a, 2004a, 2006b).

The pH in the Monticello Reservoir (2000 through 2003 and 2005) is generally neutral, ranging from 5.8 to 8.9. Winter and summer pHs are similar at all three monitoring locations. Late winter/spring pH values are higher at the Uplake 16 location due to phytoplankton photosynthetic activity in the surface waters to depths that sunlight can penetrate. Also, the water mixing process previously discussed for the Intake 2 and Discharge 6 location keeps the values lower than the Uplake 16 location (SCE&G 2001, 2002b, 2003a, 2004a, 2006b).

Specific conductance values for the Monticello Reservoir vary only slightly (2000 to 2003 and 2005), ranging from 94 to 142 micromhos per centimeter. No data analyzed from 2000 through 2003 and 2005 indicated that the waters of the Monticello Reservoir were insufficient for the support of aquatic life (SCE&G 2001, 2002b, 2003a, 2004a, 2006b).

SCDHEC also collects water quality samples from the Monticello Reservoir. The Monticello Reservoir sample locations are 100 meters north of the large mid-lake island (sample location B-327) in the main reservoir, and at the mid-lake marker in the upper impoundment (sample location B-328). The results of the 2004 data analysis for both of these locations are shown in Table 2.3-30. Results are also available for Sample Location B-327 for 2005 (Table 2.3-31). SCE&G performed additional surface water sampling at sample location B-327 in Monticello Reservoir on August 17, 2006. The results of the sampling event are given in Table 2.3-32. These results are typical for Piedmont water bodies.

Fecal coliform bacteria are regarded as indicators of other pathogenic microorganisms, and are the organisms normally monitored by state health agencies. The NPDES permit for Unit 1 requires monitoring of fecal coliform in sewage treatment plant effluent (after discharge from the chlorine contact chamber and before mixing with other waste streams). Samples are collected for fecal coliform analysis and other parameters twice a month. The NPDES permit specifies a maximum 30-day average of 200 organisms per 100 milliliter sample, and a daily maximum of 400 organisms per 100 milliliters. From 2001 to 2005, neither of these limits were exceeded during any sampling event (SCE&G 2006c). There is public access to the Parr Reservoir and Monticello Reservoir, including recreational fishing, boating, and waterfowl hunting (SCE&G 2002a).

Maximum temperatures in the Monticello Reservoir outside of the discharge canal are below the optimal temperature range for growth and reproduction of thermophilic microorganisms. These temperatures could support limited survival of these organisms in summer months, although temperatures are generally below the range most conducive to the growth of thermophilic microorganisms (SCE&G 2002a).

Another factor controlling the survival and growth of thermophilic organisms in the Monticello Reservoir is the disinfection of the Unit 1 sewage treatment plant effluent. This reduces the likelihood that a seed source or inoculant will be introduced into the Unit 1 discharge canal or the Monticello Reservoir. Following primary treatment in an aeration lagoon and secondary treatment through sand filters, the sewage treatment wastewater is moved to a contact chamber for chlorination. The wastewater is then dechlorinated before being mixed with other plant waste streams and eventually discharged to the discharge canal (SCE&G 2002a).

From a public health standpoint, the assessment of thermophilic organisms is more relevant for the Monticello Reservoir in the vicinity of the Unit 1 discharge canal than for the discharge canal proper. This is because there is no public access to the discharge canal. The discharge basin and canal are within the nuclear exclusion zone, land access to which is strictly controlled (see Section 2.1). Public exclusion from this discharge canal is actively enforced by Unit 1 security as well as SCDNR conservation officers (SCE&G 2002a).

Given the thermal characteristics of the Monticello Reservoir in the vicinity of the Unit 1 discharge outfall and the disinfection of sewage treatment plant effluent, SCE&G does not expect Unit 1 operations to stimulate growth or reproduction of thermophilic microorganisms. Under certain circumstances, these organisms might be present in limited numbers in the discharge bay and canal, where water temperatures can be as high as 41.7°C (107°F), but would not be expected in sufficient concentrations to pose a threat to recreational users of the Monticello Reservoir or downstream water users in the Parr Reservoir or the Broad River (SCE&G 2002a).

SCE&G submits annual Radiological Environmental Operating Reports for Unit 1 to NRC as required by Regulatory Guide 4.8 and Section 6.9.1.6 of the Unit 1 Technical Specifications. The sampling results for surface water that were submitted to NRC are summarized below for the years 2001 through 2005. During that period, measurements of surface water samples from monitoring locations did not indicate the presence of activated corrosion or fission products above the respective minimum detectable activities with the following exceptions: tritium was detected during 2002 and 2003 at levels of 778 picocuries per liter (highest minimum detectable activity 484 picocuries per liter) and 769 picocuries per liter (highest minimum detectable activity 521 picocuries per liter), respectively, at Site 21 on Parr Reservoir 2.7 miles south southwest of Unit 1. Measurements of drinking water samples collected from the city of Columbia water supply did not indicate the presence of activated corrosion or fission products above the respective minimum detectable activities with the exception that gross beta activity was measured during one event at 3.91 picocuries per liter during 2002. Tritium analysis did not indicate the presence of tritium above minimum detectable activities at the city of Columbia water supply. During 2004, iodine-131 was detected in one sample at Neal Shoals, 26 miles north northwest of Unit 1. (SCE&G 2002c, 2003b, 2004b, 2005a, and 2006d)

2.3.3.2 Groundwater

The jointed bedrock within the vicinity of the site does not provide a good aquifer for municipal and industrial water wells. The quality of groundwater is acceptable for most uses; however, high iron content was found in some supplies. The water quality is highly mineralized, due to prolonged contact with, and solution of, rock minerals. Chemical analyses (reported in Table 2.3-33) of water samples obtained from borings during the construction of Unit 1 are expected to be indicative of typical groundwater quality at the time of construction of the proposed units.

Two water wells associated with the town of Jenkinsville were sampled in 2004 as part of SCDHEC's program to monitor the state's ambient groundwater. Well AMB-60 is located approximately 5 miles north of Unit 1 just east of the Monticello Reservoir. Well AMB-57 is located at the extreme northern end of the reservoir. The results of the analysis for 2004 are shown in Table 2.3-34. The data is included as typical well data within the site vicinity.

Monitoring wells were installed as part of the geotechnical evaluation for Units 2 and 3. Nine wells were sampled and the groundwater analyzed for the parameters included in Table 2.3-35. The results of the analyses indicate that groundwater quality is similar to that of the Jenkinsville wells included in Table 2.3-34. The results reported in Table 2.3-35 are below EPA drinking water standards.

In 2007, additional groundwater quality data from eight monitoring wells were collected to establish preoperational environmental conditions. The results are provided in Table 2.3-36 for nonradiological chemicals. Two wells indicated the presence of tritium. Well OW-305a indicated 519 picocuries per liter on January 10, 2008. Well OW-305b showed 2,258 picocuries per liter on December 18, 2007 and 2,880 picocuries per liter on January 10, 2008. No other wells in the vicinity indicated tritium above the detection limit of 471 picocuries per liter. The EPA drinking water standard is 20,000 picocuries per liter.

A potential source of this low-level tritium is condensate polisher resin. This resin was disposed in this area in 1994 under an SCDHEC-approved waste disposal exemption under what was then 10 CFR 20.302(a), but is now 10 CFR 20.2002. Should SCE&G commence construction of this proposed project, it plans to remove the soils from the project area where land application was permitted.

The sampling results for groundwater that were submitted to NRC as part of the annual Radiological Environmental Operating Reports are summarized below for the years 2001 through 2005. During this period, measurements of groundwater from the site monitoring program and drinking water samples collected from the Jenkinsville water supply did not indicate the presence of activated corrosion or fission products above the respective minimum detectable activities or tritium above minimum detectable activities. In 2005, tritium was detected at monitoring location GW-9, which is 0.35 miles south southeast of VCSNS at a concentration of 1,800 picocuries per liter.

Naturally occurring radionuclides, radium-226, lead-214, and bismuth-214 were observed in the Jenkinsville water supply at levels above those found in surface water throughout the period. These elevated activity levels were also observed in the preoperational monitoring program and are attributed to several deep wells. The Jenkinsville community water supply is located more than 5 miles from VCSNS (SCE&G 2002c, 2003b, 2004b, 2005a, and 2006d).

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Table 2.3-1
Stream Flow Gauging Stations

Station name		Alston	Richtex	Carlisle
USGS station number		2161000	2161500	2156500
Latitude		34°14'35"	34°11'05"	34°35'46"
Longitude		81°19'11"	81°11'48"	81°25'20"
Distance from Parr Dam	mi	1.2 downstream	14 downstream	21 upstream
Period of record		October 1896 to December 1907 October 1980 to current year	October 1925 to September 1983	October 1938 to current year
Remarks		Records good except for estimated daily discharges, which are poor. Records for the 1897–1908 water years are poor. Regulation at low and medium flow by power plants above station	Discontinued in 1983.	Records good except for estimated daily discharges, which are poor. Some regulation at low and medium flow by power plants above station. Capacity of reservoirs insufficient to affect monthly figures of runoff
Drainage area	sq mi	4,790	4,850	2,790
Water years of available data used in this report		1897-1906 1980-2005	1925–83	1939–2005
Annual mean	cfs	6,302	6,155	3,880
Highest annual mean	cfs	11,750	—	5,977
Lowest annual mean	cfs	2,153	—	1,255
Highest daily mean	cfs	130,000	211,000	114,000
Lowest daily mean	cfs	48	149	44
Annual 7-day minimum	cfs	200	n/a	220
Maximum peak flow	cfs	~140,000	228,000 (on 10-3-1929)	~123,000
Annual runoff	in	17.67	—	18.89

Source: Cooney et al. 2006.

Table 2.3-2 (Sheet 1 of 2)
Mean Daily Flows on the Broad River at Richtex, South Carolina (Period of Data: 1925 to 1983)

Day of Month	Mean of daily mean values for each day (cfs)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	8,100	7,250	8,380	12,400	6,510	5,490	4,150	4,290	4,020	6,070	3,870	5,420
2	8,530	7,520	8,130	12,800	6,200	5,190	3,860	4,350	3,500	7,490	4,260	4,810
3	8,160	8,560	8,180	10,900	6,280	5,190	3,750	4,260	2,990	7,970	4,330	4,660
4	8,900	9,900	9,190	9,310	6,750	5,100	3,530	4,180	3,400	5,420	4,920	5,040
5	8,540	9,940	9,740	8,830	6,390	4,810	3,590	4,380	3,740	4,650	4,530	5,460
6	8,140	9,340	10,600	9,530	5,880	4,770	4,000	4,150	3,910	4,400	3,830	5,200
7	9,050	9,850	11,000	11,200	5,420	4,680	4,670	3,850	4,120	4,480	3,830	5,570
8	9,290	9,980	11,100	12,300	5,600	4,900	4,410	4,190	4,760	4,490	4,040	5,810
9	9,360	9,180	10,000	11,700	6,090	4,930	5,060	4,120	4,490	5,270	4,070	5,920
10	9,190	8,430	8,910	10,100	5,650	4,820	4,790	3,920	4,120	6,860	3,850	5,250
11	8,920	8,620	8,040	9,140	5,330	4,890	4,950	4,000	3,820	7,800	3,560	5,010
12	8,170	8,530	8,400	8,880	4,870	4,480	5,140	4,450	3,310	6,080	4,150	5,530
13	7,670	8,130	10,100	8,910	4,790	4,520	4,700	4,110	2,940	3,910	3,910	6,320
14	7,800	8,930	10,600	8,720	5,270	4,830	4,390	4,100	3,180	3,230	4,280	6,340
15	7,400	9,990	10,800	8,520	5,720	4,580	4,430	4,750	3,770	3,290	4,040	6,420
16	7,090	9,260	10,400	9,090	6,000	5,050	4,940	5,500	4,010	3,840	4,320	7,090
17	6,910	8,580	10,200	8,740	6,200	4,820	5,190	4,320	4,440	5,790	4,000	7,450
18	6,600	9,210	10,600	8,000	5,560	4,640	5,090	3,960	4,490	7,540	4,120	6,390
19	8,410	9,370	10,500	7,430	4,980	4,550	4,570	4,540	4,740	6,730	4,550	5,750
20	10,200	9,650	10,000	7,290	4,740	4,320	4,290	4,240	4,750	4,670	4,870	5,570
21	10,500	9,440	9,780	6,780	4,610	4,420	4,440	3,860	3,720	4,730	4,900	5,360
22	9,550	9,800	10,400	6,130	5,240	4,590	4,460	3,940	3,290	4,140	4,150	5,500
23	8,620	9,860	9,950	5,980	5,810	5,150	4,300	4,050	3,080	3,740	4,040	6,090
24	8,290	9,930	9,720	5,940	5,580	4,660	4,170	4,400	2,980	3,750	4,300	5,940
25	8,520	9,730	10,200	6,530	5,130	4,150	3,970	4,750	2,890	3,790	4,240	5,240
26	8,860	9,910	10,500	6,820	5,000	3,940	4,260	4,780	2,980	3,730	4,680	6,090

Table 2.3-2 (Sheet 2 of 2)
Mean Daily Flows on the Broad River at Richtex, South Carolina (Period of Data: 1925 to 1983)

Day of Month	Mean of daily mean values for each day (cfs)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
27	8,220	10,100	9,710	6,570	4,960	4,280	4,300	4,130	3,100	3,820	5,070	7,400
28	7,820	9,040	9,660	6,820	4,780	3,860	3,980	3,860	3,230	3,850	4,740	7,570
29	7,930	7,030	10,100	6,720	5,230	4,090	3,990	4,360	3,390	3,450	5,360	7,460
30	7,690	—	9,920	6,770	5,680	4,230	3,770	4,910	4,100	3,430	5,720	7,990
31	7,340	—	10,600	—	6,220	—	3,790	4,470	—	3,570	—	7,790

Table 2.3-3 (Sheet 1 of 2)
Mean Daily Flows on the Broad River at Alston, South Carolina (Period of Data: 1980 to 2005)

Day of Month	Mean of daily mean values for each day (cfs)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	6,070	5,790	11,300	8,260	6,980	4,300	3,480	4,910	1,720	6,420	2,390	4,090
2	6,950	6,200	10,500	7,810	6,540	6,040	4,180	5,560	1,890	4,290	2,490	4,320
3	6,650	9,020	8,560	7,490	6,650	4,820	5,220	3,610	2,180	3,010	2,400	5,090
4	8,090	11,200	6,090	7,090	6,850	4,860	5,000	3,800	3,800	2,680	2,270	5,020
5	8,280	12,800	6,230	7,300	6,350	4,790	3,880	3,510	2,580	2,350	3,100	5,050
6	7,220	10,800	8,770	6,180	6,060	4,350	3,630	3,650	2,690	2,590	3,140	6,200
7	6,940	9,630	10,600	6,650	7,680	4,640	3,370	3,520	2,370	2,690	3,060	7,440
8	5,110	9,190	10,700	7,620	7,440	4,920	4,420	3,470	5,320	2,770	3,400	6,900
9	6,030	6,840	10,600	9,870	7,220	5,470	5,060	3,540	6,970	3,050	2,780	5,490
10	6,680	6,840	10,400	10,600	6,540	4,650	4,520	3,230	8,860	2,470	2,780	4,370
11	8,520	7,080	8,280	13,100	5,080	3,640	4,000	3,320	6,110	2,830	2,900	5,890
12	8,380	8,130	5,810	12,000	4,760	3,360	2,620	3,450	2,820	3,400	2,790	7,340
13	6,200	7,590	5,910	8,920	4,010	3,910	3,100	3,700	2,150	3,340	3,800	9,050
14	4,550	8,440	6,600	8,600	4,170	3,710	4,060	3,700	2,080	2,830	3,980	7,870
15	4,640	12,800	6,030	6,460	4,100	3,350	4,410	3,140	2,300	2,110	3,520	6,630
16	4,670	14,000	6,430	6,680	4,110	4,020	3,640	4,020	2,360	2,240	2,910	6,660
17	6,250	10,500	8,010	7,330	3,520	4,620	3,420	3,810	2,580	2,730	3,240	6,440
18	6,210	9,500	10,200	7,790	3,640	3,300	3,170	2,760	2,640	2,760	3,710	5,690
19	6,690	7,680	10,500	9,950	4,030	3,860	4,000	3,460	2,400	2,710	3,280	4,350
20	6,920	7,360	11,200	9,950	4,040	3,800	3,830	3,130	2,500	2,370	3,340	4,550
21	5,910	7,690	15,100	8,120	4,570	3,190	3,250	2,220	2,130	2,120	3,860	4,500
22	6,450	7,200	15,600	6,160	4,420	3,620	2,570	2,240	1,870	2,120	3,170	3,920
23	6,840	8,200	11,600	5,770	7,230	3,250	2,700	2,330	2,640	1,930	3,070	4,130
24	9,680	9,580	8,540	6,130	9,050	3,250	3,490	1,940	2,880	1,980	3,540	5,630
25	9,630	8,200	7,170	7,350	7,960	3,150	3,550	2,230	2,310	2,070	3,290	7,740
26	8,840	6,880	7,090	5,760	5,960	4,010	4,210	2,100	2,670	2,340	3,970	9,320

Table 2.3-3 (Sheet 2 of 2)
Mean Daily Flows on the Broad River at Alston, South Carolina (Period of Data: 1980 to 2005)

Day of Month	Mean of daily mean values for each day (cfs)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
27	7,050	7,020	6,210	5,960	4,710	4,240	3,560	2,440	2,810	3,230	3,660	7,540
28	8,310	9,740	7,670	8,070	4,550	3,380	3,150	2,000	3,190	3,320	3,920	5,930
29	7,630	15,400	11,400	6,780	5,730	4,470	2,990	1,980	3,590	3,070	3,470	4,920
30	6,520	—	12,600	7,490	5,330	3,830	3,060	2,250	3,480	2,740	3,490	4,450
31	7,080	—	10,900	—	5,720	—	3,560	1,880	—	2,550	—	5,540

Table 2.3-4 (Sheet 1 of 2)
Mean Daily Flows on the Broad River at Carlisle, South Carolina (Period of Data: 1938 to 2005)

Day of Month	Mean of daily mean values for each day (cfs)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	4,360	4,480	5,890	7,910	4,370	3,400	2,530	2,930	2,420	3,830	2,690	2,960
2	4,140	5,150	5,240	6,510	4,170	3,600	2,850	2,850	2,140	3,440	2,660	2,920
3	4,110	6,000	5,360	5,340	4,400	3,450	3,030	2,800	2,090	2,730	3,190	2,890
4	4,340	6,380	5,570	5,010	4,670	3,160	2,650	3,120	2,210	2,360	3,130	2,890
5	4,270	6,210	6,060	5,360	4,470	3,230	2,630	3,100	2,340	2,630	2,800	3,290
6	4,150	5,930	6,170	5,990	3,830	3,270	2,840	2,730	2,290	3,230	2,650	3,580
7	4,530	6,690	6,630	5,990	3,840	3,190	2,880	2,700	2,650	3,190	2,810	3,860
8	4,400	6,230	5,930	6,450	4,260	3,390	3,710	2,810	3,530	2,910	2,900	4,260
9	4,580	5,310	5,870	6,320	4,100	3,380	3,920	2,610	3,770	4,170	2,560	3,760
10	4,880	4,910	5,290	5,640	3,810	3,340	3,190	2,480	3,520	4,810	2,470	3,250
11	5,190	5,330	4,860	5,760	3,510	3,280	3,280	2,850	2,390	3,730	2,550	3,750
12	4,760	4,930	5,070	6,040	3,380	3,140	3,270	2,910	2,180	2,620	2,700	4,040
13	4,180	4,990	6,030	5,610	3,630	3,210	3,100	2,810	2,020	2,250	2,710	4,580
14	4,350	5,960	6,910	5,440	3,990	3,290	3,120	3,120	2,160	2,200	2,730	4,000
15	4,150	6,450	6,680	5,350	3,990	3,510	2,990	3,960	2,510	2,320	2,640	3,680
16	4,170	5,550	6,120	5,700	4,170	3,670	3,430	3,080	2,350	2,890	2,560	4,210
17	4,390	5,550	6,010	5,650	4,140	3,540	3,580	2,640	2,790	3,890	2,480	3,890
18	4,050	5,980	6,350	5,030	3,510	3,240	3,360	3,390	3,520	3,540	2,650	3,490
19	4,440	5,850	6,000	5,250	3,460	2,900	2,830	3,440	3,640	2,790	2,870	3,550
20	4,860	5,540	6,430	5,030	3,360	2,870	2,800	2,680	2,760	2,550	3,340	3,360
21	5,160	5,520	7,400	4,280	3,450	3,180	2,870	2,550	2,400	2,610	2,990	3,370
22	5,180	5,710	7,340	4,000	3,860	3,610	2,990	2,530	2,180	2,350	2,650	3,730
23	5,050	5,810	5,810	3,990	4,430	3,650	2,700	2,770	2,410	2,250	2,700	3,670
24	5,330	5,690	6,110	4,190	4,360	3,050	2,570	3,060	2,210	2,450	2,820	3,470
25	5,280	5,560	6,360	4,090	3,720	2,810	2,540	3,140	2,270	2,680	2,930	3,740
26	5,400	6,020	5,840	4,060	3,690	3,150	2,550	3,070	2,400	2,610	3,310	4,290

Table 2.3-4 (Sheet 2 of 2)
Mean Daily Flows on the Broad River at Carlisle, South Carolina (Period of Data: 1938 to 2005)

Day of Month	Mean of daily mean values for each day (cfs)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
27	4,980	5,800	5,680	4,300	3,610	3,050	2,480	2,360	2,410	2,730	3,150	4,390
28	5,120	5,510	5,640	4,570	3,450	2,940	2,590	2,650	2,420	2,430	3,220	4,130
29	5,310	5,150	6,150	4,910	3,910	3,040	2,520	3,000	2,550	2,330	3,700	4,540
30	4,430	—	6,890	4,790	4,360	2,790	2,540	2,920	3,110	2,310	3,650	4,910
31	4,440	—	7,320	—	3,960	—	2,610	2,450	—	2,710	—	4,450

Table 2.3-5 (Sheet 1 of 3)
Mean Monthly Flows on the Broad River at Richtex, South Carolina (Period of Data: 1925 to 1983)

Year	Monthly mean flows (cfs)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1925	—	—	—	—	—	—	—	—	—	2,180	3,640	3,548
1926	9,110	10,680	7,344	6,399	2,395	1,825	3,042	4,633	2,553	1,298	2,482	4,098
1927	3,068	7,051	6,998	3,679	2,265	3,299	5,402	2,205	2,400	1,656	1,813	9,496
1928	3,788	6,218	6,355	9,609	8,183	4,879	7,334	—	—	—	—	—
1929	—	—	—	—	—	—	—	—	—	23,500	9,945	9,040
1930	8,042	8,124	6,669	4,956	4,274	3,559	2,952	2,592	2,537	1,642	5,190	6,077
1931	6,230	3,343	4,773	7,446	6,296	2,898	4,025	5,305	1,495	1,120	1,418	11,630
1932	13,710	7,120	8,463	5,518	4,303	4,826	2,446	4,609	1,837	10,450	10,250	15,300
1933	8,360	9,377	6,491	5,534	4,935	2,757	3,575	5,664	4,964	2,379	2,273	2,718
1934	3,544	4,486	9,523	6,959	6,050	10,320	3,731	3,981	4,271	9,096	3,401	5,059
1935	8,217	6,667	7,029	7,507	4,658	3,028	4,952	5,117	5,115	1,915	4,207	2,977
1936	24,110	13,270	11,550	27,690	4,485	3,506	3,062	6,437	4,143	14,960	3,607	7,336
1937	22,010	10,610	7,012	11,090	5,715	4,801	3,754	5,432	5,600	10,610	4,571	4,738
1938	5,323	3,991	5,213	6,602	3,212	5,352	6,958	3,790	3,351	1,793	3,231	4,056
1939	5,321	17,140	12,010	5,418	4,537	2,774	3,618	6,353	2,021	1,686	1,689	2,358
1940	3,862	6,032	4,975	3,789	2,482	2,580	2,212	10,620	2,746	1,605	4,421	3,744
1941	3,741	2,747	4,410	4,325	1,918	2,317	14,500	3,570	1,836	1,339	1,883	4,708
1942	3,311	9,584	12,800	3,958	4,821	3,935	3,958	4,513	4,168	2,435	2,549	5,519
1943	14,520	7,798	8,976	7,084	4,550	4,445	9,881	3,530	2,499	1,928	2,743	3,384
1944	6,290	10,900	19,020	12,710	5,768	4,337	3,177	3,312	2,337	4,425	3,085	3,742
1945	4,552	8,580	6,449	5,890	4,101	2,135	4,433	3,323	15,300	3,073	3,062	11,950
1946	14,730	12,480	8,273	6,124	7,441	3,758	4,281	5,266	3,139	5,092	3,871	3,546
1947	13,610	4,899	8,183	6,053	3,449	4,484	3,408	2,752	2,210	6,311	11,880	5,845
1948	6,873	14,330	12,230	9,996	5,503	4,097	3,722	5,760	4,279	2,780	11,900	11,520
1949	9,324	11,370	6,100	8,030	8,119	4,190	6,401	13,510	7,538	8,598	7,495	4,848
1950	5,507	4,953	6,701	4,996	4,275	4,574	4,430	2,880	4,589	3,902	2,799	5,408

Table 2.3-5 (Sheet 2 of 3)
Mean Monthly Flows on the Broad River at Richtex, South Carolina (Period of Data: 1925 to 1983)

	Monthly mean flows (cfs)											
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1951	3,363	4,683	6,243	6,644	3,186	3,227	2,456	2,261	2,673	1,625	2,465	9,374
1952	5,203	8,773	25,340	6,839	4,297	3,111	2,377	4,781	2,819	1,937	2,160	2,668
1953	7,414	11,580	9,925	4,143	6,116	3,408	2,298	1,748	2,803	1,769	1,814	6,265
1954	13,910	5,625	8,309	7,615	3,802	2,421	2,062	1,261	767	725	1,448	2,353
1955	3,178	7,320	3,342	7,996	5,064	2,503	3,405	2,507	1,370	2,205	1,891	1,807
1956	1,864	10,330	8,017	11,440	5,125	2,119	2,030	1,078	3,074	2,179	2,331	3,381
1957	3,280	7,191	7,461	7,992	4,828	5,727	2,216	2,295	3,370	4,760	14,340	7,277
1958	8,941	7,854	8,746	16,680	11,710	4,473	6,158	3,890	2,463	2,426	2,413	4,341
1959	5,471	6,439	7,278	8,729	6,542	6,546	6,356	3,482	7,120	15,440	6,000	6,741
1960	10,300	24,520	13,370	13,010	6,727	5,039	3,922	4,059	4,083	5,289	3,541	3,714
1961	5,385	15,750	9,458	12,340	6,065	7,568	5,204	6,139	3,303	2,332	3,017	10,750
1962	12,160	10,390	12,600	15,460	4,558	6,583	4,077	3,259	3,233	2,895	4,135	4,175
1963	8,015	6,774	19,530	5,059	6,686	4,758	3,695	2,096	2,345	2,438	2,504	4,420
1964	10,820	9,997	14,290	17,520	7,022	4,782	5,720	6,122	5,295	22,480	6,435	9,985
1965	6,289	10,550	15,600	11,610	6,120	8,311	7,309	4,863	2,938	4,047	3,420	3,026
1966	5,016	13,030	12,780	4,409	5,015	3,407	2,346	2,905	4,547	3,378	3,914	3,549
1967	5,750	6,661	4,627	3,120	3,813	4,753	5,992	11,290	3,872	2,682	3,507	10,870
1968	12,220	4,680	8,880	4,632	4,740	7,165	5,765	2,210	1,863	2,505	4,162	3,577
1969	6,707	10,520	10,130	13,940	4,578	5,042	2,781	4,889	6,321	3,295	3,730	6,703
1970	4,911	7,354	7,466	6,673	3,697	2,481	2,047	6,157	1,726	2,454	5,251	3,864
1971	6,465	13,270	12,560	6,185	8,595	3,575	3,960	5,131	3,995	9,002	7,047	10,260
1972	12,220	8,700	6,710	6,450	9,820	9,557	4,998	5,163	2,633	2,872	4,274	12,570
1973	8,435	14,970	14,880	16,920	9,465	10,500	5,472	4,409	6,764	3,654	3,153	5,819
1974	12,150	11,500	6,151	11,360	6,007	4,756	4,948	5,173	3,656	2,752	3,179	6,430
1975	13,620	11,970	21,020	8,042	11,330	9,087	7,001	3,875	7,326	7,756	6,074	5,384
1976	9,076	6,369	8,553	6,646	6,738	6,921	4,622	2,727	3,657	16,510	5,456	12,660

Table 2.3-5 (Sheet 3 of 3)
Mean Monthly Flows on the Broad River at Richtex, South Carolina (Period of Data: 1925 to 1983)

	Monthly mean flows (cfs)											
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1977	8,069	4,460	11,950	13,150	4,071	3,573	2,440	2,243	4,544	4,922	7,033	3,310
1978	14,190	4,888	10,010	5,912	8,271	4,053	2,802	5,195	3,074	2,022	2,296	3,139
1979	8,580	15,290	12,200	13,020	7,093	5,781	5,094	2,941	4,182	6,400	7,265	5,047
1980	9,999	5,769	19,150	12,080	6,523	6,384	3,781	2,448	3,694	6,739	5,530	4,365
1981	3,425	8,084	4,114	5,176	3,294	3,128	2,270	2,281	3,158	1,948	1,950	5,826
1982	15,410	12,740	7,699	6,410	5,498	6,202	3,950	4,363	1,978	2,232	2,823	8,365
1983	8,651	14,250	15,660	13,470	6,951	4,234	3,388	2,128	2,127	—	—	—
Mean monthly flow	8,380	9,190	9,850	8,630	5,560	4,660	4,350	4,300	3,710	4,900	4,350	6,050
Maximum monthly flow	24,110	24,520	25,340	27,690	11,710	10,500	14,500	13,510	15,300	23,500	14,340	15,300
Minimum monthly flow	1,864	2,747	3,342	3,120	1,918	1,825	2,030	1,078	767	725	1,418	1,807
Maximum daily flow	72,200	71,100	92,500	145,000	41,800	58,400	47,400	109,000	91,000	211,000	91,900	64,200
Minimum daily flow	450	634	746	895	727	250	375	284	149	149	332	400

Table 2.3-6
Mean Monthly Flows on the Broad River at Alston, South Carolina (Period of Data: 1980 to 2005)

	Monthly mean flows (cfs)											
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	—	—	—	—	—	—	—	—	—	4,891	4,402	3,776
1981	3,040	7,495	3,685	4,317	3,057	2,900	2,114	2,139	2,460	1,821	1,805	5,271
1982	14,630	12,200	7,269	5,992	5,035	5,724	3,549	3,888	1,740	2,142	2,782	8,292
1983	8,571	14,130	15,270	13,290	6,942	4,120	3,312	2,076	2,074	2,180	3,218	14,020
1984	11,100	14,210	13,040	11,120	12,550	4,920	6,516	6,579	2,532	—	—	—
1996	—	—	—	—	—	—	—	—	—	4,539	3,818	7,191
1997	7,862	10,880	10,980	7,763	6,370	4,903	4,815	2,445	2,064	3,115	4,121	6,391
1998	15,170	16,790	13,860	14,560	7,400	4,415	2,659	3,593	3,121	2,745	2,611	3,603
1999	6,620	6,746	4,356	3,985	3,736	2,265	2,077	1,147	1,042	3,128	2,408	2,895
2000	5,072	5,602	6,816	4,803	2,758	1,385	1,242	1,244	2,235	1,120	1,824	2,190
2001	2,517	2,537	7,171	4,063	1,783	2,167	2,084	1,023	1,434	1,059	1,276	1,894
2002	3,466	3,621	4,813	3,474	2,351	968	849	546	1,621	2,360	4,926	8,961
2003	3,814	8,244	18,890	18,040	14,830	8,909	8,006	9,795	3,710	2,999	3,655	4,519
2004	3,302	6,994	4,038	3,963	2,759	4,427	2,919	2,149	14,740	4,417	5,071	7,337
2005	5,008	5,432	10,020	7,429	3,805	6,115	8,130	4,017	1,926	—	—	—
Mean monthly flow	6,940	8,840	9,250	7,910	5,640	4,090	3,710	3,130	3,130	2,810	3,220	5,870
Maximum monthly flow	15,170	16,790	18,890	18,040	14,830	8,909	8,130	9,795	14,740	4,891	5,071	14,020
Minimum monthly flow	2,517	2,537	3,685	3,474	1,783	968	849	546	1,042	1,059	1,276	1,894
Maximum Daily flow	85,100	59,900	96,300	51,000	66,400	29,900	25,200	78,500	21,900	106,000	42,000	49,200
Minimum daily flow	1,040	1,060	1,100	1,090	1,120	242	327	156	48	541	838	991

Table 2.3-7 (Sheet 1 of 3)
Mean Monthly Flows on the Broad River at Carlisle, SC from 1938 to 2005

	Monthly mean flows (cfs)											
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1938	—	—	—	—	—	—	—	—	—	1,401	2,463	2,715
1939	3,252	9,948	7,025	3,554	3,171	2,193	2,429	4,520	1,488	1,309	1,236	1,574
1940	2,317	3,348	2,996	2,585	1,791	1,941	1,730	7,582	2,143	1,360	2,884	2,425
1941	2,501	1,887	2,843	2,940	1,509	1,647	8,092	2,507	1,386	1,038	1,395	2,845
1942	2,208	5,925	6,317	2,564	3,653	2,867	2,762	3,208	3,361	1,783	1,718	4,209
1943	8,375	4,828	5,243	4,681	3,237	3,441	6,001	2,614	1,879	1,436	1,952	2,141
1944	3,696	6,252	10,210	7,746	4,063	3,201	2,295	2,609	1,883	3,441	2,311	2,640
1945	3,031	4,926	4,052	3,735	2,803	1,547	3,373	2,261	9,885	2,292	2,264	7,549
1946	9,164	8,455	5,603	4,381	4,962	2,865	3,263	3,518	2,319	3,508	2,768	2,520
1947	7,874	3,249	4,548	3,775	2,455	3,568	2,605	2,003	1,642	4,911	7,507	3,498
1948	4,150	8,360	7,001	5,978	3,486	2,806	2,844	4,513	2,751	1,973	8,093	6,180
1949	5,492	6,373	4,244	5,629	5,468	3,561	4,931	9,495	5,329	6,926	5,559	3,627
1950	4,100	3,730	4,684	3,544	3,110	3,376	3,244	2,193	3,824	3,032	2,173	4,273
1951	2,480	3,455	4,596	4,532	2,474	2,480	2,006	1,739	1,794	1,175	1,801	6,105
1952	3,696	5,619	14,920	4,784	3,201	2,365	1,635	3,602	2,160	1,478	1,617	2,019
1953	4,837	7,793	6,413	3,094	3,677	2,587	1,572	1,288	2,318	1,248	1,263	3,921
1954	8,494	3,632	5,426	4,253	2,493	1,506	1,179	982	628	562	1,087	1,659
1955	1,997	4,330	2,433	4,699	3,457	1,836	2,424	1,621	892	1,546	1,374	1,271
1956	1,220	6,315	4,414	5,990	3,270	1,396	1,507	750	2,149	1,484	1,616	2,305
1957	2,216	5,048	4,822	5,582	3,056	4,205	1,653	1,782	2,679	3,339	8,651	4,413
1958	5,484	5,239	5,122	11,400	7,315	3,475	4,131	2,768	1,628	1,637	1,709	3,443
1959	3,696	3,613	4,305	5,950	4,639	4,177	3,695	2,627	4,493	9,120	3,945	4,468
1960	5,824	13,040	8,407	8,531	4,883	3,968	2,732	2,911	3,135	3,820	2,613	2,630
1961	3,635	8,702	5,690	7,608	4,390	6,013	3,740	4,932	2,561	1,830	2,392	7,503
1962	7,429	6,360	7,550	10,500	3,638	5,446	3,335	2,657	2,558	2,499	3,404	3,203

Table 2.3-7 (Sheet 2 of 3)
Mean Monthly Flows on the Broad River at Carlisle, SC from 1938 to 2005

	Monthly mean flows (cfs)											
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1963	4,855	4,107	11,680	3,643	4,235	3,213	2,659	1,711	1,840	1,601	1,798	2,634
1964	6,056	6,029	6,952	9,906	4,115	3,145	3,856	3,676	2,687	14,720	4,511	5,662
1965	4,174	6,555	8,913	6,794	4,052	4,913	5,599	3,521	2,179	3,154	2,418	2,189
1966	2,875	8,345	7,398	2,968	3,288	2,464	1,689	2,014	3,089	2,413	3,142	2,700
1967	3,654	4,115	3,251	2,149	2,601	3,647	4,775	7,226	2,727	2,241	2,374	7,546
1968	6,907	3,249	5,723	2,988	3,322	3,386	3,461	1,815	1,461	2,129	2,643	2,330
1969	3,110	6,766	6,318	7,730	3,256	3,454	2,183	3,643	4,212	2,688	3,089	4,857
1970	3,517	4,982	4,036	4,333	2,810	2,132	1,885	5,373	1,648	2,058	3,266	2,643
1971	3,890	8,033	6,542	3,935	5,688	2,480	2,951	3,297	2,968	7,076	5,302	6,953
1972	6,847	6,293	4,553	4,247	6,841	6,330	3,183	2,467	1,910	2,129	3,316	7,531
1973	5,379	9,095	9,708	9,573	6,929	6,763	3,472	3,132	3,061	2,682	2,276	4,311
1974	7,514	7,162	4,344	7,801	4,390	3,657	3,380	3,290	2,437	2,031	2,049	3,114
1975	7,184	6,549	13,070	5,205	8,534	6,435	4,324	2,622	5,021	5,873	4,413	3,765
1976	5,957	4,475	4,833	4,469	4,765	5,042	2,839	1,869	2,537	10,840	3,268	7,125
1977	4,542	2,954	7,377	7,354	2,956	2,507	1,782	1,808	3,769	3,031	5,509	3,644
1978	10,610	4,954	6,669	4,050	5,350	2,867	2,123	3,484	2,269	1,704	1,799	2,448
1979	5,597	8,865	8,033	7,423	5,063	4,141	3,559	2,409	3,712	4,955	5,338	3,414
1980	5,649	3,579	9,444	7,660	5,665	4,999	3,066	2,210	2,712	3,805	3,650	2,991
1981	2,400	4,376	2,685	2,900	2,310	2,151	1,561	1,220	1,417	1,184	1,263	2,960
1982	7,719	6,770	3,974	3,380	3,129	3,232	2,405	2,412	1,324	1,419	1,955	4,748
1983	4,451	7,512	8,407	7,999	4,666	3,030	2,388	1,609	1,548	1,836	2,405	7,498
1984	5,768	8,293	8,481	6,996	7,657	3,570	4,162	4,142	1,966	2,377	2,206	2,807
1985	3,168	6,404	2,858	2,481	2,004	1,453	1,763	4,375	1,651	—	—	—
1996	—	—	—	—	—	—	—	—	—	2,103	2,205	4,318
1997	4,108	5,601	6,415	5,079	3,963	3,239	2,478	1,634	1,462	2,049	2,257	3,376
1998	8,115	9,258	8,099	7,288	4,584	2,930	1,888	2,220	1,588	1,666	1,648	2,155

Table 2.3-7 (Sheet 3 of 3)
Mean Monthly Flows on the Broad River at Carlisle, SC from 1938 to 2005

	Monthly mean flows (cfs)											
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1999	3,740	3,700	2,638	2,627	2,244	1,518	1,412	722	693	1,733	1,473	1,797
2000	2,539	2,916	4,160	3,301	1,785	1,051	793	696	1,062	651	985	1,298
2001	1,393	1,546	3,865	2,421	1,314	1,364	1,533	783	1,046	743	815	1,150
2002	2,199	1,941	2,722	1,889	1,333	687	535	375	713	1,440	3,029	5,252
2003	2,885	4,783	10,600	11,660	10,220	6,281	5,396	6,678	2,772	2,309	2,897	3,446
2004	2,411	4,726	2,685	2,957	2,104	3,477	2,238	1,747	11,010	2,950	3,810	5,367
2005	3,686	3,381	6,119	4,743	2,783	3,615	5,800	2,854	1,486	—	—	—
Mean monthly flow	4,640	5,670	6,100	5,290	3,930	3,240	2,930	2,890	2,590	2,890	2,870	3,770
Maximum monthly flow	10,610	13,040	14,920	11,660	10,220	6,763	8,092	9,495	11,010	14,720	8,651	7,549
Minimum monthly flow	1,220	1,546	2,433	1,889	1,314	687	535	375	628	562	815	1,150
Maximum daily flow	62,800	54,000	70,400	57,400	50,400	41,000	31,200	85,500	71,200	114,000	55,600	36,500
Minimum daily flow	352	500	536	478	192	90	57	63	44	50	295	275

Table 2.3-8
Major Historic Floods and Peak flows in the Broad River near the Site

Date	Observed at Richtex[(a)] or Alston[(b)] Station		Estimated at Parr Shoals Dam[(c)]	
	Maximum Discharge (cfs)	Water Elevation (feet, NGVD29[(d)])	Maximum Discharge (cfs)	Water Elevation (feet, NGVD29[(d)])
October 3, 1929	228,000 [(a)]	215.54[(e)]	223,299	266.2
August 17, 1928	222,000 [(a)]	214.94[(e)]	217,423	266.1
April 8, 1936	157,000 [(a)]	209.80[(e)]	153,763	264.2
October 11, 1976	146,000 [(a)]	208.54	142,990	263.9
August 16, 1940	120,000 [(a)]	205.94	117,526	263.0
October 18,1964	102,000 [(a)]	204.14	99,897	262.4
October 18, 1932	101,000 [(a)]	204.04	98,918	262.4
October 14, 1990	119,000 [(b)]	238.81	118,006	263.0
March 3, 1987	108,000 [(b)]	237.51	107,098	262.7

(a) Recorded in Broad River at Richtex USGS gauging station No. 02161500 (drainage area: 4,850 square miles).
(b) Recorded in Broad River at Alston USGS gauging station No. 02161000 (drainage area: 4,790 square miles).
(c) Peak values at Parr Shoals Dam (drainage area: 4,750 square miles) are estimated based on drainage area ratios.
(d) At the VCSNS site the difference between the NGVD29 datum and the NAVD88 is –0.696 feet. For example, EL 425 feet NGVD29 is equivalent to EL 424.304 feet NAVD88
(e) Data obtained from the PSAR for the VCSNS unit 1 (SCE&G 1971).

Table 2.3-9
Flood Frequency Data for the Broad River at Parr Shoals Dam

Return Period (Year)	Exceedance Probability (%)	Peak Flood Discharge (cfs)
500.00	0.2	280,000
200.00	0.5	230,000
100.00	1.0	197,000
50.00	2.0	167,000
20.00	5.0	132,000
10.00	10.0	108,000
5.00	20.0	85,500
2.00	50.0	56,800
1.25	80.0	39,300
1.11	90.0	33,000
1.05	95.0	28,800
1.01	99.0	22,800

Table 2.3-10 (Sheet 1 of 2)
N-Day Low Flow Values for Broad River at Parr Shoals Dam

	N-day Low Flow Values (cfs)						
Year	3-day	7-day	10-day	30-day	60-day	183-day	365-day
1929	614	1,254	1,463	2,114	2,521	3,403	7,048
1930	792	947	1,061	1,412	2,012	2,787	3,923
1931	715	950	931	1,065	1,166	2,638	4,125
1932	1,355	1,678	2,029	1,808	2,173	3,508	5,494
1933	1,123	1,606	1,612	2,085	2,170	3,146	3,946
1934	927	1,773	1,848	2,500	3,475	4,778	4,906
1935	622	1,254	1,331	1,732	2,394	3,870	4,942
1936	2,158	2,707	2,640	3,260	3,774	5,394	7,793
1937	1,466	1,806	1,912	2,842	3,450	4,478	5,196
1938	1,250	1,614	1,544	1,727	1,988	3,451	4,216
1939	798	1,174	1,219	1,404	1,591	2,746	3,184
1940	1,010	1,202	1,207	1,461	1,841	3,004	3,639
1941	658	880	915	1,152	1,426	2,663	3,782
1942	1,414	1,644	1,808	2,102	2,340	3,501	4,794
1943	1,365	1,715	1,728	1,858	2,115	3,322	4,905
1944	1,515	1,570	1,667	1,984	2,592	3,263	4,169
1945	1,952	2,212	2,280	2,675	2,969	4,909	5,221
1946	1,356	1,669	1,653	2,135	2,323	3,641	5,036
1947	1,544	1,757	1,725	2,136	2,333	3,361	4,936
1948	2,004	2,392	2,363	2,553	3,094	4,224	6,539
1949	1,655	2,199	2,191	2,777	3,534	4,195	5,213
1950	1,170	1,251	1,333	1,935	2,215	3,325	3,788
1951	1,095	1,158	1,290	1,576	1,980	2,387	3,455
1952	1,123	1,203	1,341	1,653	1,818	2,725	4,505
1953	545	625	617	752	994	2,253	4,502
1954	399	580	573	633	712	1,390	2,694
1955	518	633	678	961	1,070	1,894	3,335
1956	851	1,212	1,345	1,746	2,023	2,034	3,674
1957	1,998	2,114	2,165	2,413	2,918	3,629	4,254
1958	1,792	2,073	2,081	2,264	2,344	3,285	4,794
1959	2,559	2,867	3,113	3,543	3,814	5,994	5,605
1960	2,282	2,374	2,760	3,235	3,524	4,018	6,107
1961	1,890	2,155	2,161	2,237	2,430	4,451	6,472
1962	1,355	1,539	1,637	1,797	1,959	3,514	5,706
1963	1,560	1,770	1,745	1,905	2,264	2,827	5,217
1964	2,148	2,454	2,554	2,878	3,708	6,705	7,400
1965	1,479	1,570	1,634	2,149	2,365	3,554	4,992
1966	1,671	1,887	2,055	2,672	3,081	3,241	3,899

Table 2.3-10 (Sheet 2 of 2)
N-Day Low Flow Values for Broad River at Parr Shoals Dam

	N-day Low Flow Values (cfs)						
Year	3-day	7-day	10-day	30-day	60-day	183-day	365-day
1967	1,332	1,437	1,464	1,793	1,984	4,303	4,805
1968	1,254	1,336	1,364	1,543	1,728	2,868	4,525
1969	1,031	1,302	1,283	1,591	2,082	3,721	4,580
1970	1,087	1,161	1,207	1,420	1,692	2,940	4,375
1971	2,115	2,247	2,332	2,498	3,644	4,812	6,111
1972	2,119	2,219	2,222	2,410	2,645	4,775	6,461
1973	2,693	2,751	2,779	2,934	3,142	4,682	6,350
1974	2,364	2,471	2,488	2,562	2,760	3,997	6,047
1975	1,890	1,987	2,054	2,340	2,691	5,084	6,075
1976	1,639	1,761	1,875	2,022	2,115	4,759	6,088
1977	405	1,185	1,417	2,130	3,306	3,231	5,473
1978	1,054	1,284	1,434	1,949	2,075	3,026	4,930
1979	1,234	1,581	1,969	2,273	2,471	5,043	6,636
1980	975	1,193	1,300	1,914	2,097	3,142	4,178
1981	901	967	1,141	1,317	1,787	2,284	3,406
1982	1,290	1,482	1,489	1,831	2,047	3,388	5,612
1983	1,083	1,519	1,717	1,930	1,967	2,790	6,796
1984	1,230	1,638	1,700	2,000	2,153	3,321	3,995
1985	833	894	1,025	1,169	1,409	2,671	4,204
1986	1,088	1,118	1,160	1,717	2,044	2,985	3,702
1987	787	790	795	1,010	1,123	2,116	3,075
1988	1,114	1,118	1,122	1,439	1,344	1,566	2,388
1989	1,292	1,407	1,527	2,078	2,246	3,652	4,218
1990	1,299	1,487	1,559	2,008	2,406	3,354	6,068
1991	1,249	1,748	1,802	2,164	2,322	3,062	4,605
1992	1,372	1,662	1,886	2,079	2,222	4,726	4,666
1993	1,345	1,354	1,379	1,776	1,961	2,594	4,305
1994	1,616	1,864	2,006	2,539	3,185	5,143	5,370
1995	1,636	1,905	2,111	2,462	2,996	4,805	7,437
1996	1,144	1,418	1,525	1,699	2,193	3,824	5,900
1997	1,240	1,655	1,681	2,064	1,922	3,348	5,699
1998	591	727	760	959	1,030	2,355	3,364
1999	599	681	783	1,054	1,086	1,957	3,061
2000	512	527	554	850	1,198	1,467	2,418
2001	175	198	250	475	572	1,405	2,078
2002	784	1,018	1,072	1,633	1,098	1,354	2,131
Minimum	175	198	250	475	572	1,354	2,078

Source: USGS 2006a

Table 2.3-11
Daily Average Water Temperature versus Depth Data at Monticello Reservoir Circulating Water Intake Station for Summer of 1994

	Temperature (°F)					
Depth (feet)	Jun (6/2/94)	Jun (6/30/94)	Jul (7/21/94)	Aug (8/17/94)	Aug (8/25/94)	Sep (9/8/94)
0.5	78.1	83.0	84.8	81.4	83.5	81.1
3.8	75.5	82.8	82.4	81.4	82.8	80.6
6.9	74.3	80.0	82.4	81.4	82.3	79.4
10.2	73.6	79.6	82.2	81.4	82.1	79.2
13.1	72.7	79.4	82.1	81.4	81.9	79.1
16.2	72.7	—	82.1	81.4	81.7	78.8
20.0	72.5	79.2	81.7	81.2	81.7	78.9
23.4	72.2	79.2	81.7	81.2	81.7	78.8
26.7	71.6	79.0	81.7	81.2	81.5	78.8
30.0	71.2	79.0	81.2	81.2	81.4	78.8
33.1	70.8	79.0	81.2	81.2	81.2	78.8
36.4	70.6	78.9	81.2	81.2	81.1	78.7
39.7	70.1	78.5	81.2	81.2	81.2	78.8
42.8	69.9	78.5	81.2	81.2	81.2	78.7
46.2	69.6	78.1	80.9	81.2	80.6	78.7
49.5	69.1	77.7	80.6	81.2	80.4	78.5
52.6	68.9	77.0	80.3	81.2	80.3	78.4
56.0	68.9	76.3	80.0	81.2	80.1	78.4
59.1	68.5	76.1	79.7	81.0	79.4	78.0
62.4	68.2	75.8	79.6	81.0	78.8	77.9
65.7	68.0	74.3	79.4	81.0	78.8	77.6
68.9	66.9	73.6	79.4	80.8	78.5	77.4
72.2	66.5	72.7	78.7	80.6	78.3	77.1
75.3	66.5	71.1	76.9	79.4	78.1	76.7
78.8	66.5	69.5	75.7	78.8	77.9	76.4
81.8	63.3	68.9	73.2	74.8	77.8	75.0
85.2	—	64.4	71.1	68.0	76.2	—
88.5	—	59.4	63.2	60.1	61.6	70
91.9	—	58.0	58.8	59.9	60.3	—

Table 2.3-12 (Sheet 1 of 4)
Monthly Water Temperature Data versus Depth at Three Stations in Monticello Reservoir for Year 1995

Depth (feet)	Temperature (°F) Jan (1/25/95)	Feb (2/22/95)	Mar (3/24/95)	Apr	May (5/22/95)	Jun (6/21/95)	Jul (7/21/95)	Aug (8/25/95)	Sep (9/20/95)	Oct (10/26/95)	Nov (11/20/95)	Dec (12/13/95)
Uplake 16												
0.0	52.0	49.3	64.3	—	76.0	79.2	88.6	84.8	80.5	73.4	63.7	59.0
3.3	51.8	49.1	62.8	—	75.6	78.8	88.2	84.8	80.3	72.9	62.8	58.1
6.6	51.1	49.0	62.3	—	75.2	78.7	87.5	84.8	79.9	72.5	62.6	57.6
9.8	51.1	48.2	61.9	—	74.9	78.5	87.1	84.8	79.9	72.5	62.5	57.2
13.1	51.1	48.1	61.7	—	73.8	77.6	86.9	84.8	79.7	72.5	62.3	57.2
16.4	51.1	48.1	61.6	—	72.2	77.4	86.6	84.6	79.7	72.5	62.1	57.2
19.7	50.9	48.1	61.6	—	71.8	76.5	82.3	84.6	79.7	72.4	61.9	57.2
23.0	50.9	48.1	61.4	—	71.3	76.1	81.9	84.6	79.7	72.4	61.7	56.3
26.2	50.9	48.1	56.9	—	70.9	75.8	81.5	84.2	79.7	72.2	61.4	56.3
29.5	50.9	48.1	55.6	—	70.6	75.8	81.4	84.2	79.7	72.0	61.4	56.3
32.8	50.9	48.1	54.0	—	69.8	75.6	81.2	84.2	79.7	72.0	61.2	56.3
36.1	50.9	47.9	53.5	—	69.3	75.4	81.2	84.2	79.7	72.0	61.2	56.3
39.4	50.9	47.9	52.9	—	69.5	75.4	80.6	84.2	79.7	71.8	61.0	56.3
42.7	50.9	47.9	52.4	—	69.1	75.2	80.6	84.2	79.7	71.8	61.0	55.9
45.9	50.9	47.9	52.2	—	68.9	75.2	80.5	84.2	79.7	71.8	61.0	55.9
49.2	50.9	47.9	52.2	—	68.9	75.2	80.1	84.1	79.7	71.8	61.0	55.9
52.5	50.8	47.9	52.0	—	68.8	75.1	79.9	84.1	79.7	71.6	60.8	55.8
55.8	50.6	47.9	51.8	—	68.4	75.1	79.9	83.9	79.7	71.6	60.8	55.8
59.1	50.6	47.9	—	—	68.2	74.9	79.7	83.9	79.7	71.6	60.8	55.8
62.3	50.4	47.9	—	—	67.9	74.5	79.6	83.7	79.7	71.5	60.5	55.8
65.6	50.2	47.9	—	—	67.5	74.2	—	83.5	79.4	71.5	60.1	55.8
68.9	—	47.7	—	—	67.1	73.8	—	83.5	79.4	71.1	59.9	55.8
72.2	—	47.7	—	—	66.8	73.1	—	83.3	79.2	70.2	—	55.8

Table 2.3-12 (Sheet 2 of 4)
Monthly Water Temperature Data versus Depth at Three Stations in Monticello Reservoir for Year 1995

	Temperature (°F)											
Depth (feet)	Jan (1/25/95)	Feb (2/22/95)	Mar (3/24/95)	Apr	May (5/22/95)	Jun (6/21/95)	Jul (7/21/95)	Aug (8/25/95)	Sep (9/20/95)	Oct (10/26/95)	Nov (11/20/95)	Dec (12/13/95)
Uplake 16 (continued)												
75.5	—	47.7	—	—	65.7	71.8	—	83.2	79.0	69.8	—	55.8
78.7	—	—	—	—	64.8	70.7	—	82.8	79.0	69.3	—	55.8
82.0	—	—	—	—	63.4	68.6	—	—	—	69.1	—	55.8
85.3	—	—	—	—	60.7	—	—	—	—	—	—	55.8
Intake 2												
0.0	51.3	50.2	64.4	—	75.8	76.0	83.3	84.4	81.4	72.7	61.4	57.2
3.3	50.9	49.0	61.7	—	75.2	75.6	82.6	84.2	81.2	72.7	61.2	57.2
6.6	50.8	49.0	61.2	—	74.0	75.2	82.3	84.2	81.0	72.7	61.2	57.2
9.8	50.6	49.0	60.8	—	73.6	75.2	82.3	84.2	80.8	72.5	61.2	56.8
13.1	50.4	49.0	60.3	—	72.5	75.2	82.3	84.2	80.6	72.2	61.2	56.8
16.4	50.2	49.0	60.1	—	71.8	75.2	82.1	84.2	80.6	72.2	61.2	56.8
19.7	50.2	49.0	59.4	—	71.3	75.1	82.1	84.2	80.6	72.0	61.2	56.8
23.0	50.2	49.0	58.9	—	71.1	75.1	82.1	84.2	80.5	72.0	61.2	56.3
26.2	50.2	49.0	58.3	—	70.7	75.1	81.9	84.2	80.5	72.0	61.2	56.3
29.5	50.2	49.0	58.0	—	69.8	75.1	81.9	84.2	80.5	72.0	61.2	56.3
32.8	50.2	49.0	57.8	—	69.7	75.1	81.9	84.2	80.5	71.8	61.2	56.3
36.1	50.2	48.8	57.2	—	69.5	75.1	81.7	84.2	80.5	71.8	61.2	56.3
39.4	50.2	49.0	56.3	—	69.3	74.9	81.2	84.2	80.5	71.8	61.2	56.3
42.7	50.2	49.0	55.4	—	69.1	74.9	81.0	84.2	80.5	71.8	61.2	55.9
45.9	50.2	49.0	54.5	—	68.8	74.9	80.8	84.2	80.5	71.5	61.0	55.8
49.2	50.2	48.8	53.8	—	68.6	74.9	80.5	84.2	80.5	70.9	61.2	55.8
52.5	50.2	49.0	52.2	—	68.4	74.9	80.1	84.2	80.5	70.7	61.0	55.6
55.8	50.2	48.8	51.1	—	68.2	74.9	79.9	84.2	80.5	70.7	61.0	55.4
59.1	50.2	48.8	50.4	—	68.0	74.9	78.8	84.2	80.5	70.6	61.0	55.4

Table 2.3-12 (Sheet 3 of 4)
Monthly Water Temperature Data versus Depth at Three Stations in Monticello Reservoir for Year 1995

	Temperature (°F)											
Depth (feet)	Jan (1/25/95)	Feb (2/22/95)	Mar (3/24/95)	Apr	May (5/22/95)	Jun (6/21/95)	Jul (7/21/95)	Aug (8/25/95)	Sep (9/20/95)	Oct (10/26/95)	Nov (11/20/95)	Dec (12/13/95)
Intake 2 (continued)												
62.3	50.2	48.8	50.0	—	68.0	74.9	78.7	84.2	80.3	70.6	60.8	55.4
65.6	50.2	48.8	49.9	—	67.7	74.9	78.3	—	80.1	70.6	60.5	—
68.9	50.0	48.8	49.9	—	66.4	74.9	78.1	—	79.9	70.4	59.9	—
72.2	50.0	—	49.9	—	66.1	74.7	76.5	—	79.7	70.4	59.8	—
75.5	49.9	—	47.7	—	64.4	—	76.1	—	79.4	70.2	59.2	—
78.7	49.5	—	47.7	—	62.8	—	75.8	—	78.8	70.2	59.0	—
82.0	—	—	47.7	—	—	—	74.5	—	78.7	—	—	—
85.3	—	—	47.7	—	—	—	68.8	—	78.5	—	—	—
88.6	—	—	47.7	—	—	—	—	—	—	—	—	—
Discharge 6												
0.0	65.9	54.7	73.1	—	—	89.6	92.2	98.8	92.2	86.8	72.4	73.4
3.3	59.6	50.4	68.0	—	75.8	81.2	90.0	92.5	86.2	76.7	66.4	60.8
6.6	53.1	49.9	60.1	—	74.0	76.3	83.0	86.5	81.4	73.3	61.6	57.2
9.8	52.7	49.5	59.8	—	73.8	76.3	82.6	86.2	81.2	72.7	61.6	57.2
13.1	52.6	49.1	59.8	—	72.7	76.1	82.4	85.0	81.0	72.7	61.6	57.2
16.4	52.4	49.1	59.8	—	72.4	76.0	82.4	85.0	81.0	72.7	61.6	57.2
19.7	52.4	49.0	59.0	—	72.2	76.0	82.1	85.0	80.8	72.5	61.6	57.2
23.0	52.4	49.0	58.3	—	71.8	75.8	82.1	84.8	80.8	72.5	61.6	57.2
26.2	52.0	49.0	57.8	—	71.3	75.8	81.9	84.8	80.6	72.4	61.4	57.2
29.5	51.8	49.0	57.1	—	70.9	75.6	81.9	84.8	80.6	72.2	61.4	57.2
32.8	51.8	49.0	56.5	—	70.2	75.6	81.9	84.8	80.6	72.2	61.0	57.0
36.1	81.8	48.8	55.8	—	69.8	75.4	81.7	84.6	80.6	72.2	60.8	57.0
39.4	51.7	48.8	54.4	—	69.7	75.4	81.5	84.6	80.5	72.0	60.5	57.0
42.7	51.5	48.6	53.5	—	69.5	75.4	81.4	84.6	80.5	72.0	60.3	57.0

Table 2.3-12 (Sheet 4 of 4)
Monthly Water Temperature Data versus Depth at Three Stations in Monticello Reservoir for Year 1995

	Temperature (°F)											
Depth (feet)	Jan (1/25/95)	Feb (2/22/95)	Mar (3/24/95)	Apr	May (5/22/95)	Jun (6/21/95)	Jul (7/21/95)	Aug (8/25/95)	Sep (9/20/95)	Oct (10/26/95)	Nov (11/20/95)	Dec (12/13/95)
Discharge 6 (continued)												
45.9	51.5	48.8	52.7	—	69.1	75.2	81.2	84.4	80.1	71.8	30.1	57.0
49.2	51.3	48.6	52.6	—	68.8	75.1	81.0	—	80.1	71.8	59.8	57.0
52.5	51.1	—	—	—	—	—	80.8	—	79.9	71.6	—	57.0
55.8	51.1	—	—	—	—	—	80.6	—	79.7	71.6	—	57.0
59.1	50.9	—	—	—	—	—	79.9	—	79.6	71.5	—	56.8
62.3	50.9	—	—	—	—	—	79.6	—	79.6	71.5	—	56.8
65.6	—	—	—	—	—	—	—	—	79.6	71.1	—	56.3
68.9	—	—	—	—	—	—	—	—	—	—	—	56.3

Table 2.3-13 (Sheet 1 of 4)
Monthly Water Temperature Data versus Depth at Three Stations in Monticello Reservoir for Year 1996

	Temperature (°F)											
Depth (feet)	Jan (1/26/96)	Feb (2/22/96)	Mar (3/22/96)	Apr (4/18/96)	May (5/22/96)	Jun (6/19/96)	Jul (7/22/96)	Aug (8/27/96)	Sep (9/26/96)	Oct (10/24/96)	Nov (11/20/96)	Dec (12/17/96)
Uplake 16												
0.0	48.6	55.3	52.9	65.7	81.0	86.2	85.5	85.3	80.1	70.9	63.4	56.5
3.3	48.6	53.3	52.9	64.8	80.8	86.0	85.5	84.6	79.7	70.7	63.4	56.3
6.6	48.6	50.6	52.6	63.7	80.1	85.5	85.3	84.1	79.4	70.6	62.8	56.3
9.8	48.6	50.0	52.6	62.6	72.0	85.3	85.3	83.9	79.2	70.6	62.1	56.3
13.1	48.6	49.7	52.0	61.4	69.5	83.5	84.8	83.9	79.2	70.6	61.9	56.3
16.4	48.6	49.7	52.0	60.5	68.8	77.6	84.1	83.9	79.0	70.6	61.9	56.3
19.7	48.6	49.7	52.0	59.9	68.0	76.5	84.1	83.7	79.0	70.6	61.7	56.3
23.0	48.6	49.5	51.8	59.4	67.7	76.0	83.5	83.7	78.7	70.4	61.7	56.3
26.2	48.4	49.1	51.8	58.3	67.5	75.4	82.4	83.2	78.5	70.6	61.6	56.3
29.5	48.4	49.0	51.8	57.6	67.1	75.1	81.7	82.6	78.5	70.4	61.4	56.3
32.8	48.4	48.6	51.8	57.2	66.8	74.9	81.4	82.4	78.5	70.4	61.4	56.2
36.1	48.4	48.2	51.8	56.7	66.6	74.7	81.0	82.3	78.5	70.2	61.2	56.0
39.4	48.4	47.9	51.8	56.3	66.2	74.5	80.8	82.3	78.3	70.0	61.2	55.6
42.7	48.4	47.7	51.8	56.0	65.9	74.3	80.6	82.1	78.3	69.8	61.0	55.6
45.9	48.4	47.7	51.8	55.4	65.7	74.0	80.6	82.1	78.3	68.8	61.0	55.6
49.2	48.4	47.7	51.8	55.1	65.3	73.6	80.5	82.1	78.1	69.8	61.0	55.6
52.5	48.4	47.7	51.8	54.7	65.0	73.3	80.5	82.1	78.1	69.7	61.0	55.6
55.8	48.2	47.5	51.7	54.5	64.6	73.1	80.3	81.9	78.1	69.7	61.0	55.6
59.1	48.2	47.5	51.3	54.4	64.4	72.5	80.1	81.9	78.1	69.7	61.0	55.6
62.3	48.2	47.5	51.1	54.0	63.9	72.4	79.9	81.9	77.9	69.7	61.0	55.4
65.6	48.1	47.3	50.8	53.8	63.5	72.0	79.9	81.9	77.8	69.7	60.8	55.3
68.9	47.7	47.3	50.2	53.5	62.6	71.5	79.7	81.7	77.6	69.5	60.8	55.1
72.2	47.5	47.3	50.0	53.1	61.9	70.9	79.6	81.5	77.4	69.1	60.8	55.1

Table 2.3-13 (Sheet 2 of 4)
Monthly Water Temperature Data versus Depth at Three Stations in Monticello Reservoir for Year 1996

	Temperature (°F)											
Depth (feet)	Jan (1/26/96)	Feb (2/22/96)	Mar (3/22/96)	Apr (4/18/96)	May (5/22/96)	Jun (6/19/96)	Jul (7/22/96)	Aug (8/27/96)	Sep (9/26/96)	Oct (10/24/96)	Nov (11/20/96)	Dec (12/17/96)
Uplake 16 (continued)												
75.5	47.3	47.2	49.9	52.7	60.3	69.5	79.6	81.4	77.0	68.8	60.8	54.9
78.7	47.3	47.2	49.7	52.4	58.0	67.7	79.4	—	76.9	68.6	60.8	54.7
82.0	47.3	—	49.7	52.4	—	65.9	78.7	—	—	68.8	60.8	54.7
Intake 2												
0.0	46.8	—	51.7	61.0	70.4	81.5	82.6	82.8	78.3	68.9	61.2	56.0
3.3	47.0	48.8	51.5	60.1	70.0	79.2	82.6	82.4	78.3	68.9	61.2	55.6
6.6	46.8	48.8	51.3	59.8	70.0	78.3	82.6	82.4	78.3	68.8	61.2	55.3
9.8	46.6	48.6	51.1	59.6	69.3	77.6	82.6	82.4	78.3	68.8	61.2	54.9
13.1	46.6	48.6	51.1	59.2	69.1	77.6	82.6	82.3	78.3	68.8	61.2	54.5
16.4	46.6	48.6	51.1	59.0	69.1	77.6	82.4	82.3	78.3	68.8	61.2	54.5
19.7	46.6	48.4	51.1	58.9	—	77.6	82.4	82.3	78.3	68.8	61.0	54.4
23.0	46.4	48.2	51.1	58.9	68.9	77.6	82.4	82.3	78.3	68.8	61.0	54.4
26.2	46.4	48.2	51.1	58.7	68.9	77.4	82.3	82.3	78.3	68.6	61.0	54.4
29.5	46.6	48.2	50.9	58.3	68.9	77.4	82.3	82.3	78.3	68.6	61.0	54.2
32.8	46.6	48.2	50.8	58.1	68.8	77.2	82.3	82.3	78.3	68.6	61.0	54.2
36.1	46.4	48.2	50.8	57.6	68.2	77.0	82.3	82.3	78.3	68.6	61.0	54.2
39.4	46.4	48.1	50.8	57.6	67.3	77.0	82.3	82.3	78.1	68.6	61.0	54.0
42.7	46.4	48.1	50.8	57.4	67.0	74.7	82.1	82.1	77.9	68.6	61.0	53.6
45.9	46.4	47.9	50.8	55.8	65.0	73.3	81.9	82.1	77.8	68.6	61.0	53.6
49.2	46.3	47.9	50.8	54.2	63.5	72.5	81.9	82.1	77.8	68.4	61.0	53.6
52.5	46.3	47.9	50.8	53.6	63.0	71.3	81.9	82.1	77.8	—	61.0	53.6
55.8	46.3	47.9	50.6	52.9	62.8	70.9	81.9	82.1	77.8	68.2	61.0	53.5
59.1	46.3	47.9	50.6	52.7	62.6	70.4	81.9	82.1	77.6	68.2	60.8	53.5
62.3	46.3	47.7	50.6	52.2	61.7	69.7	81.7	82.1	77.6	68.2	60.5	53.5

Table 2.3-13 (Sheet 3 of 4)
Monthly Water Temperature Data versus Depth at Three Stations in Monticello Reservoir for Year 1996

	Temperature (°F)											
Depth (feet)	Jan (1/26/96)	Feb (2/22/96)	Mar (3/22/96)	Apr (4/18/96)	May (5/22/96)	Jun (6/19/96)	Jul (7/22/96)	Aug (8/27/96)	Sep (9/26/96)	Oct (10/24/96)	Nov (11/20/96)	Dec (12/17/96)
Intake 2 (continued)												
65.6	46.3	47.7	50.6	52.0	61.7	69.7	81.7	81.9	77.6	68.0	60.5	53.5
68.9	46.3	47.7	50.6	51.8	61.7	69.1	81.7	81.9	77.2	67.7	60.3	53.3
—	—	—	—	—	—	—	—	—	—	—	—	—
72.2	46.1	47.7	50.6	51.8	61.7	67.9	81.7	81.9	77.0	67.5	59.9	53.3
75.5	46.1	47.7	50.4	51.7	61.0	66.4	80.8	81.5	77.0	—	59.2	53.1
78.7	46.1	47.7	50.6	51.5	56.3	65.5	73.3	81.4	77.0	67.5	58.9	53.1
82.0	46.1	47.5	50.6	51.5	54.0	63.0	67.5	79.4	76.7	67.5	58.7	53.1
85.3	46.1	47.3	50.4	51.5		59.9	61.0		76.5	67.3		53.1
88.6	46.1	—	—	—	—	—	—	—	—	—	—	—
Discharge 6												
0.0	60.3	61.7	64.6	63.4	77.2	92.3	95.2	93.6	94.0	82.8	73.1	64.8
3.3	54.2	56.0	60.8	61.9	77.2	83.5	88.4	89.6	83.2	74.7	67.0	61.2
6.6	48.2	48.8	53.1	59.8	76.9	78.5	83.5	83.3	79.4	69.8	61.9	56.2
9.8	48.1	48.2	52.6	59.2	76.5	78.1	83.2	83.2	79.0	69.7	61.7	56.0
13.1	47.9	48.2	52.6	59.0	74.9	77.6	82.8	83.0	78.8	69.7	61.6	55.8
16.4	47.7	48.2	52.4	58.7	72.4	77.4	82.8	83.0	78.7	69.7	61.6	55.8
19.7	47.7	48.1	52.4	58.3	70.7	77.2	82.4	82.8	78.5	69.7	61.6	55.6
23.0	47.5	48.1	52.4	58.1	69.7	76.9	82.3	82.8	78.5	69.7	61.6	55.6
26.2	47.5	48.1	52.4	58.0	68.9	76.1	81.7	82.8	78.5	69.7	61.6	54.9
29.5	47.3	48.1	50.2	57.6	68.6	76.0	81.5	82.6	78.5	69.5	61.6	54.7
32.8	47.3	47.9	50.2	57.4	68.0	75.6	81.4	82.6	78.3	69.5	61.6	54.7
36.1	47.3	47.9	50.2	57.2	67.5	75.2	81.2	82.6	78.3	69.5	61.6	54.5
39.4	47.3	47.7	51.8	57.1	—	75.2	81.2	82.3	78.3	69.5	61.6	54.5
42.7	47.3	47.7	51.3	—	—	75.1	81.0	82.3	78.3	69.5	61.6	54.4

Table 2.3-13 (Sheet 4 of 4)
Monthly Water Temperature Data versus Depth at Three Stations in Monticello Reservoir for Year 1996

	Temperature (°F)											
Depth (feet)	Jan (1/26/96)	Feb (2/22/96)	Mar (3/22/96)	Apr (4/18/96)	May (5/22/96)	Jun (6/19/96)	Jul (7/22/96)	Aug (8/27/96)	Sep (9/26/96)	Oct (10/24/96)	Nov (11/20/96)	Dec (12/17/96)
Discharge 6 (continued)												
45.9	47.3	47.7	50.9	—	—	74.9	81.0	82.3	78.1	69.5	—	54.4
49.2	47.3	47.5	50.9	—	—	74.9	80.6	—	—	—	—	54.4
52.5	47.3	—	50.8	—	—	—	80.5	—	—	—	—	54.4
55.8	47.2	—	50.6	—	—	—	—	—	—	—	—	54.4
59.1	—	—	50.6	—	—	—	—	—	—	—	—	54.4
62.3	—	—	50.6	—	—	—	—	—	—	—	—	54.2
65.6	—	—	—	—	—	—	—	—	—	—	—	54.4

Table 2.3-14 (Sheet 1 of 3)
Monthly Water Temperature Data versus Depth at Three Stations in Monticello Reservoir for Year 2006

Depth (feet)	Temperature (°F)											
	Jan (1/4/06)	Feb (2/22/06)	Mar (3/29/06)	Apr (4/21/06)	May	Jun (6/8/06)	Jul (7/5/06)	Aug (8/30/06)	Sep	Oct (10/18/06)	Nov (11/10/06)	Dec (12/11/06)
Uplake 16												
0.0	53.2	56.1	59.1	71.4	—	78.7	87.2	87.3	—	72.7	65.2	57.7
3.3	53.0	56.0	58.7	71.8	—	78.6	87.2	87.3	—	73.1	64.9	57.9
6.6	52.9	54.9	58.0	71.4	—	78.2	87.2	87.2	—	73.2	64.5	57.2
9.8	52.8	53.4	57.8	70.3	—	77.8	87.0	87.2	—	73.2	64.1	56.7
13.1	52.7	53.3	57.7	69.9	—	77.2	86.8	87.2	—	73.1	63.9	56.6
16.4	52.0	53.2	57.6	68.6	—	77.1	86.8	87.1	—	73.1	63.8	56.5
19.7	51.4	53.0	57.3	67.9	—	76.8	86.6	86.6	—	73.1	63.8	56.5
23.0	51.1	52.8	57.1	65.3	—	76.7	83.4	85.6	—	73.1	63.8	56.4
26.2	50.7	52.1	56.8	64.5	—	76.1	81.3	85.0	—	73.1	63.8	56.4
29.5	50.5	51.5	56.6	64.0	—	75.3	80.9	84.5	—	73.1	63.8	56.2
32.8	50.2	51.5	56.6	63.4	—	74.9	80.5	84.5	—	73.1	63.7	56.1
36.1	50.1	51.1	56.3	63.2	—	72.4	80.4	84.3	—	73.1	63.7	56.0
39.4	50.1	50.9	55.8	62.9	—	74.2	80.2	84.2	—	73.0	63.7	55.9
42.7	49.8	50.6	55.8	62.6	—	74.0	80.1	84.1	—	73.0	63.7	55.9
45.9	49.6	50.5	55.5	62.3	—	73.9	80.0	84.0	—	73.0	63.7	55.9
49.2	49.5	50.4	55.4	61.9	—	73.7	79.8	84.0	—	73.0	63.7	55.9
52.5	49.4	50.2	55.3	61.6	—	73.6	79.7	83.9	—	73.0	63.7	55.9
55.8	49.4	50.2	55.3	61.3	—	73.5	79.6	83.9	—	73.0	63.7	55.9
59.1	49.3	50.1	55.2	61.1	—	73.5	79.4	83.8	—	73.0	63.6	55.8
62.3	49.3	50.1	55.2	60.8	—	73.4	79.3	83.7	—	72.9	63.6	55.8
65.6	49.3	50.1	55.1	60.3	—	73.3	79.2	83.7	—	72.8	63.6	55.8
68.9	49.3	50.1	55.0	60.1	—	73.1	79.0	83.6	—	72.8	63.5	55.8
72.2	49.3	50.0	55.0	59.9	—	72.9	78.8	83.5	—	—	63.5	55.7

Table 2.3-14 (Sheet 2 of 3)
Monthly Water Temperature Data versus Depth at Three Stations in Monticello Reservoir for Year 2006

Depth (feet)	Temperature (°F) Jan (1/4/06)	Feb (2/22/06)	Mar (3/29/06)	Apr (4/21/06)	May	Jun (6/8/06)	Jul (7/5/06)	Aug (8/30/06)	Sep	Oct (10/18/06)	Nov (11/10/06)	Dec (12/11/06)
Uplake 16 (continued)												
75.5	49.3	50.0	55.0	59.5	—		78.5	83.4	—	—	63.5	55.7
78.7	49.2	50.0	54.9	59.3	—	—	78.3	83.4	—	—	63.5	55.7
82.0	—	—	54.9	58.9	—	—	77.8	83.2	—	—	63.6	55.7
85.3	—	—	—	—	—	—	76.7	—	—	—	—	—
Intake 2												
0.0	52.6	51.5	56.1	71.9	—	74.9	81.8	84.3	—	73.2	64.4	—
3.3	52.5	51.4	56.0	71.9	—	74.9	81.4	84.2	—	73.2	64.0	56.8
6.6	52.4	51.6	55.6	70.0	—	74.9	81.4	84.2	—	73.2	63.7	56.0
9.8	52.3	49.9	55.5	68.4	—	74.9	81.2	84.1	—	73.1	63.5	55.8
13.1	51.7	49.7	55.3	67.2	—	74.9	81.2	84.1	—	73.1	63.4	55.8
16.4	51.2	49.7	55.2	66.3	—	74.9	81.2	84.1	—	73.1	63.4	55.7
19.7	50.8	49.7	55.2	64.9	—	74.9	81.2	84.1	—	73.1	63.4	55.7
23.0	50.3	49.6	55.1	64.5	—	74.9	81.1	84.1	—	73.1	63.4	55.7
26.2	50.3	49.6	55.1	63.8	—	74.9	81.1	84.1	—	73.1	63.4	55.6
29.5	50.2	49.5	54.9	63.5	—	74.9	81.1	84.1	—	73.1	63.4	55.6
32.8	50.2	49.4	54.8	62.7	—	74.9	81.0	84.1	—	73.1	63.3	55.5
36.1	50.2	449.3	54.8	62.5	—	74.9	80.9	84.1	—	73.1	63.3	55.4
39.4	50.2	49.3	54.8	62.2	—	74.9	80.9	84.1	—	73.1	63.3	55.4
42.7	50.2	49.2	54.7	61.6	—	74.9	80.9	84.1	—	73.1	63.3	55.3
45.9	50.1	49.1	54.7	61.1	—	74.9	80.9	84.1	—	73.1	63.3	55.3
49.2	50.1	49.1	54.7	60.9	—	74.8	80.8	84.1	—	73.1	63.3	55.3
52.5	50.1	49.0	54.7	60.6	—	74.8	80.8	84.1	—	73.1	63.3	55.3
55.8	50.0	48.9	54.7	60.3	—	74.7	80.6	84.1	—	73.1	63.3	55.2
59.1	49.9	48.8	54.7	60.1	—	74.7	80.4	84.1	—	73.1	63.1	55.1

Table 2.3-14 (Sheet 3 of 3)
Monthly Water Temperature Data versus Depth at Three Stations in Monticello Reservoir for Year 2006

	Temperature (°F)											
Depth (feet)	Jan (1/4/06)	Feb (2/22/06)	Mar (3/29/06)	Apr (4/21/06)	May	Jun (6/8/06)	Jul (7/5/06)	Aug (8/30/06)	Sep	Oct (10/18/06)	Nov (11/10/06)	Dec (12/11/06)
Intake 2 (continued)												
62.3	49.8	48.8	54.7	60.0	—	74.6	79.5	84.1	—	73.1	62.4	55.0
65.6	49.7	48.7	54.7	60.0	—	—	79.0	—	—	73.1	62.3	55.1
68.9	49.7	48.6	—	60.0	—	—	77.9	—	—	73.0	62.2	55.1
72.2	49.5	48.4	—	59.3	—	—	76.1	—	—	73.0	62.1	55.0
75.5	49.4	48.2	—	58.5	—	—	74.7	—	—	73.0	61.8	—
78.7	49.4	48.2	—		—	—		—	—	72.8	61.6	—
82.0	49.3	48.5	—		—	—		—	—			—
85.3	—	—	—	—	—	—	—	—	—	—	—	—
Discharge 6												
3.3	64.3	61.0	63.5	74.3	—	80.6	89.9	89.2	—	73.1	64.6	62.7
6.6	54.9	51.0	57.5	69.4	—	76.2	83.0	85.1	—	73.2	64.2	58.3
9.8	54.2	50.3	56.4	68.2	—	75.6	81.4	84.9	—	73.2	64.0	56.2
13.1	53.7	50.2	56.0	66.7	—	75.2	81.2	84.7	—	73.1	63.9	56.1
16.4	53.1	50.1	55.9	66.1	—	75.1	81.1	84.6	—	73.1	63.8	56.0
19.7	52.9	50.0	55.8	65.9	—	74.9	80.9	84.5	—	73.1	63.8	55.9
23.0	52.7	49.9	55.8	65.3	—	74.8	80.8	84.5	—	73.1	63.7	55.9
26.2	52.0	—	55.7	64.3	—	74.8	80.7	84.4	—	73.1	63.7	55.9
29.5	51.6	—	55.7	63.9	—	74.8	80.7	84.4	—	73.0	63.7	55.9
32.8	—	—	55.7	63.5	—	74.7	80.6	84.3	—	73.0	63.7	55.8
36.1	—	—	55.6	—	—	74.7	80.4	84.2	—	—	—	55.8
39.4	—	—	—	—	—	74.6	—	—	—	—	—	55.8
42.7	—	—	—	—	—	—	—	—	—	—	—	55.8
45.9	—	—	—	—	—	—	—	—	—	—	—	55.8
49.2	—	—	—	—	—	—	—	—	—	—	—	55.8
52.5	—	—	—	—	—	—	—	—	—	—	—	55.8

Table 2.3-15
Sediment Data Availability

DHEC Water Quality Monitoring Station ID	Site Description	Station Latitude	Station Longitude	From	To	Suspended Sediment Data (Pre-1999)		Suspended Sediment Data (1999–Present)			
						Count	Parameter	Count	Parameter	Count	Parameter
B-046	Broad River at SC 72/ 215/121, 3 MI E of Carlisle	34.5949167	–81.4201389	March 18, 1963	December 5, 2005	120	Turbidity	84	Turbidity	74	Total Suspended Solids
B-047	Broad River at SC 34, 14 MI NE of Newberry	34.3939722	–81.3966944	May 17, 1963	December 6, 2004	50	Turbidity	26	Turbidity	26	Total Suspended Solids
B-075	Sandy River at SC 215, 2.5 MI Above Confluence With Broad River	34.5931389	–81.3929167	June 6, 1963	December 5, 2005	45	Turbidity	76	Turbidity	0	Total Suspended Solids
B-155	Browns Creek at S-44-86, 8 MI E of Union	34.7246389	–81.4864722	September 18, 1972	December 5, 2005	8	Turbidity	69	Turbidity	0	Total Suspended Solids
B-335	Gregorys Creek at S-44-86, 8 MI E of Union	34.7196389	–81.4824722	September 6, 1995	December 2, 2004	2	Turbidity	22	Turbidity	0	Total Suspended Solids
B-346	Parr Reservoir 4.8 KM N of Dam, Upstream of Monticello Reservoir	34.3047222	–81.3553889	May 20, 1999	December 7, 2004	0	Turbidity	18	Turbidity	0	Total Suspended Solids

Table 2.3-16
Total Suspended Solids and Daily Flows at Carlisle Station for B-046

Station ID	Date	Total Suspended Solids (mg/l)	Flow from Carlisle Station (cfs)	Station ID	Date	Total Suspended Solids (mg/l)	Flow from Carlisle Station (cfs)
B-046	1/26/99	70.0	5,960	B-046	10/21/02	66.0	1,130
B-046	2/3/99	23.0	8,690	B-046	11/7/02	22.0	2,900
B-046	4/6/99	9.9	3,240	B-046	12/3/02	97.0	1,420
B-046	6/17/99	16.0	1,990	B-046	2/5/03	36.0	3,040
B-046	7/14/99	2.4	2,180	B-046	3/11/03	18.0	3,650
B-046	9/7/99	1.6	823	B-046	4/8/03	200.0	17,500
B-046	10/13/99	110.0	4,030	B-046	5/12/03	22.0	5,610
B-046	11/3/99	6.4	2,000	B-046	6/9/03	16.0	22,400
B-046	12/7/99	2.8	1,690	B-046	7/14/03	79.0	12,200
B-046	1/20/00	4.4	2,410	B-046	8/19/03	13.0	8,050
B-046	2/24/00	9.1	2,040	B-046	9/15/03	19.0	2,180
B-046	3/23/00	140.0	7,230	B-046	10/2/03	12.0	2,450
B-046	4/24/00	7.0	2,190	B-046	11/19/03	6.3	2,390
B-046	5/9/00	4.0	1,660	B-046	1/29/04	6.0	2,520
B-046	6/15/00	2.9	1,110	B-046	2/19/04	18.0	3,750
B-046	7/13/00	7.0	912	B-046	3/10/04	160.0	2,810
B-046	8/7/00	14.0	950	B-046	4/21/04	8.4	2,440
B-046	9/20/00	20.0	724	B-046	6/15/04	22.0	3,560
B-046	10/25/00	0.6	694	B-046	7/12/04	7.2	1,800
B-046	12/28/00	2.0	1,140	B-046	8/2/04	22.0	1,850
B-046	1/9/01	5.1	1,130	B-046	9/15/04	26.0	4,880
B-046	2/7/01	3.8	902	B-046	10/11/04	7.2	2,630
B-046	4/4/01	18.0	3,410	B-046	11/8/04	18.0	3,920
B-046	5/7/01	14.0	992	B-046	12/1/04	7.0	3,290
B-046	6/19/01	38.0	1,050	B-046	1/4/05	9.0	3,020
B-046	8/8/01	30.0	1,090	B-046	2/3/05	7.3	3,360
B-046	9/10/01	110.0	854	B-046	3/3/05	30.0	5,410
B-046	10/8/01	17.0	682	B-046	4/5/05	14.0	4,550
B-046	11/13/01	1.0	729	B-046	5/9/05	5.6	2,430
B-046	12/4/01	430.0	945	B-046	6/20/05	12.0	2,810
B-046	1/9/02	36.0	1,480	B-046	7/12/05	38.0	4,980
B-046	2/13/02	8.6	2,140	B-046	8/8/05	10.0	2,360
B-046	4/24/02	14.0	1,660	B-046	9/13/05	8.1	1,330
B-046	5/21/02	2.9	1,050	B-046	10/6/05	92.0	1,630
B-046	7/17/02	0.7	529	B-046	11/1/05	130.0	1,530
B-046	8/28/02	8.6	389	B-046	12/5/05	24.0	4,000
B-046	9/23/02	2.6	637				

Table 2.3-17
Total Suspended Solids and Daily Flows at Carlisle Station for B-047

Station ID	Date	Total Suspended Solids (mg/l)	Flow from Alston Station (cfs)
B-047	1/28/1999	26.0	5,090
B-047	2/18/1999	—	5,050
B-047	3/18/1999	13.0	5,070
B-047	4/15/1999	17.0	3,330
B-047	5/20/1999	26.0	3,280
B-047	6/17/1999	53.0	1,770
B-047	7/29/1999	27.0	1,230
B-047	8/26/1999	—	2,450
B-047	9/23/1999	9.5	1,010
B-047	10/5/1999	45.0	2,290
B-047	5/18/2000	14.0	1,770
B-047	6/15/2000	9.1	639
B-047	7/12/2000	9.5	916
B-047	8/24/2000	11.0	494
B-047	9/28/2000	26.0	3,430
B-047	10/26/2000	4.4	1,190
B-047	1/20/2004	6.5	3,340
B-047	2/5/2004	15.0	5,240
B-047	3/23/2004	5.9	2,790
B-047	4/20/2004	18.0	2,890
B-047	5/11/2004	23.0	2,700
B-047	6/30/2004	51.0	4,220
B-047	7/7/2004	38.0	3,460
B-047	8/2/2004	16.0	2,480
B-047	9/21/2004	38.0	8,900
B-047	10/14/2004	10.0	4,080
B-047	11/16/2004	8.9	3,860
B-047	12/6/2004	5.2	3,630

Table 2.3-18
Gradation of Bed Materials in Parr Reservoir (January 2007 Sampling)

NO.	Depth (feet)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	D50 (mm)	D50 Material[(a)]
SED1	0–2	0	32.6	12.3	55.1	—	—
SED1	4–6	0	78.0	10.0	12.0	0.143	Fine Sand
SED2	0–1	0	13.2	44.6	42.2	0.008	Fine Silt
SED2	1–7	0	14.0	41.2	44.8	0.008	Fine Silt
SED3	0–8	0	11.7	40.8	47.5	0.006	Vf Silt
SED4	0.85	0	1.5	36.4	62.1	0.003	Clay
SED5	0–4	0	34.3	48.7	17.0	0.032	Clay
SED5	4–8	0	86.7	3.4	9.9	0.296	Med Sand
SED6	0–5	0	98.5	0.0	1.5	0.283	Med Sand
SED6	5–7.5	0	8.3	37.0	54.7	0.004	Vf Silt
SED7	0–4.5	0	98.9	0.0	1.1	0.294	Med Sand
SED8	0–1	0	53.7	35.0	11.3	0.076	Vf Sand
SED8	1–6	0	98.4	0.0	1.6	0.243	Fine Sand
SED8	6–7	0	33.8	28.7	37.5	0.011	Fine Silt
SED9	0–1.5	0	96.6	2.1	1.3	0.168	Fine Sand
SED9	1.5–3.0	0	24.6	54.3	21.1	0.020	Med Silt
SED9	3.0–4.0	0	94.5	3.0	2.5	0.147	Fine Sand
SED9	4.0–9.0	0	26.3	58.8	14.9	0.026	Med Silt
SED10	0–3	0	7.9	61.1	31.0	0.009	Clay
SED10	3–4	0	60.7	27.1	12.2	0.088	Clay
SED10	4–9	0	13.7	38.8	47.5	0.006	Clay
SED11	0–1.5	0	87.1	2.6	10.3	0.264	Med Sand
SED11	1.5–6.0	0	8.2	32.0	59.8	0.003	Clay
SED12	0–6	0	27.5	40.2	32.3	0.018	Med Silt
SED12	6–9	12.9	72.9	4.3	9.9	0.409	Med Sand
SED13	0–8	0	7.0	40.5	52.5	0.004	Vf Silt
SED14	0–5.5	0	98.0	0.0	2.0	0.281	Med Sand
SED14	5.5–8.0	0	6.9	25.4	67.7	0.003	Clay
SED15	0–2.5	0	84.5	6.9	8.6	0.215	Fine Sand
SED15	2.5–5.5	0	51.1	24.4	24.5	0.080	Vf Sand
SED16	0–4.5	2	60.2	13.0	24.8	0.135	Fine Silt

(a) Based on Udden-Wentworth (*i.e.*, Pettijohn, 1972) size classification

Table 2.3-19 (Sheet 1 of 2)
Observation Well Details

Well ID	Northing[(a)]	Easting[(a)]	GS Elevation[(b)] (feet)	Top of Casing Elevation[(b)] (feet)	Total Well Depth (feet bgs)	Screen Interval Depth (feet)	Screen Interval Elevation (feet)	Top of Filter Pack (feet bgs)	Top of Filter Pack Elevation (feet)	Formation of Screen Interval
OW-205a	892829.3	1903189.8	423.3	425.9	110.00	98.5–108.5	324.8–314.8	80.0	343.3	Sound Rock
OW-205b	892842.4	1903192.5	422.9	425.0	60.00	54.9–59.9	368.0–363.0	49.9	373.0	PWR[(c)]
OW-212	893105.1	1903036.8	396.2	399.3	68.00	56–66	340.2–330.2	53.0	343.2	Saprolite / PWR
OW-213	892975.6	1903457.3	402.1	404.5	55.25	44.75–54.75	357.3–347.3	41.5	360.6	Saprolite
OW-227	892494.0	1903408.0	422.7	425.1	84.25	71.25–81.25	351.4–341.4	67.0	355.7	Bedrock
OW-233	892786.5	1902693.4	426.2	428.3	120.00	99–119	327.2–307.2	74.0	352.2	Bedrock
OW-305a	892008.7	1902841.2	424.9	427.8	141.00	119.5–139.5	305.4–285.4	95.0	329.9	Sound Rock
OW-305b	891996.7	1902857.5	423.7	426.3	66.50	54.5–64.5	369.2–359.2	51.0	372.7	PWR / Sound Rock
OW-312	892256.5	1902709.6	425.1	427.1	36.50	30.5–35.5	394.6–389.6	26.4	398.7	Saprolite / PWR
OW-313	892167.6	1903132.5	420.9	423.8	59.00	48–58	372.9–362.9	44.1	376.8	Saprolite / PWR
OW-327	891669.2	1903084.1	410.7	413.4	66.00	55–65	355.7–345.7	51.5	359.2	PWR
OW-333	891954.4	1902319.6	394.5	397.1	71.00	60–70	334.5–324.5	52.0	342.5	Sound Rock
OW-401a	891017.8	1903595.5	404.1	406.3	92.50	80–90	324.1–314.1	76.0	328.1	Sound Rock
OW-401b	891013.1	1903585.0	404.1	406.8	66.00	60–65	344.1–339.1	57.0	347.1	Saprolite/PWR
OW-405	890180.4	1903650.2	392.6	395.4	58.50	44–54	348.6–338.6	41.0	351.6	PWR
OW-501	897817.4	1903702.3	429.5	431.9	32.00	20–30	409.5–399.5	17.5	412.0	Fill / Residual Soil
OW-612	892415.5	1904227.3	406.8	409.4	62.00	47.5–57.5	359.3–349.3	44.5	362.3	Saprolite
OW-614	891671.1	1903536.1	376.1	379.1	33.00	21.5–31.5	354.6–344.6	18.5	357.6	Saprolite
OW-617	889886.3	1902373.7	447.2	450.1	108.00	98–108	349.2–339.2	93.0	354.2	PWR
OW-618	890955.6	1901480.1	307.4	310.5	32.50	18.5–28.5	288.9–278.9	13.8	293.6	Saprolite
OW-619	892594.0	1901843.9	405.7	407.7	104.00	83–103	322.7–302.7	77.5	328.2	Bedrock
OW-620	893593.8	1903017.2	382.8	385.0	91.00	76.5–86.5	306.3–296.3	74.0	308.8	PWR
OW-621b	893742.6	1903677.8	421.2	423.6	71.00	60–70	361.2–351.2	55.0	366.2	Saprolite / PWR
OW-622	894292.2	1904118.1	438.1	440.7	62.00	48.5–58.5	389.6–379.6	44.5	393.6	Bedrock
OW-623	893819.9	1904946.1	439.6	441.8	90.00	76.5–86.5	363.1–353.1	72.0	367.6	Bedrock
OW-624	891595.7	1904623.8	359.3	361.6	62.00	48.5–58.5	310.8–300.8	45.0	314.3	Bedrock

Table 2.3-19 (Sheet 2 of 2)
Observation Well Details

Well ID	Northing[(a)]	Easting[(a)]	GS Elevation[(b)] (feet)	Top of Casing Elevation[(b)] (feet)	Total Well Depth (feet bgs)	Screen Interval Depth (feet)	Screen Interval Elevation (feet)	Top of Filter Pack (feet bgs)	Top of Filter Pack Elevation (feet)	Formation of Screen Interval
OW-625	889895.0	1904957.3	403.2	405.9	108.00	84.5–104.5	318.7–298.7	80.5	322.7	Saprolite
OW-626	893202.4	1904129.9	416.4	418.8	85	71–81	345.4–335.4	63.0	353.4	Saprolite
OW-627a	891239.9	1902130.4	327.6	330.3	86	66–86	261.6–241.6	64.0	263.6	Sound Rock
OW-627b	891231.6	1902129.7	326.9	329.5	56	43–53	283.9–273.9	37.0	289.9	Saprolite / PWR

(a) South Carolina State Plane NAD 83
(b) All elevations given in this table are with respect to the NAVD88 datum
(c) PWR = partially weathered rock

Table 2.3-20 (Sheet 1 of 2)
Monthly Groundwater Level Elevations

			Water Level Elevation[a]												
			2006							2007					
Well ID	Formation	Hydrostratigraphic Zone	6-23	7-25	8-30	9-19	10-24	11-29	12-20	1-25	2-20	3-20	4-19	5-23	6-27
OW-205a	Sound Rock	Deep Bedrock	357.29	357.29	357.09	357.18	357.08	357.43	357.46	358.35	358.58	358.85	359.07	359.01	358.97
OW-205b	Partially Weathered Rock (PWR)	Saprolite / Shallow Bedrock	364.95	365.01	365.20	366.04	366.15	365.33	365.40	365.52	365.72	365.90	366.30	366.85	367.15
OW-212	Saprolite / PWR	Saprolite / Shallow Bedrock	351.40	351.05	351.25	351.16	350.86	351.60	351.35	352.55	352.80	353.12	352.91	352.75	352.59
OW-213	Saprolite	Saprolite / Shallow Bedrock	359.17	359.08	359.11	359.10	358.99	359.12	359.24	360.30	360.60	361.00	361.10	361.00	360.82
OW-227	Bedrock	Deep Bedrock	361.46	361.34	361.30	361.29	361.29	361.25	361.25	361.41	361.73	361.95	362.29	362.60	362.84
OW-233	Bedrock	Deep Bedrock	322.45	339.85	358.55	362.34	365.15	366.18	366.42	366.89	367.08	367.10	367.30	367.22	367.43
OW-305a	Sound Rock	Deep Bedrock	368.20	368.29	368.13	368.18	368.22	368.28	368.30	368.34	368.51	368.60	368.80	368.99	369.18
OW-305b	PWR / Sound Rock	Saprolite / Shallow Bedrock	367.39	367.48	367.40	367.42	367.43	367.53	367.50	367.58	367.72	367.80	367.97	368.15	368.35
OW-312	Saprolite / PWR	Saprolite / Shallow Bedrock	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
OW-313	Saprolite / PWR	Saprolite / Shallow Bedrock	372.80	372.69	372.88	373.00	373.18	373.25	373.23	373.38	373.75	374.08	374.51	374.90	375.05
OW-327	PWR	Saprolite / Shallow Bedrock	359.23	359.15	359.24	359.30	359.39	359.61	359.72	360.00	360.24	360.40	360.75	361.10	361.39
OW-333	Sound Rock	Deep Bedrock	333.88	334.73	335.10	335.15	335.10	334.65	335.03	336.28	337.67	338.55	339.54	339.54	339.05
OW-401a	Sound Rock	Deep Bedrock	351.19	350.99	351.13	351.22	351.55	351.38	351.30	351.73	352.30	352.59	352.92	353.00	352.87
OW-401b	Saprolite/PWR	Saprolite / Shallow Bedrock	351.04	350.86	350.98	351.08	351.37	351.20	351.10	351.55	352.08	352.40	352.71	352.85	352.72
OW-501	Fill / Residual Soil	Saprolite / Shallow Bedrock	NA	NA	419.06	419.29	418.89	418.07	419.00	418.89	418.55	418.52	418.50	418.90	418.70
OW-405	PWR	Saprolite / Shallow Bedrock	353.80	353.68	353.85	353.90	354.03	353.90	353.85	354.29	354.85	355.25	355.74	355.95	355.95
OW-612	Saprolite	Saprolite / Shallow Bedrock	357.35	357.25	357.32	357.35	357.37	357.35	357.35	357.65	357.96	358.26	358.55	358.74	358.75
OW-614	Saprolite	Saprolite / Shallow Bedrock	349.92	349.15	349.41	349.21	348.40	350.18	349.42	351.95	351.42	351.75	351.10	350.52	350.00
OW-617	PWR	Saprolite / Shallow Bedrock	349.26	349.15	349.16	349.11	349.00	348.91	348.87	348.83	348.77	348.70	348.72	348.67	348.67
OW-618	Saprolite	Saprolite / Shallow Bedrock	303.50	303.34	303.60	303.64	303.35	303.85	303.70	304.20	304.28	304.18	304.08	303.54	303.55
OW-619	Bedrock	Deep Bedrock	303.04	303.89	305.60	306.66	308.45	310.30	311.35	313.11	314.41	315.70	317.09	318.63	320.15

Table 2.3-20 (Sheet 2 of 2)
Monthly Groundwater Level Elevations

			Water Level Elevation[(a)]												
			2006							2007					
Well ID	**Formation**	**Hydrostratigraphic Zone**	**6-23**	**7-25**	**8-30**	**9-19**	**10-24**	**11-29**	**12-20**	**1-25**	**2-20**	**3-20**	**4-19**	**5-23**	**6-27**
OW-620	PWR	Saprolite / Shallow Bedrock	348.09	347.80	348.05	348.11	347.78	348.19	348.03	348.85	349.00	349.08	348.96	348.70	348.59
OW-621a	Sound Rock	Deep Bedrock	325.90	327.52	328.53	329.01	329.98	330.78	331.20	331.85	332.55	333.12	333.72	334.41	335.09
OW-621b	Saprolite / PWR	Saprolite / Shallow Bedrock	368.65	368.55	368.70	368.75	368.75	368.80	368.80	369.07	369.46	369.78	370.35	370.83	371.26
OW-622	Bedrock	Saprolite / Shallow Bedrock	394.00	393.94	394.11	394.16	394.15	394.20	394.15	394.19	394.39	394.60	394.82	394.85	394.79
OW-623	Bedrock	Saprolite / Shallow Bedrock	369.70	369.64	369.69	369.71	369.69	369.77	369.76	369.94	370.39	370.70	371.11	371.23	371.22
OW-624	Bedrock	Saprolite / Shallow Bedrock	302.47	307.55	313.50	315.90	317.90	318.73	319.08	319.83	320.15	320.45	320.75	320.68	320.52
OW-625	Saprolite	Saprolite / Shallow Bedrock	316.95	317.11	317.68	318.08	318.40	318.30	318.23	318.69	319.10	319.15	319.34	319.22	319.15
OW-626	Saprolite	Saprolite / Shallow Bedrock	368.93	368.81	368.89	368.90	368.98	369.05	369.04	369.36	369.75	370.15	370.00	370.96	371.15
OW-627a	Sound Rock	Deep Bedrock	258.55	267.50	249.50	249.30	254.80	259.70	262.32	270.72	276.84	282.62	288.24	293.35	297.85
OW-627b	Saprolite / PWR	Saprolite / Shallow Bedrock	317.32	317.19	317.35	317.26	316.60	317.58	317.25	318.55	318.44	318.38	318.00	317.20	317.20

(a) All water level elevations given in this table are with respect to the NAVD88 datum

Table 2.3-21
Slug Test Results

Well Number	Test Interval: Screened Interval (feet bgs)	Test Interval: Hydrostratigraphic Zone	Test Interval: Submerged Screen	Hydraulic Conductivity: Falling Head Test (cm/s)	Hydraulic Conductivity: Rising Head Test (cm/s)	Hydraulic Conductivity: Maximum Test Result (feet/day)
OW-205A	98.5–108.5	Deep bedrock	Fully submerged screen	3.1E-6	Discard	0.0088
OW-212	56–66	Saprolite/Shallow bedrock	Fully submerged screen	8.7E-4	3.6E-4	2.5
OW-213	44.75–54.75	Saprolite/Shallow bedrock	Fully submerged screen	No test	5.9E-4	1.7
OW-227	71.25–81.25	Deep bedrock	Fully submerged screen	4.5E-5	4.4E-5	0.13
OW-305A	119.5–139.5	Deep bedrock	Fully submerged screen	7.3E-6	6.2E-6	0.021
OW-313	48–58	Saprolite/Shallow bedrock	Partially submerged screen	No test	3.4E-3	9.6
OW-327	55–65	Saprolite/Shallow bedrock	Fully submerged screen	No test	7.1E-5	0.20
OW-333	60–70	Deep bedrock	Partially submerged screen	No test	1.3E-4	0.38
OW-401A	80–90	Deep bedrock	Fully submerged screen	8.2E-5	6.9E-5	0.23
OW-401B	60–65	Saprolite/Shallow bedrock	Fully submerged screen	1.7E-5	1.5E-5	0.047
OW-405	44–54	Saprolite/Shallow bedrock	Fully submerged screen	6.4E-3	4.9E-3	18
OW-612	47.5–57.5	Saprolite/Shallow bedrock	Partially submerged screen	No test	5.0E-4	1.4
OW-617	98–108	Saprolite/Shallow bedrock	Fully submerged screen	No test	5.9E-7	0.0017
OW-618	18.5–28.5	Saprolite/Shallow bedrock	Fully submerged screen	2.2E-4	4.3E-4	1.2
OW-620	76.6–86.5	Saprolite/Shallow bedrock	Fully submerged screen	1.1E-3	1.3E-3	3.6
OW-621B	60–70	Saprolite/Shallow bedrock	Fully submerged screen	2.2E-4	2.2E-4	0.61
OW-622	48.5–58.5	Saprolite/Shallow bedrock	Fully submerged screen	4.8E-4	4.8E-4	1.4
OW-623	76.5–86.5	Saprolite/Shallow bedrock	Fully submerged screen	1.8E-4	1.1E-4	0.52
OW-625	84.5–104.5	Saprolite/Shallow bedrock	Partially submerged screen	No test	4.2E-4	1.2
OW-626	71–81	Saprolite/Shallow bedrock	Fully submerged screen	3.1E-5	1.3E-5	0.087
OW-627B	43–53	Saprolite/Shallow bedrock	Fully submerged screen	5.6E-5	1.6E-5	0.16

Hydrostratigraphic Zone	Maximum Test Result: Low (feet/day)	Maximum Test Result: High (feet/day)	Maximum Test Result: Geometric Mean (feet/day)
Saprolite/Shallow Bedrock Zone	0.0017	18.00	0.62
Deep Bedrock Zone	0.0088	0.38	0.07
All	0.0017	18.00	0.37

Table 2.3-22
Packer Test Results

	Test Interval		Hydraulic Conductivity	
Boring Number	Test Section Depth (feet bgs)	Material	Feet/Year	Feet/ Day
B-201	65–75	Sound Rock	0	0.00
	86–96	Sound Rock	49	0.13
B-205	59–69	Rock/Sound Rock	417	1.14
	96–106	Sound Rock	0	0.00
B-305	62–72	Sound Rock	86	0.24
	72–82	Sound Rock	0	0.00
B-330	57–67	Sound Rock	5	0.014
	67–77	Sound Rock	92	0.25

Hydraulic Conductivity (feet/day)		
Minimum	Maximum	Geometric Mean
0	1.14	0.166

Table 2.3-23 (Sheet 1 of 2)
Summary of Laboratory Test Results for Grain Size, Moisture Content and Specific Gravity and Derived Porosity Values

Source of Sample	Sample Number	Sample Depth	USCS	Unit[(a)]	Gs	Dry Density (pcf)	Void Ratio[(b)]	Porosity[(b)]	Wet Density	Water Content
B-204	UD-2	18.5	ML	Residual Soil	2.870	95.07	0.884	0.469	112	17.8%
B-204	UD-3	28.5	ML	Saprolite	2.950	87.44	1.105	0.525	109	24.1%
B-209	UD-1	8.5	MH	Residual Soil	2.810	70.59	1.484	0.597	101	42.9%
B-209[(c)]	UD-2	18.5	SM	Residual Soil	2.795	64.38	1.709	0.631	96	48.7%
B-209	UD-4	38.5	ML	Saprolite	2.860	87.32	1.044	0.511	114	30.2%
B-210	UD-1	8.5	ML	Residual Soil	2.750	88.56	0.938	0.484	108	22.3%
B-210	UD-3	28.5	ML	Saprolite	2.730	95.85	0.777	0.437	118	23.4%
B-210	UD-4	38.5	ML	Saprolite	2.780	84.91	1.043	0.511	108	27.1%
B-215	UD-1	8.5	SM	Saprolite	2.780	85.97	1.018	0.504	112	30.5%
B-215[(c)]	UD-2	18.5	SM	Saprolite	2.820	91.17	0.930	0.482	113	24.2%
B-215[(c)]	UD-3	28.5	SM	Saprolite	2.791	86.70	1.009	0.502	108	24.2%
B-216[(c)]	UD-1	6.5	ML	Saprolite	2.791	64.05	1.719	0.632	87	35.8%
B-216[(c)]	UD-2	13.5	ML	Saprolite	2.791	81.19	1.145	0.534	108	32.6%
B-216[(c)]	UD-3	23.8	ML	Saprolite	2.791	81.55	1.136	0.532	110	35.4%
B-217[(c)]	UD-1	8.5	SM	Saprolite	2.791	87.93	0.981	0.495	112	27.8%
B-222	UD-1	8.5	ML	Residual Soil	2.710	90.49	0.869	0.465	115	26.7%
B-222	UD-2	18.5	ML	Residual Soil	2.840	89.78	0.974	0.493	110	22.3%
B-222[(c)]	UD-3	28.5	SM	Saprolite	2.791	87.10	1.000	0.500	105	20.3%
B-309[(c)]	UD-1	8.5	SM	Saprolite	2.791	87.19	0.997	0.499	107	22.4%
B-309[(c)]	UD-3	28.5	ML	Saprolite	2.791	81.45	1.138	0.532	104	27.7%
B-309[(c)]	UD-4	38.5	SM	Saprolite	2.791	88.60	0.966	0.491	108	21.7%
B-319[(c)]	UD-2	18.5	SM	Saprolite	2.791	91.60	0.901	0.474	109	19.5%
B-319	UD-3	28.5	ML	Saprolite	2.750	91.85	0.868	0.465	115	24.9%
B-319	UD-4	38.5	ML	Saprolite	2.750	102.80	0.669	0.401	123	19.6%
B-321[(c)]	UD-2	18.5	SM	Saprolite	2.791	90.79	0.918	0.479	109	19.7%
B-321	UD-3	28.5	SM	Saprolite	2.830	102.60	0.721	0.419	120	16.7%
B-322[(c)]	UD-2	18.5	SM	Saprolite	2.791	88.28	0.973	0.493	102	15.2%
B-325[(c)]	UD-1	3.5	ML	Residual Soil	2.795	78.20	1.230	0.552	108	38.0%

Table 2.3-23 (Sheet 2 of 2)
Summary of Laboratory Test Results for Grain Size, Moisture Content and Specific Gravity and Derived Porosity Values

Source of Sample	Sample Number	Sample Depth	USCS	Unit(a)	Gs	Dry Density (pcf)	Void Ratio(b)	Porosity(b)	Wet Density	Water Content
B-325	UD-3	13.5	SM	Saprolite	2.77	82.91	1.085	0.520	104	25.8%
B-325	UD-8	38.5	SM	Saprolite	2.69	97.39	0.724	0.420	118	21.0%
		Min Values:		Residual Soil	2.71	64.38	0.869	0.465	96	17.8%
				Saprolite	2.69	64.05	0.669	0.401	87	15.2%
		Max Values:		Residual Soil	2.87	95.07	1.709	0.631	115	48.7%
				Saprolite	2.95	102.80	1.719	0.632	123	35.8%
		Mean Values:		Residual Soil	2.80	82.44	1.155	0.527	107.1	31.2%
				Saprolite	2.79	88.11	0.994	0.494	109.7	24.8%

(a) Unit from Table 2A of Mactec (2007)
(b) Calculated values using Equation 1.20 of Craig (1998), Page 26
(c) No Gs value was obtained for these samples. For these samples, the average value was used to calculate the void ratio and porosity values

Data summarized from Table F-1— Summary of Soil Tests, Mactec Final Data Report — Results of Geotechnical Exploration and Testing, February 2007. Values are average values per sample.

Equation 1.20

$P_d = ((G_s)/(1+e))*P_w$

This can be rearranged to show:

e = (Gs*yw/y)-1

Porosity can be derived from the void ratio by:

n = e/(1+e)

Where:

P_d = Dry Density
P_w = Density of Water
e = Void ratio
n = Porosity
Gs = Specific Gravity

Table 2.3-24
Deleted

Table 2.3-25
Groundwater Travel Time Summary

Primary Pathlines	K (ft/day)	n_e	h_o (ft) (NAVD88)	h_1 (ft) (NAVD88)	L (ft)	dh/dx	v (ft/day)	t (yrs)
Unit 2 saprolite/shallow bedrock to unnamed creek	1.7	0.18	367.15	340	850	-0.032	0.30	7.7
Unit 3 saprolite/shallow bedrock to unnamed creek	1.7	0.18	368.35	303.55	1727	-0.038	0.35	13.3
Alternate Pathlines								
Unit 2 saprolite/shallow bedrock to Mayo Creek	1.7	0.18	367.15	308	2800	-0.021	0.20	38.4
Unit 3 saprolite/shallow bedrock to Mayo Creek	1.7	0.18	368.35	308	2800	-0.022	0.20	37.7
Unit 2 deep bedrock to Broad River	0.4	0.04	358.97	265	4400	-0.021	0.21	56.4
Unit 3 deep bedrock to Broad River	0.4	0.04	369.18	265	4300	-0.024	0.24	48.6
Unit 2 deep bedrock to Mayo Creek	0.4	0.04	358.97	308	2800	-0.018	0.18	42.1
Unit 3 deep bedrock to Mayo Creek	0.4	0.04	369.18	308	2800	-0.022	0.22	35.1
Unit 2 deep bedrock to hypothetical private well	0.4	0.04	NA	NA	4600	-0.018	0.18	69.2
Unit 3 deep bedrock to hypothetical private well	0.4	0.04	NA	NA	4500	-0.022	0.22	56.4

NA — Not applicable, the gradient used for the hypothetical private well pathlines is assumed to equal the gradient used for the the Mayo Creek pathlines.
Sources of the h_0 and h_1 data are presented in Table 2.3-37.

Table 2.3-26
Groundwater Use by County (Millions of Gallons) in 50-Mile Radius, 2004

County	County Total	Thermoelectric	Aquaculture	Golf Course	Industry	Irrigation	Mining	Public Water Supply
Aiken	6,870	—	—	29.9	1,450	485	29.2	4,880
Calhoun	1,260	—	—	38.2	138	854	NR	235
Cherokee	1.3	—	—	—	—	—	—	—
Chester	19.4	—	—	18	1.4	—	—	—
Edgefield	96.9	—	—	75.9	—	21	—	—
Fairfield	64.3	—	—	—	—	—	—	64.3
Greenwood	35.3	—	—	7	—	1.2	—	27.1
Kershaw	1,140	—	—	47.6	418	—	—	674
Lancaster	1.2	—	—	1.2	—	—	—	—
Laurens	—	—	—	—	—	—	—	—
Lee	694	—	—	—	—	98.4	—	596
Lexington	2,980	—	—	36.8	414	1,620	465	441
McCormick	—	—	—	—	—	—	—	—
Newberry	91.7	—	—	—	—	60.7	—	31
Orangeburg	7,050	1,660	—	20.1	701	2,280	1,710	676
Richland	1,340	—	67.3	22.2	677	7.1	236	335
Saluda	2.4	—	—	—	—	—	—	2.4
Spartanburg	46.6	—	—	5.7	15.1	NR	—	25.8
Sumter	6,870	—	—	82.7	316	797	—	5,680
Union	2.5	—	—	—	2.5	—	—	—
York	89.3	—	—	58.8	3.7	—	13.0	13.9
Total	28,700	1,660	67.3	444	4,140	6,230	2,450	13,700
Percent Use		5.8	0.2	1.5	14.4	21.7	8.6	47.7

Source: SCDHEC (2005)
— not reported

Table 2.3-27
Surface Water Use by County (Millions of Gallons) 50-Mile Radius in 2004

County	County Total	Hydroelectric	Thermoelectric	Aquaculture	Golf Course	Industry	Irrigation	Mining	Public Water Supply
Aiken	69,400	—	46,700	—	180	19,400	1,020	—	2,080
Calhoun	28,500	—	—	—	48.8	28,300	142	—	—
Cherokee	459,000	455,000	—	—	—	483	—	—	3,540
Chester	2,170,000	2,170,000	—	—	14.0	91.2	—	—	1,100
Edgefield	1,000,000	1,000,000	—	—	43.5	—	507	—	1,500
Fairfield	3,270,000	3,030,000	247,000	—	—	—	—	—	796
Greenwood	322,000	317,000	116	—	47.6	49.9	—	—	4,900
Kershaw	1,210,000	1,210,000	—	—	57.5	924	—	—	1,820
Lancaster	1,100,000	1,090,000	—	—	2.7	1,010	—	—	7,750
Laurens	1,810	149	—	—	54.6	—	—	—	1,610
Lee	8.0	—	—	—	—	—	8.0	—	—
Lexington	264,000	202,000	46,300	—	205	10,200	497	564	5,290
McCormick	462	—	—	—	39.6	—	—	—	422
Newberry	2,410	—	—	—	10.0	—	126	—	2,270
Orangeburg	4,750	—	0.3	—	93.5	155	1,500	—	3,010
Richland	677,000	473,000	170,000	13.9	341	10,300	0.3	—	23,300
Saluda	356	—	—	—	—	—	356	—	—
Spartanburg	27,700	13,800	—	35.1	120	—	100	—	13,600
Sumter	787	—	—	—	201	—	587	—	—
Union	318,000	316,000	—	—	8.8	516.	—	—	1,250
York	998,000	932,000	37,800	—	123	22,800	2.5	—	5,530
Total	11,900,000	11,200,000	547,000	49	1590	94,200	4,800	564	79,800
Percent Use		93.9	4.6	0	0	0.8	0	0	0.7

Source: SCDHEC (2005)
— = Not Reported

Table 2.3-28
Significant Downstream Surface Water Users

User	Water Body	Withdrawal Rate	
		Million Gallons Per Year	Million Gallons Per Day
Consumptive Users			
Columbia Canal Water Plant (city of Columbia)	Broad-Canal	12,587.46	34.5
W. Columbia Saluda Intake	Saluda River[(a)]	1,208.00	3.3
Martin Marietta Cayce Plant	Congaree River	415.64	1.1
City Cayce Intake #2	Congaree River	1,128.60	3.1
Eastman Chemical Voridian Div.	Congaree River	26,392.68	72.3
Santee Cooper Resort C.C.	Lake Marion	39.54	0.1
St. Julian Plantation	Lake Marion	7.06[(b)]	0.058
Santee Cooper Cross Station	Lake Moultrie	21,794.14	59.7
Ga. Pacific Russellville Plywood	Lake Moultrie (rediversion canal)	112.78	0.3
Santee Cooper Reg. Water	Lake Moultrie	5,071.40	13.9
Amoco Chemical Cooper River Plant	Back River Reservoir	1,983.41	5.4
Bayer Corp. Bushy Park (Sun Chemical)	Back River Reservoir.	876.4	2.4
Charleston CPW Bushy Park	Back River Reservoir	16,871.60	46.2
Chargeurs Wool Prouvost	Santee River	49.8	0.1
SCSPA Winyah Steam Station	North Santee River	289.7	0.8
Nonconsumptive Users			
Columbia Canal Hydro	Broad-Canal	469,660.89	1,286.7
Santee Cooper L. Marion Hydro	Lake Marion (spillway)	142,890.28	391.5
US Army / St Stephen	Lake Moultrie (rediversion canal)	2,079,847[(c)]	5,698.2
Santee Cooper Jeffries Hydro	Lake Moultrie	1,108,728.73	3,037.6
SCE&G A.M. Williams Station	Back River Reservoir	191,813.00	525.5

(a) Intake is in the confluence of the Saluda and Broad and at times does receive water from the Broad River
(b) For 4 months only
(c) Flow computed from daily mean discharge at USGS 02171645
Source: SCDHEC (2006c)

Table 2.3-29
Mayo Creek Water Quality 2006

July 2006				
Parameters	**Station 1**	**Station 2**	**Station 3**	**Station 4**
Temperature	23.8°C (74.8°F)	23.6°C (74.5°F)	24.6°C (76.3°F)	—
DO (mg/L)	5.6	7.2	7.3	—
Specific Conductance (micromhos/cm)	113	117	116	—
pH	5.4	6	6.6	—
Turbidity	0	0	0	—
November 2006				
Parameters	**Station 1**	**Station 2**	**Station 3**	**Station 4**
Temperature	—	12.5°C (54.5°F)	12.7°C (54.9°F)	13.0°C (55.4°F)
DO (mg/L)	—	8.8	8.9	8.5
Specific Conductance (micromhos/cm)	—	110	117	113
pH	—	6.5	6.4	6.2
Turbidity	—	—	—	—

Source: TtNUS (2007)
mg/L = milligrams per liter
— = Not Sampled
DO = dissolved oxygen

Table 2.3-30 (Sheet 1 of 2)
Surface Water Quality Data 2004

Analyzed Parameters	Freshwater Standard[(a)]	Monticello Reservoir		Parr Reservoir	
		Sample Location B-327	Sample Location B-328	Sample Location B-345	Sample Location B-346
Temperature (oC)/(oF)	(b)	9.3°–31.6°C 48.7°–88.9°F	8.9°–31.2°C 48°–88.2°F	8.0°–29.2° C 46.4°–84.6°F	7.0°–28° C 44.6°–82.4°F
Turbidity (NTU)	Not to exceed 25 NTUs provided existing uses are maintained.	3.0–12.0	1.3–4.9	4.6–46	6.4–95
Dissolved Oxygen (mg/L)	Daily average not less than 5.0 mg/L with a low of 4.0 mg/L.	6.38–12.72	6.99–13.25	4.95–11.50	6.14–11.90
BOD (mg/L)	NE	Less than QL–2.0	All less than QL	All less than QL	All less than QL
pH	Between 6.0 and 8.5	7.11–8.68	7.41–8.11	6.95–7.66	7.12–7.68
Alkalinity, Carbonate as CaCO3 (mg/L)	NE	17–25	23–24	16–26	14–25
Total Nitrogen (NH3) (mg/L)	1.50 mg/L	Less than QL–0.50	Less than QL–0.20	Less than QL–0.20	Less than QL–0.50
Total N (Kjeldahl) (mg/L)	NE	0.22–0.60	0.38–0.74	0.23–0.48	0.14–0.61
Total N (nitrite/nitrate) (mg/L)	NE	0.11–0.46	Less than QL–0.062	0.25–0.51	0.28–0.58
Total Phosphorous (mg/L)	0.06 mg/L	Less than QL–0.039	Less than QL–0.021	Less than QL–0.052	0.030–0.13
Total Fecal Coliform (# cells/100 mL)	(c)	Less than QL–7	Less than QL–32	2 – 140	Less than QL–240
Total Organic Carbon (mg/L)	NE	2.4–3.2	4.7–5.2	2.2–2.9	2.0–3.3
Cadmium, Total (μg/L)	5 μg/L	All less than QL	All less than QL	All less than QL	All less than QL
Chromium, Total (μg/L)	(d)	All less than QL	All less than QL	All less than QL	All less than QL
Copper, Total (μg/L)	3.8 μg/L[(e)]	All less than QL	All less than QL	All less than QL	All less than QL
Iron, Total (μg/L)	NE	130–600	42–160	220–880	450–1100
Lead, Total (μg/L)	14 μg/L(e)	All less than QL	All less than QL	Less than QL	All less than QL
Manganese, Total (μg/L)	NE	Less than QL–18	Less than QL–44	20–40	33–50

Table 2.3-30 (Sheet 2 of 2)
Surface Water Quality Data 2004

Analyzed Parameters	Freshwater Standard[(a)]	Monticello Reservoir		Parr Reservoir	
		Sample Location B-327	Sample Location B-328	Sample Location B-345	Sample Location B-346
Mercury, Total (µg/L)	2 µg/L	All less than QL	Less than QL–19	All less than QL	All less than QL
Nickel, Total (µg/L)	150 µg/L(e)	All less than QL	All less than QL	All less than QL	All less than QL
Zinc, Total (µg/L)	37 µg/L(e)	Less than QL–21	All less than QL	Less than QL–48	All less than QL

(a) Standards from SCDHEC Regulation R.61-68, Water Classifications & Standards, Section G.10. Human health standards (MCLs) are presented for toxic pollutants. Where no human health standard is provided, the Freshwater standard for protection of aquatic life is presented.
(b) The weekly average water temperature of all Freshwaters which are lakes shall not be increased more than 5°F (2.8°C) above natural conditions and shall not exceed 90°F (32.2°C) as a result of the discharge of heated liquids unless a different site-specific temperature standard or a mixing zone has been established or a Section 316(a) determination under the Federal Clean Water Act has been completed.
(c) Not to exceed a geometric mean of 200/100 mL, based on five consecutive samples during any 30 day period; nor shall more than 10% of the total samples during any 30 day period exceed 400/100 mL.
(d) The MCL for Chromium III and VI is 100 µg/L.
(e) Indicates CMC for Freshwater aquatic life.

Source: U.S. EPA (2006)
Note: Sample depths 0.3 meters
QL = quantification limit
< = Less than
MCL = Maximum Contaminant Level
NE = Not Established
CMC = Criteria Maximum Concentration (estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed briefly without resulting in an unacceptable effect).

Table 2.3-31
Surface Water Quality Data 2005

Analyzed Parameter	Freshwater Standard[a]	Monticello Reservoir Sample Location B-327 Result	Parr Reservoir Sample Location B-345 Result
Temperature (°C)/(°F)	[b]	11.4°–32°C 52.5°F–89.6°F	10.6°C–29.3 °C 51.1°F–84.7°F
Turbidity (NTU)	[c]	2.5–12	6.5–47
Dissolved Oxygen (mg/L)	Daily average not less than 5.0 mg/L with a low of 4.0 mg/L	5.15–10.92	4.32–10.52
BOD (mg/L)	NE	All less than QL	All less than QL
pH (SU)	Between 6.0 and 8.5	6.9–8.5	6.7–7.88
Total Nitrogen (NH_3) (mg/L)	1.50 mg/L	<QL–0.2	<QL–0.25
Total N (Kjeldahl) (mg/L)	NE	0.21–0.53	0.24–0.56
Total N (nitrite/nitrate) (mg/L)	NE	0.14–0.59	0.27– 0.62
Total Phosphorous (mg/L)	0.06 mg/L	<QL–0.038	0.027–0.083
Hardness, Ca & Mg-Total (mg/L)	NE	14	15
Alkalinity, Carbonate as $CaCO_3$, Total (mg/L)	NE	17–24	17–24
Cadmium, Total (µg/L)	5 µg/L	All less than QL	All less than QL
Total Organic Carbon (mg/L)	NE	<QL–3.2	3.0–3.9
Chromium, Total (µg/L)	[d]	All less than QL	<L–25
Copper, Total (µg/L)	3.8 µg/L[e]	All less than QL	All less than QL
Iron, Total (µg/L)	NE	150–350	330–1800
Lead, Total (µg/L)	14 µg/L[e]	All less than QL	All less than QL
Nickel, Total (µg/L)	150 µg/L[e]	All less than QL	All less than QL
Zinc, Total (µg/L)	37 µg/L[e]	<QL–10	All less than QL
Total Fecal Coliform (# cells/100 mL)	[f]	<QL–100	2–480
Enterococcus Group Bacteria, Total (# cells/100 mL)	NE	<QL–12	<QL–310

(a) Standards from SCDHEC Regulation R.61-68, Water Classifications & Standards, Section G.10. Human health standards (MCLs) are presented for toxic pollutants. Where no human health standard is provided, the Freshwater standard for protection of aquatic life is presented.
(b) The weekly average water temperature of all Freshwaters which are lakes shall not be increased more than 5°F (2.8°C) above natural conditions and shall not exceed 90°F (32.2°C) as a result of the discharge of heated liquids unless a different site-specific temperature standard or a mixing zone has been established or a Section 316(a) determination under the Federal Clean Water Act has been completed.
(c) Not to exceed 25 NTUs provided existing uses are maintained.
(d) The MCL for Chromium III and VI is 100 µg/L.
(e) Indicates CMC for Freshwater aquatic life.
(f) Not to exceed a geometric mean of 200/100 mL, based on five consecutive samples during any 30 day period; nor shall more than 10% of the total samples during any 30 day period exceed 400/100 mL.

Source: U.S. EPA (2006)
QL = quantification limit
< = Less than
MCL = Maximum Contaminant Level
NE = Not Established
CMC = Criteria Maximum Concentration (estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed briefly without resulting in an unacceptable effect).

Table 2.3-32
Monticello Reservoir Water Quality 2006

Analyzed Parameter	Freshwater Standard[a]	Result
Antimony (µg/L)	6 µg/L	<QL
Arsenic (µg/L)	10 µg/L	<QL
Barium (µg/L)	2000 µg/L	17.7
Beryllium (µg/L)	4 µg/L	<QL
Cadmium (µg/L)	5 µg/L	<QL
Calcium (µg/L)	NE	3,425
Chromium (µg/L)	(b)	<QL
Copper (µg/L)	3.8 µg/L[c]	<QL
Iron (µg/L)	NE	101
Lead (µg/L)	14 µg/L(c)	<QL
Magnesium (µg/L)	NE	1,856
Manganese (µg/L)	NE	<QL
Mercury (liquid) (µg/L)	2 µg/L	<QL
Ammonia- N (mg/L)	(d)	0.21
Chlorophyll a (mg/L)	40 µg/L	0.00690
Ortho-phosphorous (mg/L)	NE	0.034
Phosphorous (mg/L)	0.06 mg/L	0.021
BOD 5-day (mg/L)	NE	<QL
Fecal Coliform-MF (# cells/100 ml)	(e)	<QL
Nickel (µg/L)	150 µg/L(c)	<QL
Potassium (µg/L)	NE	2,206
Selenium (µg/L)	50 µg/L	<QL
Silver (µg/L)	0.37 µg/L(c)	<QL
Sodium (µg/L)	NE	10,280
Thallium (µg/L)	2 µg/L	<QL
Zinc (µg/L)	37 µg/L(c)	<QL
Silica (µg/L)	NE	8,025
Sulfate (mg/L)	NE	4.3
Total Dissolved Solids (mg/L)	NE	63
Total Hardness (Calcium) (mg/L)	NE	16.2
Total Suspended Solids (mg/L)	NE	3
Turbidity (nephelometric turbidity units)	Not to exceed 25 NTUs provided existing uses are maintained	2.3
Platinum-Cobalt (SU)	NE	15
Total Organic Carbon (mg/L)	NE	1.7
Strontium (mg/L)	NE	0.038
Chemical Oxygen Demand (mg/L)	NE	<QL
Cyanide (mg/L)	0.2 mg/L	<QL

(a) Standards from SCDHEC Regulation R.61-68, Water Classifications & Standards, Section G.10. Human health standards (MCLs) are presented for toxic pollutants. Where no human health standard is provided, the Freshwater standard for protection of aquatic life is presented.
(b) The MCL for Chromium III and VI is 100 µg/L.
(c) Indicates CMC for Freshwater aquatic life.
(d) The one-hour average concentration of total ammonia nitrogen (in mg N/L) does not exceed, more than once every three years on the average, the CMC calculated using the following equation: CMC = [0.275/(1+107.204-pH)]+[39.0/(1+10pH-7.204)]. In situations where salmonids are absent, the CMC may be calculated using the following equation: CMC = [0.411/(1+107.204-pH)]+[58.4/(1+10pH-7.204)].
(e) Not to exceed a geometric mean of 200/100 mL, based on five consecutive samples during any 30 day period; nor shall more than 10% of the total samples during any 30 day period exceed 400/100 mL.

Water Sample also analyzed for Volatile Organics (Method 624), Semi-volatile Organics Method 625), and for Pesticides/PCBs (Method 608). All Parameter results were below laboratory quantitative levels.
QL = Quantification Limit
< = Less than
MCL = Maximum Contaminant Level
NE = Not Established
CMC = Criteria Maximum Concentration (estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed briefly without resulting in an unacceptable effect).

Table 2.3-33
Groundwater Quality Data for Unit 1 Construction[(a)]

Parameters	Boring N-23	Boring 3-14	Boring 3-2
pH	6.60	6.70	7.00
Alkalinity (mg/L) (phenolphthalein)	0.00	0	0
Alkalinity (mg/L) (methyl orange)	29.00	50.00	45.00
Sodium Chloride (mg/L)	7.37	10.36	5.38
Total hardness (mg/L)	16.00	42.00	28.00
Calcium Hardness (mg/L)	12.00	30.00	16.00
Magnesium Hardness (mg/L)	4.00	12.00	12.00
Conductivity (μmho/cm)	60.00	140.00	100.00
Dissolved Solids (mg/L)	50.00	608.00	332.00
Silica (mg/L)	4.70	22.50	16.50
Iron (mg/L)	2.60	2.70	4.90
Copper (mg/L)	0.80	0.70	1.00

(a) As reported in SCE&G (2005b)
mg/L = milligrams per liter
μmho/cm = micromhos per centimeter

Table 2.3-34
Jenkinsville Water Wells Water Quality Data for 2004

Parameters Analyzed	Jenkinsville #11 Well AMD-057	Jenkinsville #4 Well AMD-060
pH	—	—
Conductivity (µmhos/cm)	99.4	130
Alkalinity (mg/L)	34	44
Total Dissolved Solids (mg/L)	99	110
Hardness ($CaCO_3$) (mg/L)	20	39
Lead, Total (µg/L)	<0.050	<0.050
Nitrates (NO_3) (µg/L)	0.86	2.0
Total Organic Carbon (TOC)	4.4	<2.0
Chloride (Cl) (µg/L)	3.4	4.9
Sulfate (SO_4) (µg/L)	5.8	<5.0
Sodium (Na) (µg/L)	11	7.7
Calcium (Ca) (µg/L)	6.0	10
Strontium (Sr) (µg/L)	0.070	0.070
Total Nitrogen (TNK) (µg/L)	<0.10	0.16
Manganese (Mn) (µg/L)	<0.010	<0.010
Zinc (Zn) (µg/L)	0.018	<0.010
Aluminum (Al) (µg/L)	<0.10	<0.10
Beryllium (Be) (µg/L)	<0.0030	<0.0030
Boron (B) (µg/L)	<0.10	<0.10
Cobalt (Co) (µg/L)	<0.010	<0.010
Mercury (Mg) (µg/L)	1.3	3.5
Molybdenum (Mo) (µg/L)	<0.020	<0.020
Selenium (Se) (µg/L)	<0.0020	<0.0020
Silver (Ag) (µg/L)	<0.030	<0.030
Tin (Sn) (µg/L)	<0.020	0.047
Uranium (U) (µg/L)	<0.10	<0.10
Cadmium (Cd) (µg/L)	<0.010	<0.010
Chromium (Cr) (µg/L)	<0.010	<0.010
Nickel (Ni) (µg/L)	<0.020	<0.020
Lithium (Li) (µg/L)	0.013	<0.010
Antimony (Sb) (µg/L)	<0.050	<0.050
Silicate (SiO) (µg/L)	55	42

Source: SCDHEC (2006d)
— = Not analyzed
mg/L = milligrams per liter
µg/L = micrograms per liter
µmhos/cm = micromhos per centimeter
< = less than

Table 2.3-35
Units 2 and 3 Site Evaluation Groundwater Quality Analysis 2006

		Parameters									
Sample Location	Date Sampled	Total Dissolved Solids (mg/L)	Nitrite/ Nitrate[a] (mg/L)	Bromide (mg/L)	Chloride (mg/L)	Fluoride (mg/L)	Sulfate (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	Alkalinity (mg/L)
OW-227	08/23/2006	71	0.36	<0.25	2.2[(b)]	0.1	8.7	0.36	<0.02	0.077	23
OW-620	08/23/2006	82	0.53	<0.25	2.8[(b)]	0.085[c]	0.9	0.57	<0.02	<0.05	39
OW-212	08/28/2006	59	0.38	<0.25	2.3[(b)]	0.071[c]	1.1	0.33	<0.02	<0.05	31
OW-327	08/28/2006	47	0.21	<0.25	2.9[(b)]	0.080[c]	3.2	0.18	<0.02	<0.05	22
OW-333	08/28/2006	117	0.55	<0.25	4.1[(b)]	0.085[c]	1.5	1.10	<0.02	<0.05	29
OW-618	08/29/2006	140	0.30	<0.25	9.6[(b)]	0.15	3.7	0.073	<0.02	<0.05	66
OW-627A	09/01/2006	178	0.16	<0.25	7.4[(b)]	0.67	10.4	0.18	<0.02	0.093	126
OW-205A	09/01/2006	96	0.26	0.16[(c)]	7.2[(b)]	0.15	16.8	0.28	<0.02	0.05	44
OW-305A	09/01/2006	87	<0.05	<0.25	3.9[(b)]	0.25	7.4	0.038	<0.02	<0.05	48

(a) Results from nitrite/nitrate analysis represents data from second analytical series dated September 28, 2006.
(b) Analyte was detected within the method blank; actual value may be lower than reported value.
(c) Estimated result; reported result is below typical lab reporting limit but above lab method detection limit.
Source: MACTEC (2007)

Table 2.3-36 (Sheet 1 of 2)
Water Quality Monitoring

			OW-205a	OW-205b		OW-305a	OW-305b		OW-618	OW-619	OW-624			OW-672b	
Analysis	MCL[(a)]	MDL/Units	07/09/07	09/20/07	12/18/07	07/09/07	09/20/07	12/18/07	07/09/07	07/09/07	07/09/07	09/20/07	12/18/07	09/20/07	12/18/07
Phosphorus	NE	0.050 mg/L	0.115	1.95	3.42	0	1.01	0.683	0.662	0.98	0.822	1.98	1.934	0.6	0.969
Arsenic	10 PPB	5.0 PPB	0	0	0	0	0	0	0	0	0	0	0	0	0
Barium	2000 PPB	10.0 PPB	52	261	81	20	76	37	215	458	59	103	95	81	65
Cadmium	5 PPB	1.0 PPB	0	1	0	0	0	0	5	8	1	0	0	0	0
Calcium	NE	100.0 PPB	12525	4319	3182	14630	9607	6174	15530	150900	15382	73440	81630	10470	10490
Chromium	100 PPB	10.0 PPB	13	13.6	0	0	15	0	22	52	58	0	0	0	0
Copper	1000 PPB	10.0 PPB	0	20	0	0	10	0	90	61	36	29	0	0	0
Iron	300 PPB	10.0 PPB	1298	17130	4092	154	4033	571	24588	37822	4458	8022	1610	5005	2749
Lead	15 PPB	5.0 PPB	0	0	0	0	0	0	6	8	16	0	0	0	0
Magnesium	NE	100.0 PPB	2970	5325	2030	2058	2458	1573	10515	11250	2637	9854	9047	5427	4855
Mercury (liquid)	2 PPB	0.4 PPB	0	0	0	0	0	0	0	0	0	0	0	0	0
Potassium	NE	100.0 PPB	9880	4705	2517	3259	2279	1718	4774	25680	41780	16060	1346	2714	2379
Selenium	50 PPB	5.0 PPB	0	0	0	0	0	0	0	0	0	0	0	0	0
Silver	100 PPB	10.0 PPB	0	0	0	0	0	0	0	0	0	0	0	0	0
Sodium	NE	1000.0 PPB	5905	3777	4183	6.998	4097	4103	11210	35550	54130	78070	85720	10480	9752
Total Hardness (calc)	NE	0.0 mg/L	44	33	16	45	34	22	83	424	49	41	242	49	47
Chlorides	250 mg/L	0.5 mg/L	5.8	2.01	1.75	6	3.24	3.4	7.3	8.3	6.4	5.49	5.16	5.2	5.6
Conductivity	NE	0.05 umhos	138.4	75.73	48.88	218.2	76.07	96.31	159.9	652.5	496.5	739.9	795.5	149.5	139.7
Nitrate-N	10 mg/L	0.11 mg/L as N	0.54	0.28	0.267	0	0.23	0.212	0.36	0.99	0	1.12	1.13	0.28	0.32
Orthophosphate	NE	0.010 mg/L	0.128	0.604	7.1	0.159	0.153	2.4	0.126	0.06	0.262	0.114	8.4	0.202	1.6
pH	6.5–8.5 S.U.	0.0 S.U.	7.7	5.51	5.37	7.01	5.71	5.81	6.43	6.8	7.73	5.2	6.73	6.23	6.35
Sulfates	250 mg/L	0.5 mg/L	13.1	0	0.9	19.5	0.82	2.4	1.98	164.4	83.3	232	292	1.29	3.1
Total Alkalinity	NE	1.0 mg/L	44.6	18	17.55	76.1	25.8	29.25	68.3	154.9	126	123.6	146.25	74.7	67.28
Total Dissolved Solid	500 mg/L	2.0 mg/L	111	80	132	118	83	131	141	472	427	514	788	151	221
Total Suspended Solid	NE	1.0 mg/L	21	—	1950	5	—	431	20	1504	229	628	5519	83	63
Temperature	NE	degrees (C)	21.6	19.8	15.1	21.9	19.9	14.9	19.4	22	20.6	19.5	13.1	20.5	16.2

Table 2.3-36 (Sheet 2 of 2)
Water Quality Monitoring

			OW-205a	OW-205b		OW-305a	OW-305b		OW-618	OW-619	OW-624			OW-672b	
Analysis	**MCL(a)**	**MDL/Units**	**07/09/07**	**09/20/07**	**12/18/07**	**07/09/07**	**09/20/07**	**12/18/07**	**07/09/07**	**07/09/07**	**07/09/07**	**09/20/07**	**12/18/07**	**09/20/07**	**12/18/07**
Turbidity	1 NTU	0.05 NTU	33.5	898	921	35.8	294	155	15.5	744	43	547	246	142	27.9
Fecal Coliform	0	2.0 #/100 ml	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Coliform	TCR	Present/ Absent	Present	Present	Present	Present	Present	Present	Present	Present	Present	Present	Present	Present	Present
Alkalinity	NE	10 mg/L	51	16	12	70	27	23	65	150	100	120	130	67	57
Ammonia-N (phenate)	NE	0.10 mg/L	0	0	0	0.1	0	0.1	0	0.18	0.76	1	0	0	0
Bicarbonate alkanlinity	NE	10 mg/L	51	16	12	70	27	23	65	150	79	120	130	67	57
BOD, 5 day	NE	2 mg/L	0	0	0	0	4.5	0	0	0	2.4	5.3	0	3	4.6
Dissolved Oxygen	NE	2 mg/L	—	—	9.8	—	—	9.2	—	—	—	—	9.2	—	0
COD	NE	50 mg/L	0	53	65	0	51	0	0	560	81	160	65	0	8.3
Nitrite-N	1 mg/L	0.020 mg/L	0.068	0.053	0.025	0.063	0.055	0.031	0.061	0.082	0.31	0.38	0.052	0.057	0.035
Platinum-cobalt color	15 color units	5.0 color units	15	2800	65	5	280	15	45	35	30	500	50	80	15
TKN	NE	0.5 mg/L	0	0	0	0	0	0	0	1.2	1.9	0.72	0.53	0	0
Silicon	NE	1000 ug/l	15000	15000	16000	20000	11000	14000	37000	16000	8000	14000	13000	20000	23000
Silica	NE	1.1 mg/L	32000	32	35	42000	24	31	80000	34000	17000	31	27	44	49
Boron	NE	0.050 mg/L	0	0	0	0	0	0	0	0	0	0	0	0	0

(a) Standards from SCDHEC Regulation R.61-58 State Primary Drinking Water Regulation (§61.58-5.B, 61-58.5F, 61-58.5.F, 61-58.5.G, 61-58.5.R and 61-58.11.B).

Note: 0 — Represents that values are less than the MDL for that particular parameter
NE = Not Established
TCR = Total coliform rule. For water systems analyzing at least 40 samples per month, no more than 5.0 percent of the monthly samples may be positive for total coliforms. For systems analyzing fewer than 40 samples per month, no more than one sample per month may be positive for total coliforms.
NTU = Nephelometric Turbidity Units

Table 2.3-37
Sources Used for Head Data

Pathline	h_o data source	h_1 data source
Unit 3 saprolite/shallow bedrock to unnamed creek	OW-305b	OW-618
Unit 3 deep bedrock to Broad River	OW-305a	Parr Reservoir full pool
Unit 2 saprolite/shallow bedrock to unnamed creek	OW-205b	topo map
Unit 2 deep bedrock to Broad River	OW-205a	Parr Reservoir full pool
Unit 3 saprolite/shallow bedrock to Mayo Creek	OW-305b	topo map
Unit 3 deep bedrock to Mayo Creek	OW-305a	topo map
Unit 2 saprolite/shallow bedrock to Mayo Creek	OW-205b	topo map
Unit 2 deep bedrock to Mayo Creek	OW-205a	topo map

Water level data from the observation wells were taken on 6-27-07
The values used for each h_o and h_1 are presented in Table 2.3-25

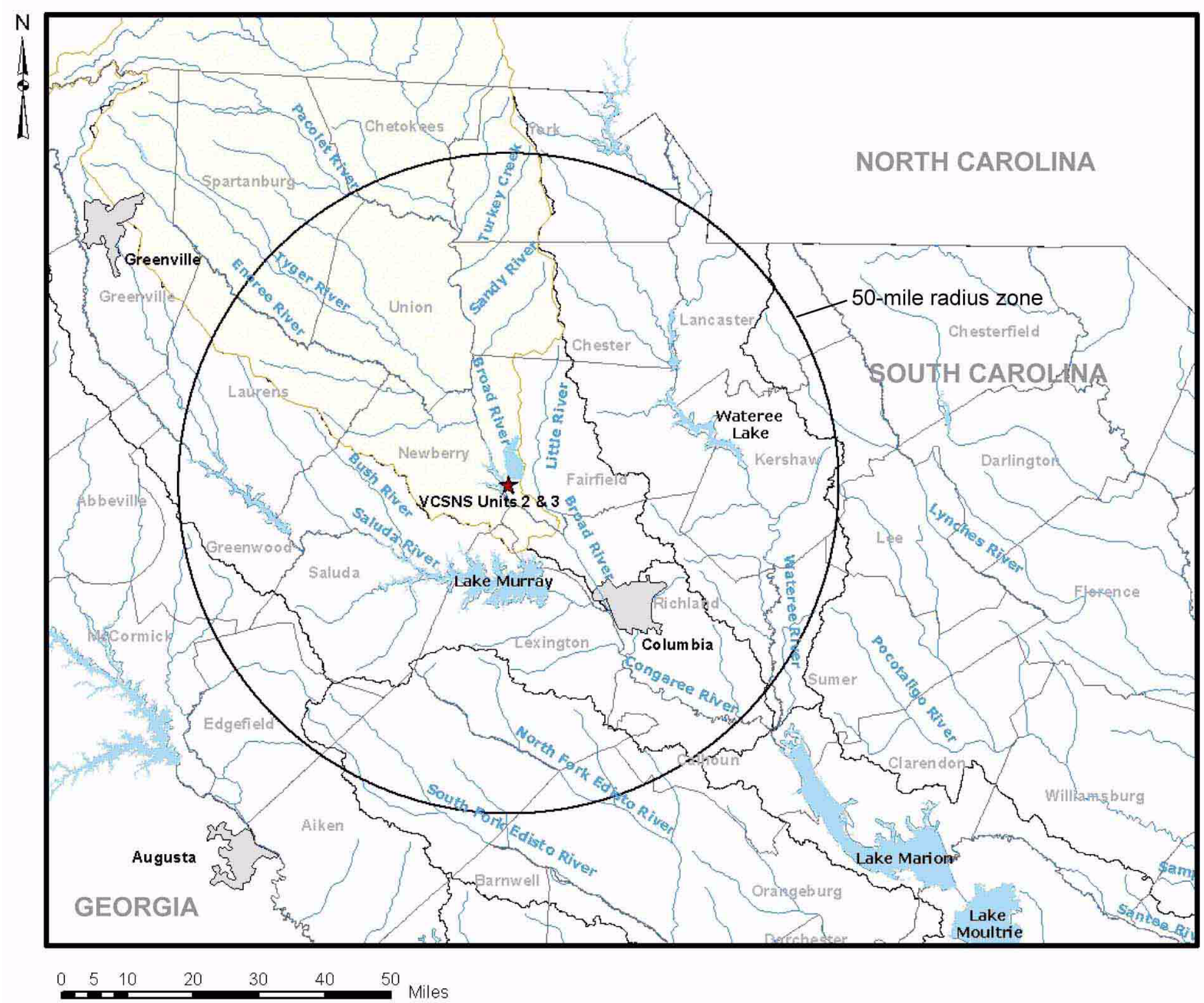


Figure 2.3-1. Major Hydrologic Features within the 50-mile Radius Zone around Units 2 and 3

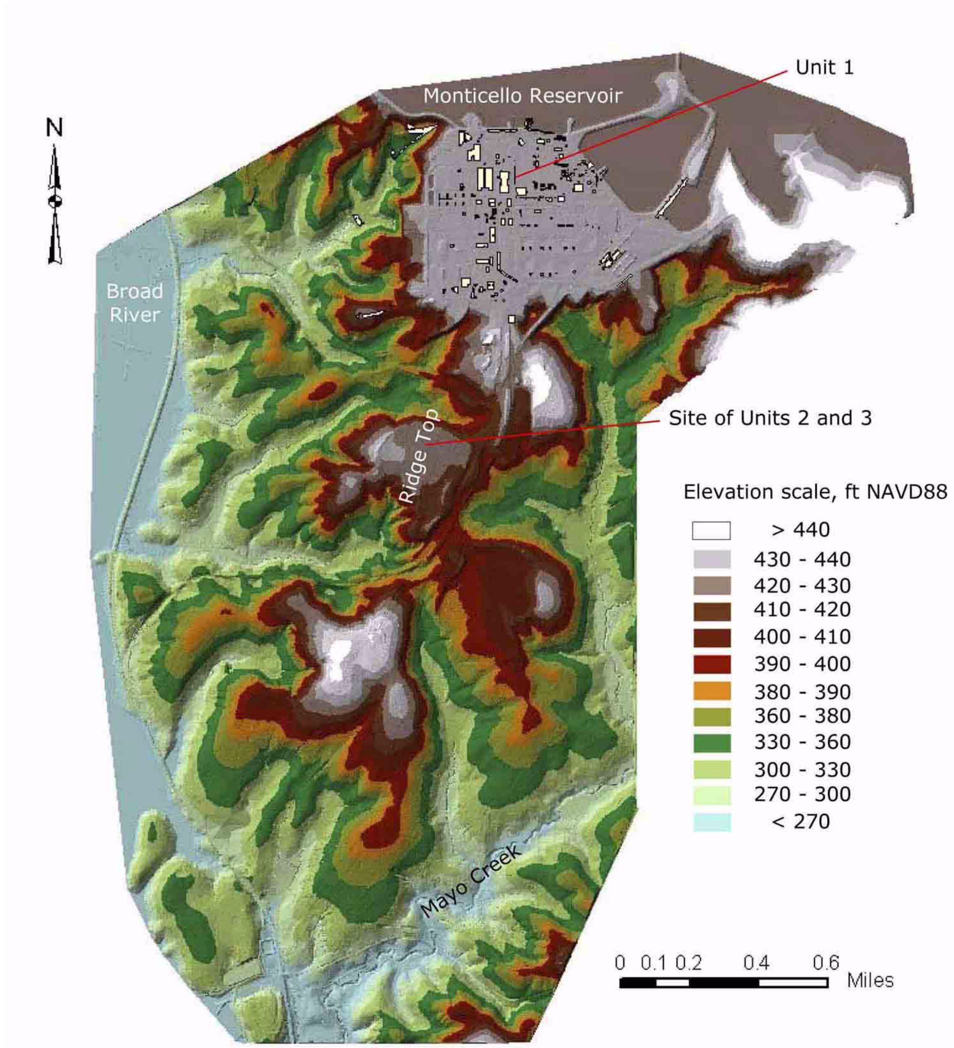


Figure 2.3-2. Topography of the Vicinity of the Units 2 and 3 and Monticello Reservoir, Based on Data from the Aerial Survey Conducted in 2006

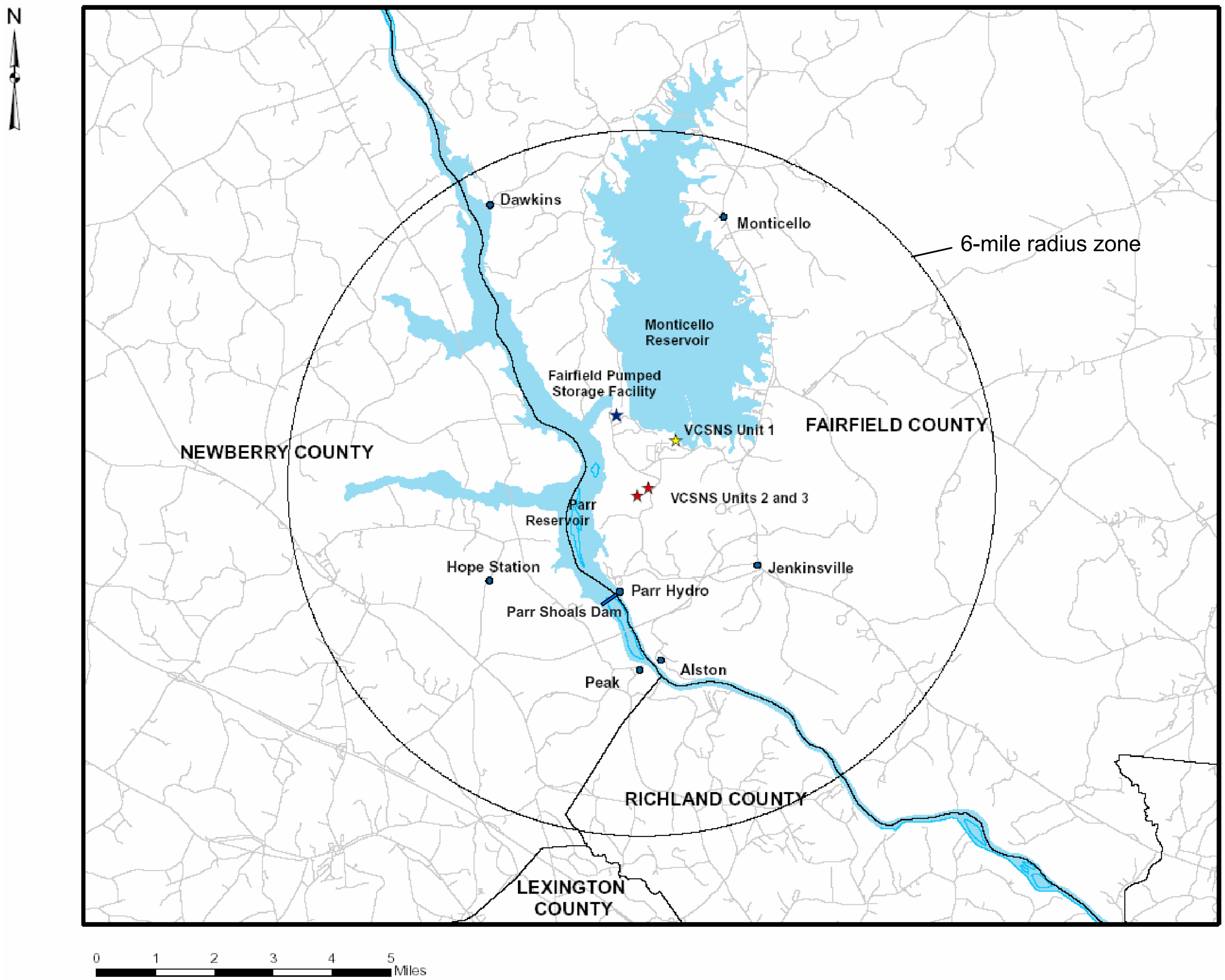


Figure 2.3-3. Major Hydrologic Features Within the 6-mile Radius Zone around Units 2 and 3

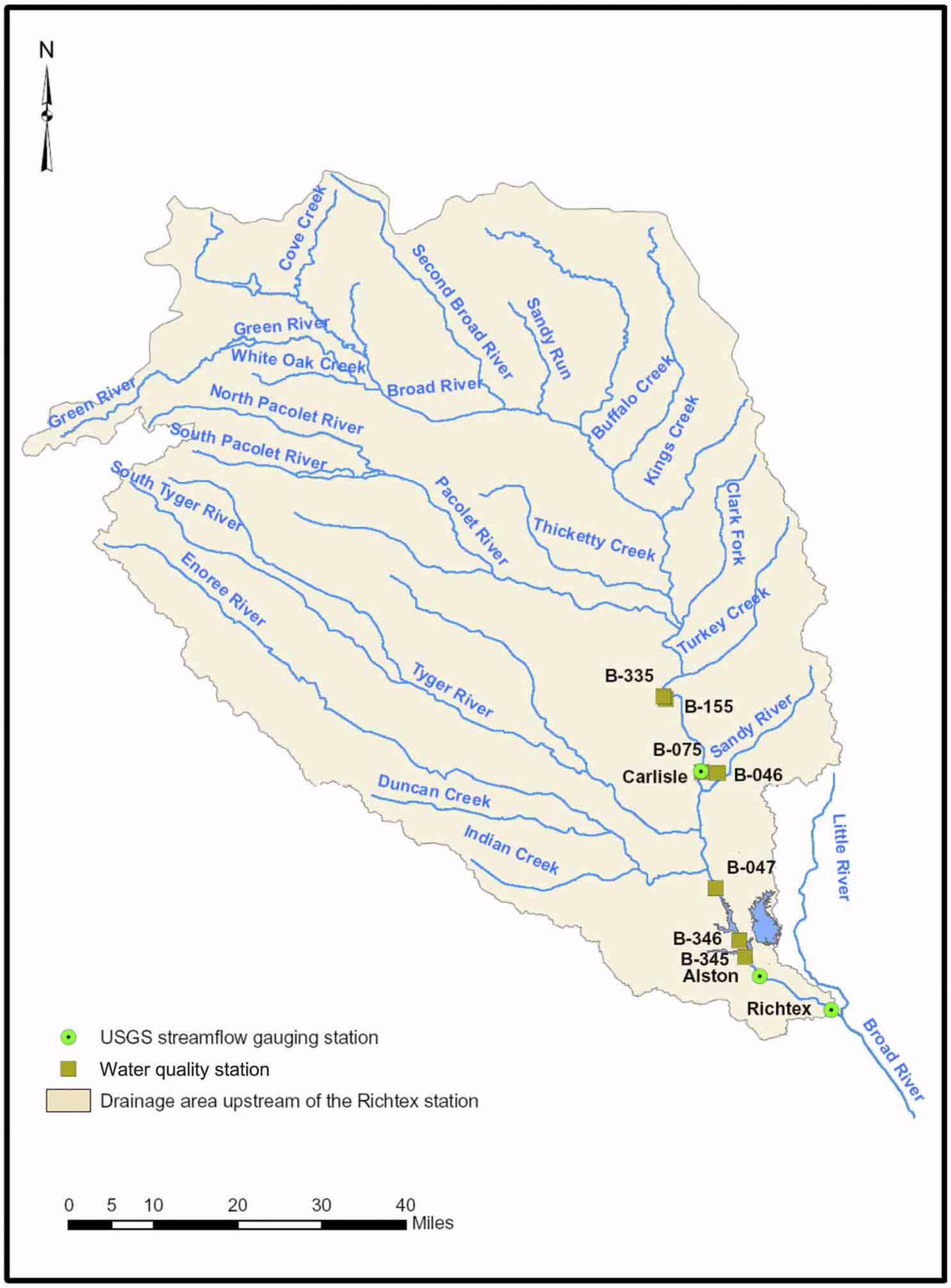


Figure 2.3-4. Broad River Watershed Upstream of the Site and Nearest Stream Flow Gauging Stations

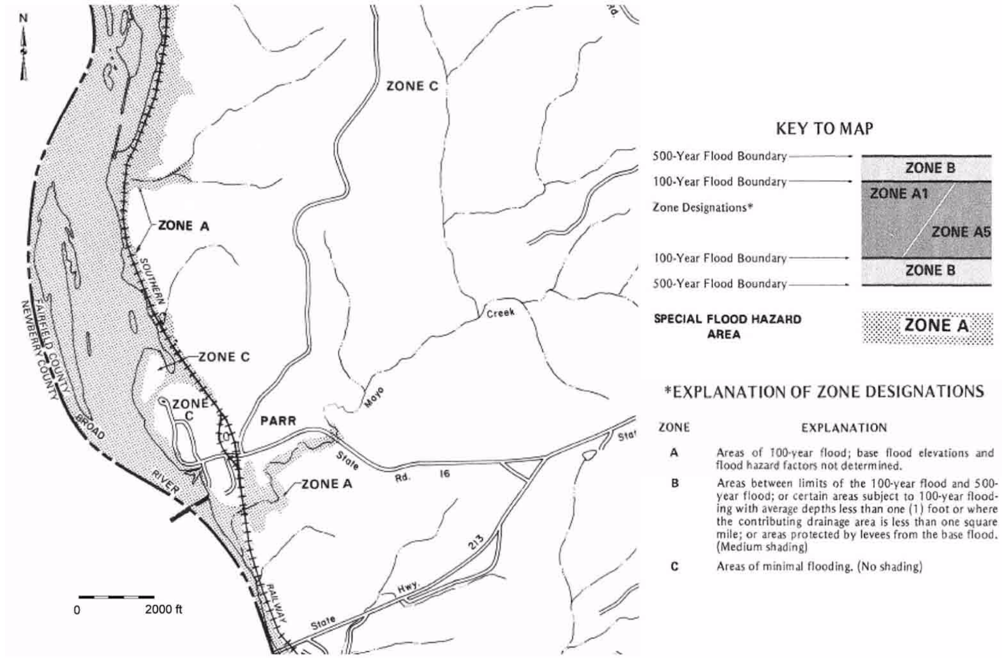


Figure 2.3-5. 100-year Floodplain Map in the Vicinity of VCSNS (Source: FEMA issued flood map, Fairfield County, South Carolina, ID 4500750175B)

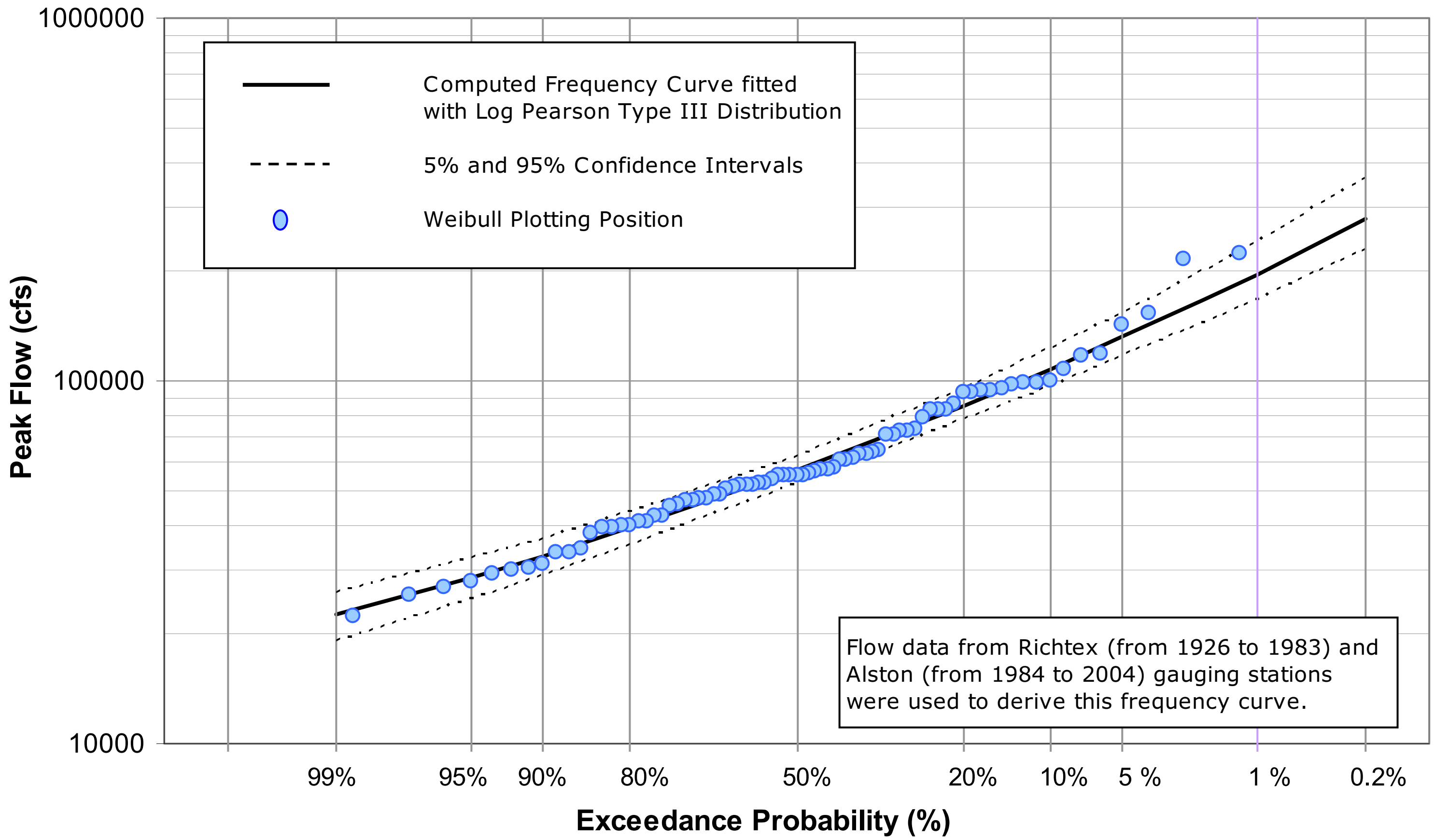
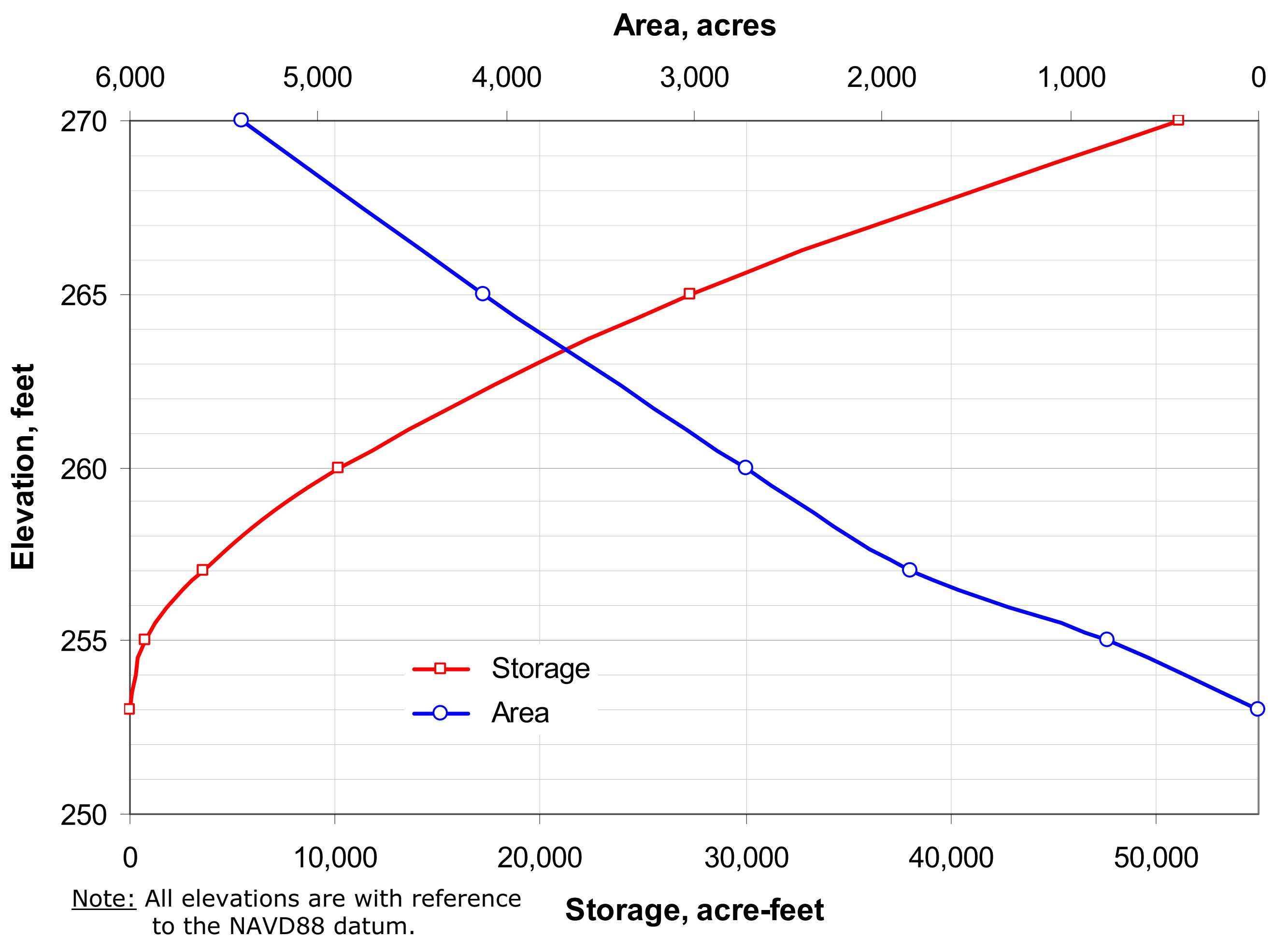
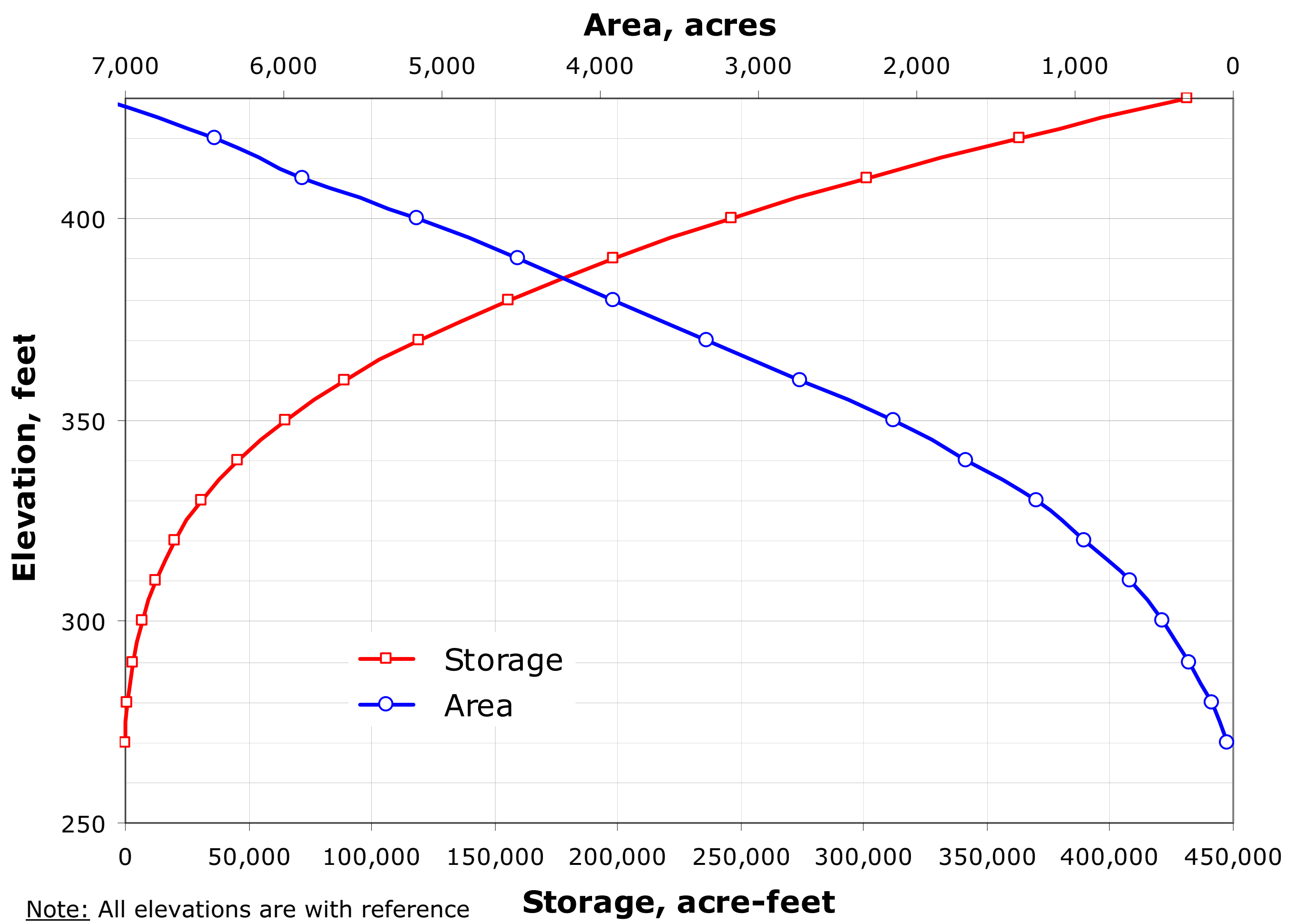


Figure 2.3-6. Flood Frequency Curve for the Broad River at Parr Shoals Dam



Note: All elevations are with reference to the NAVD88 datum.

Figure 2.3-7. Parr Reservoir Area and Storage Capacity Curves



Note: All elevations are with reference to the NAVD88 datum.

Figure 2.3-8. Monticello Reservoir Area and Storage Capacity Curves

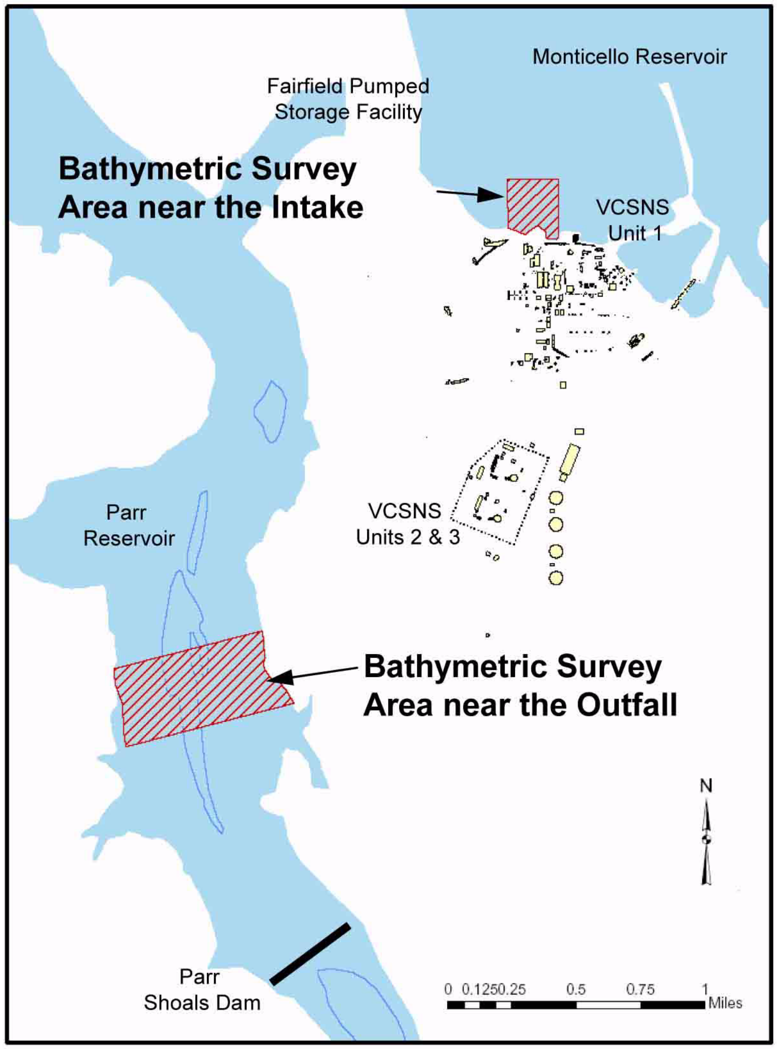


Figure 2.3-9. Location of Bathymetric Survey Areas

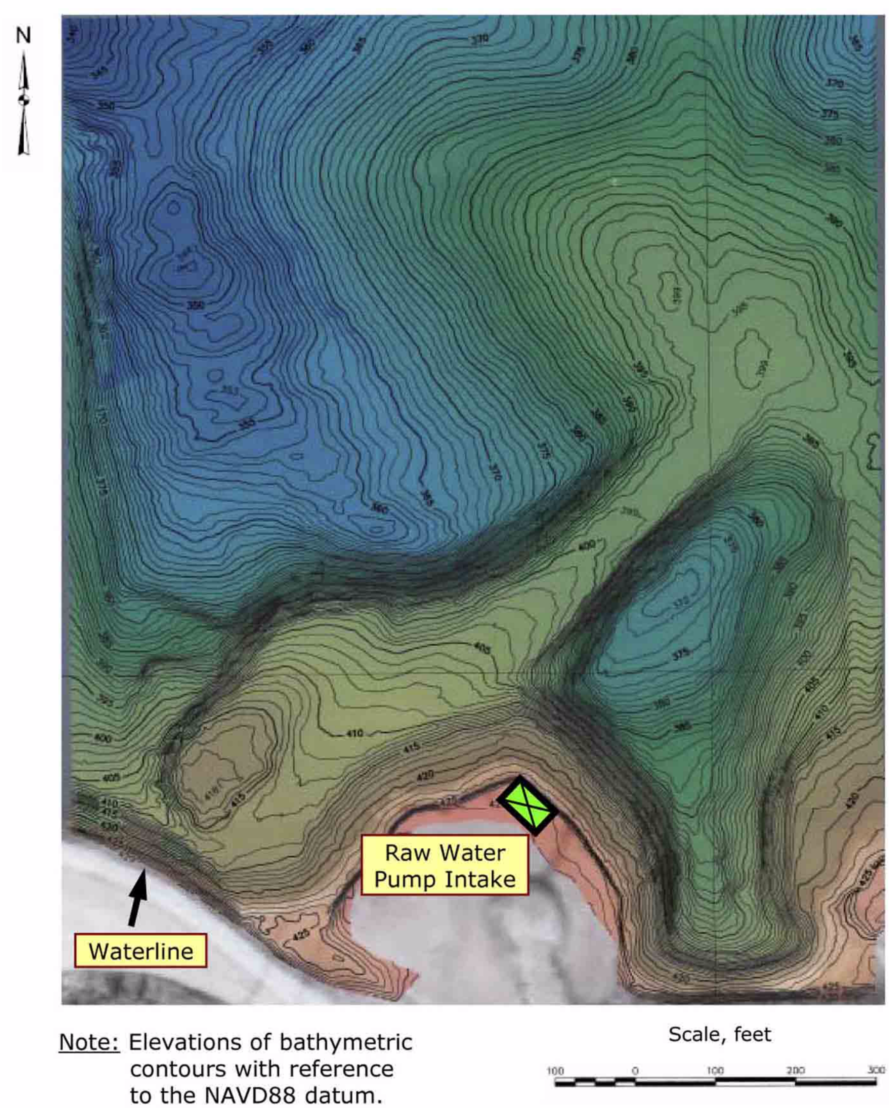


Figure 2.3-10. Proposed Intake Location Monticello Reservoir, South Carolina

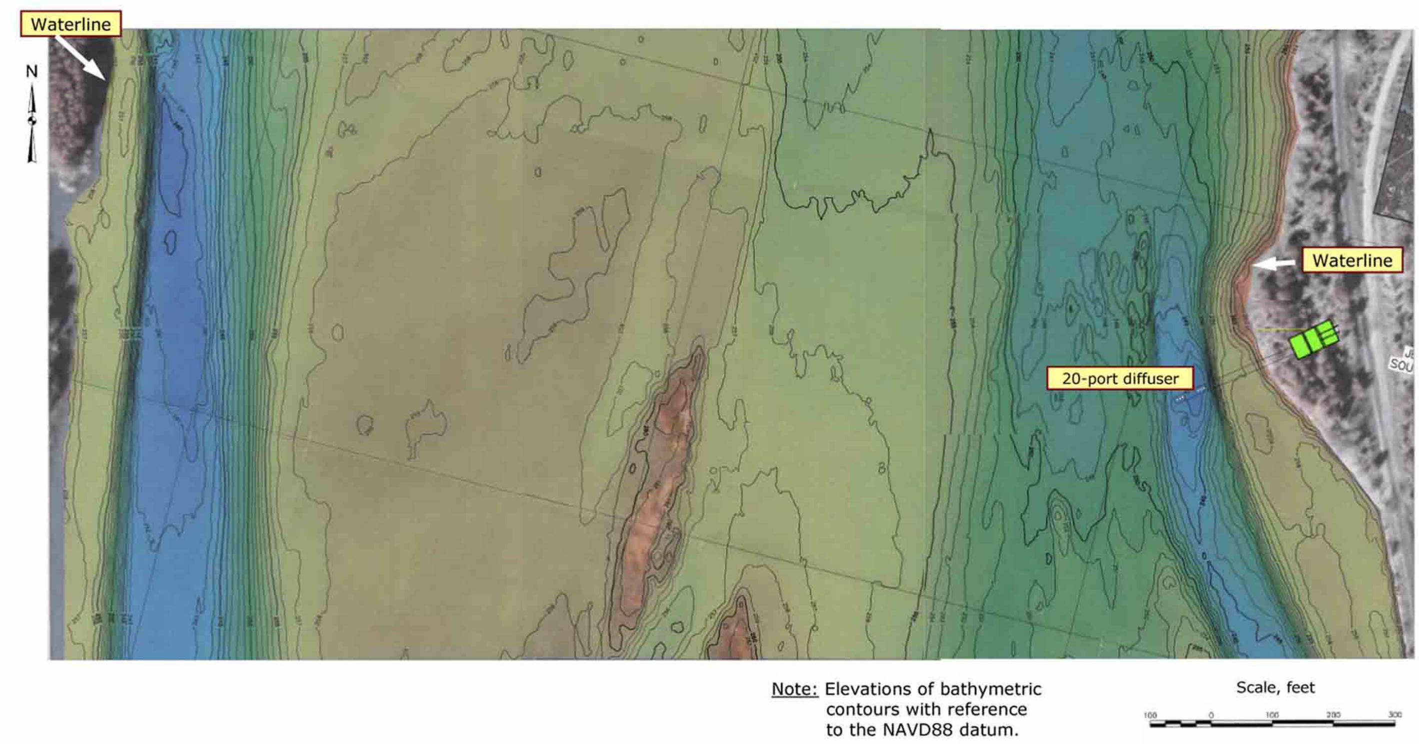


Figure 2.3-11. Proposed Discharge Location Parr Reservoir, South Carolina

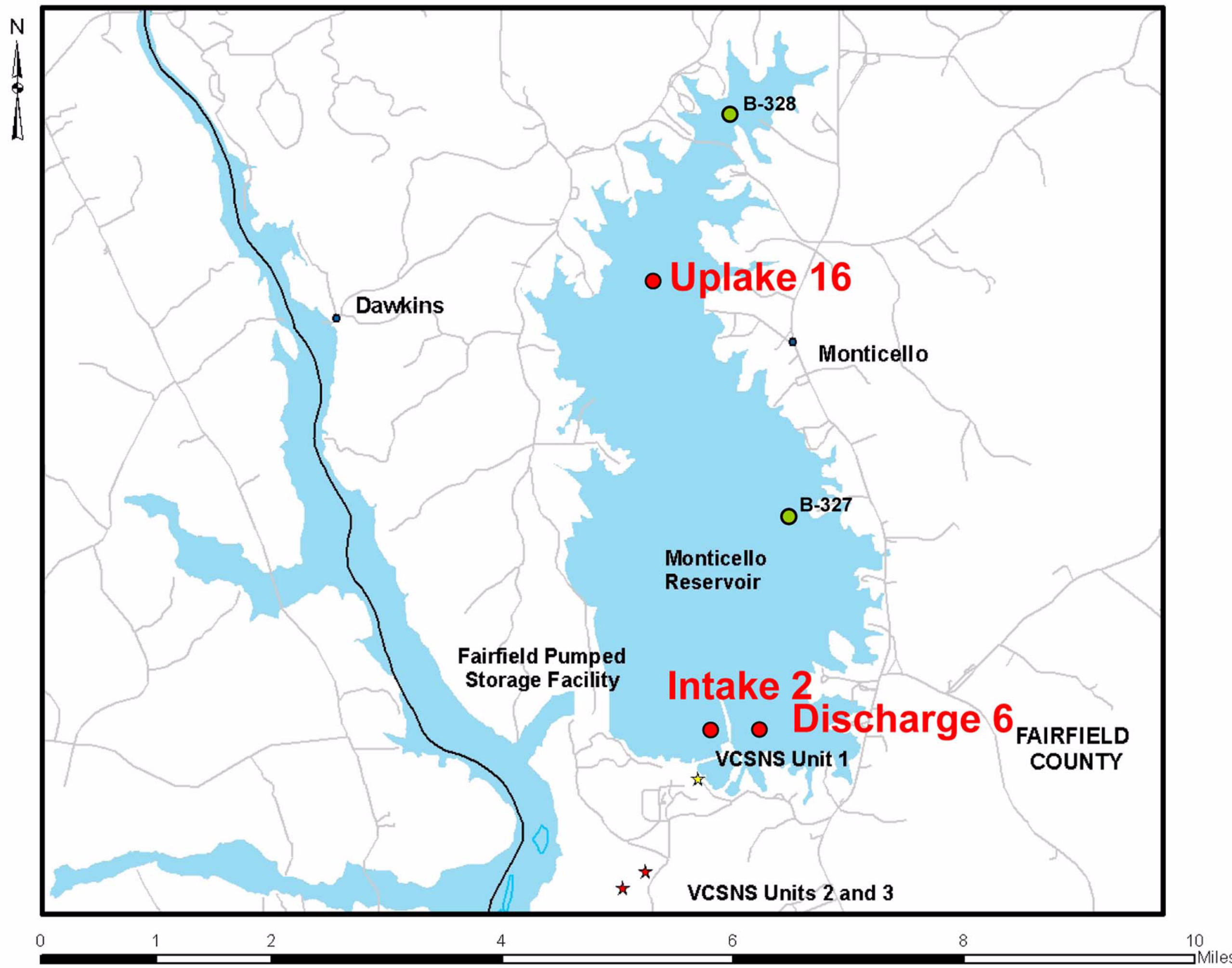


Figure 2.3-12. Locations of Water Quality Monitoring Stations in Monticello Reservoir

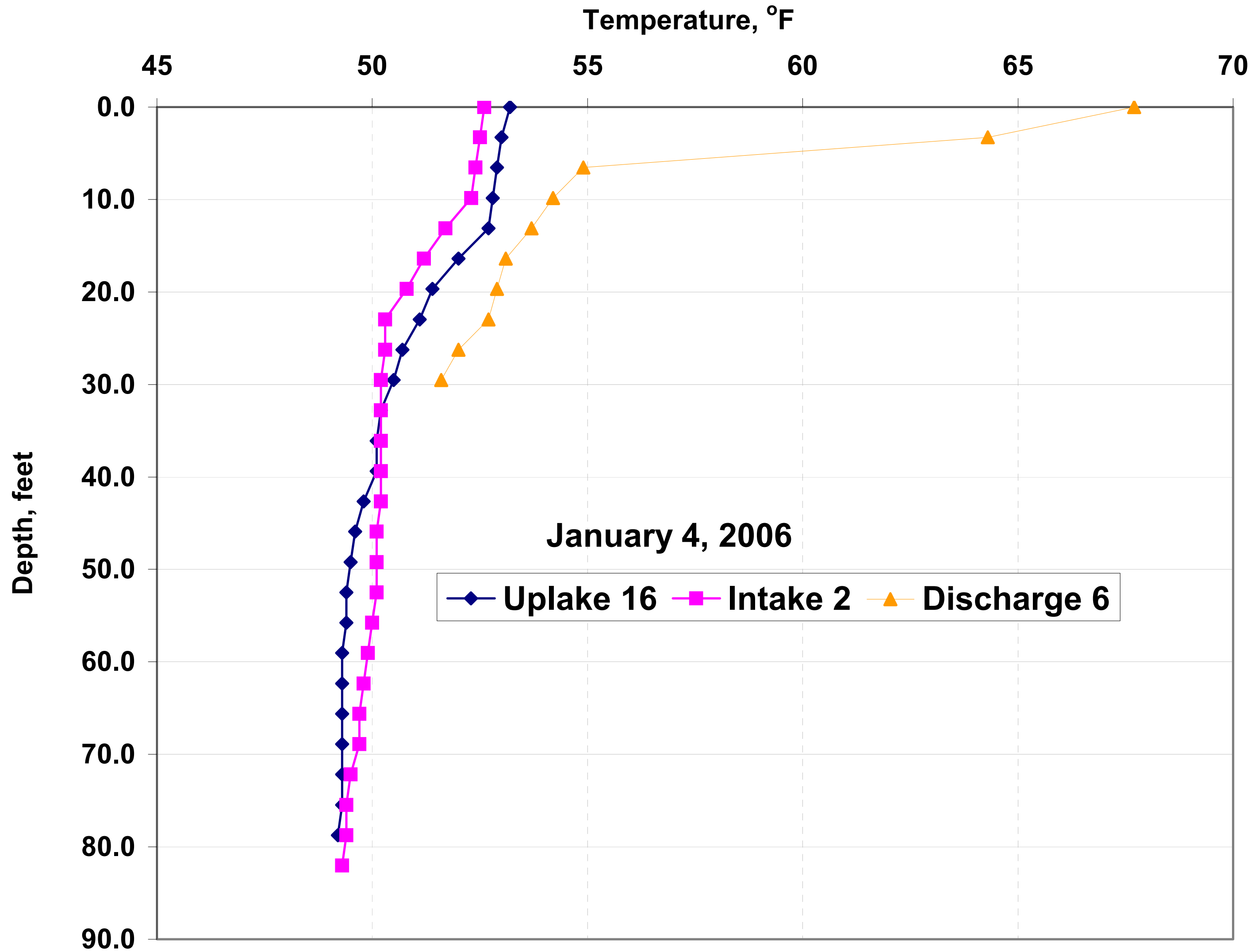


Figure 2.3-13. January Vertical Profiles for Water Temperatures in Monticello Reservoir in 2006

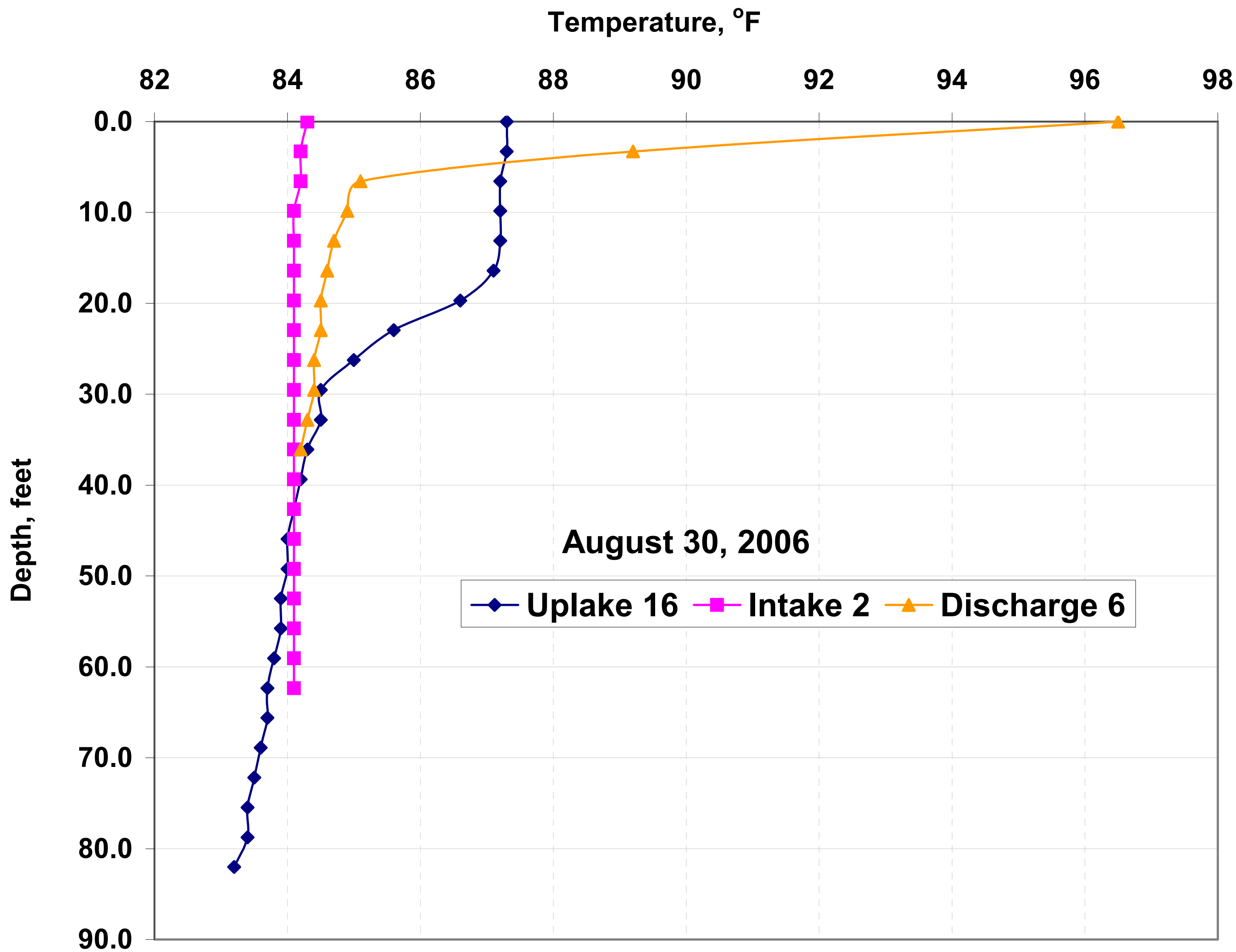


Figure 2.3-14. August Vertical Profiles for Water Temperatures in Monticello Reservoir in 2006

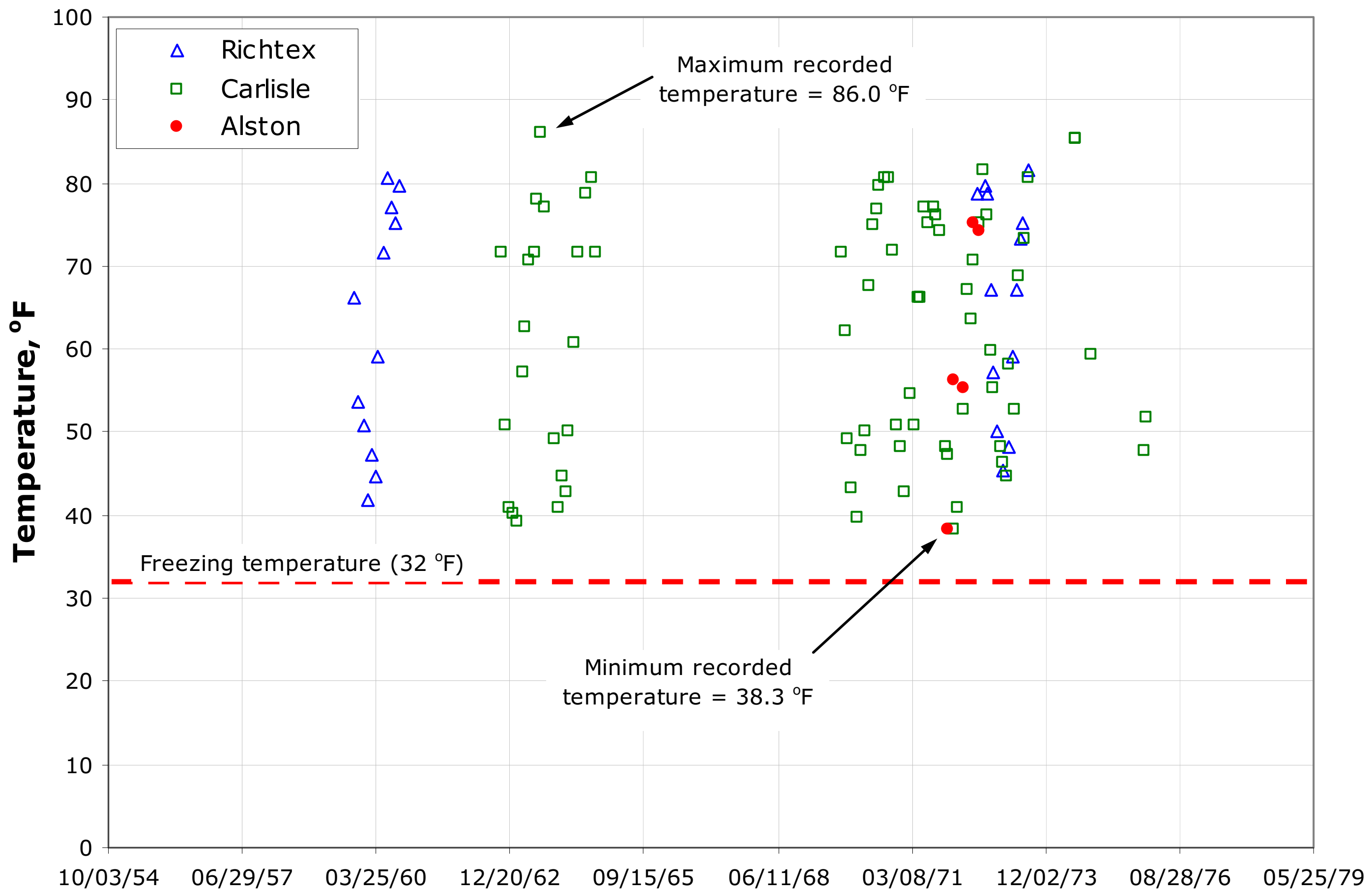
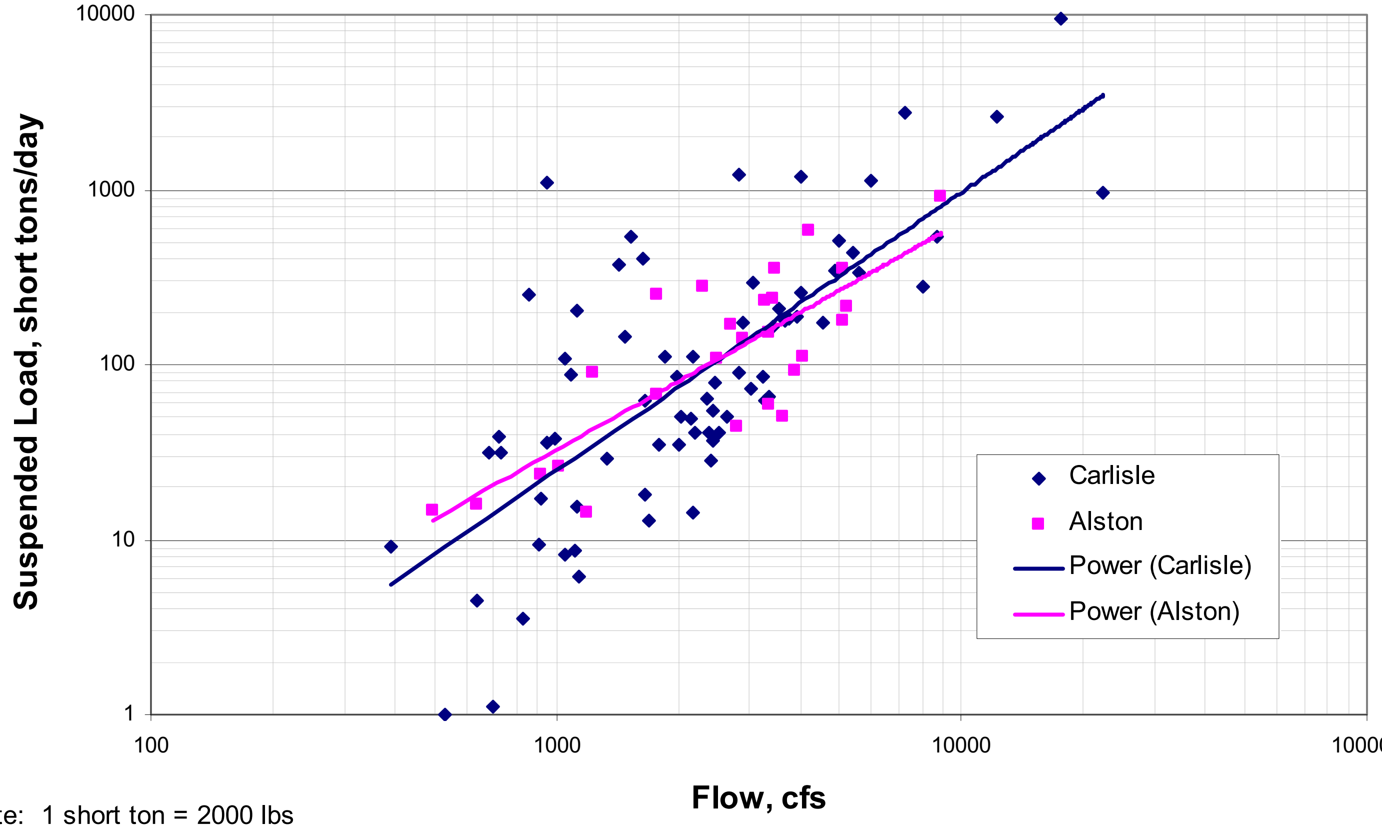


Figure 2.3-15. Recorded Water Temperatures in Broad River



Note: 1 short ton = 2000 lbs

Figure 2.3-16. Suspended Sediment in the Broad River for the Carlisle and Alston Gauges (USGS #02156500 and USGS #0216100, respectively)

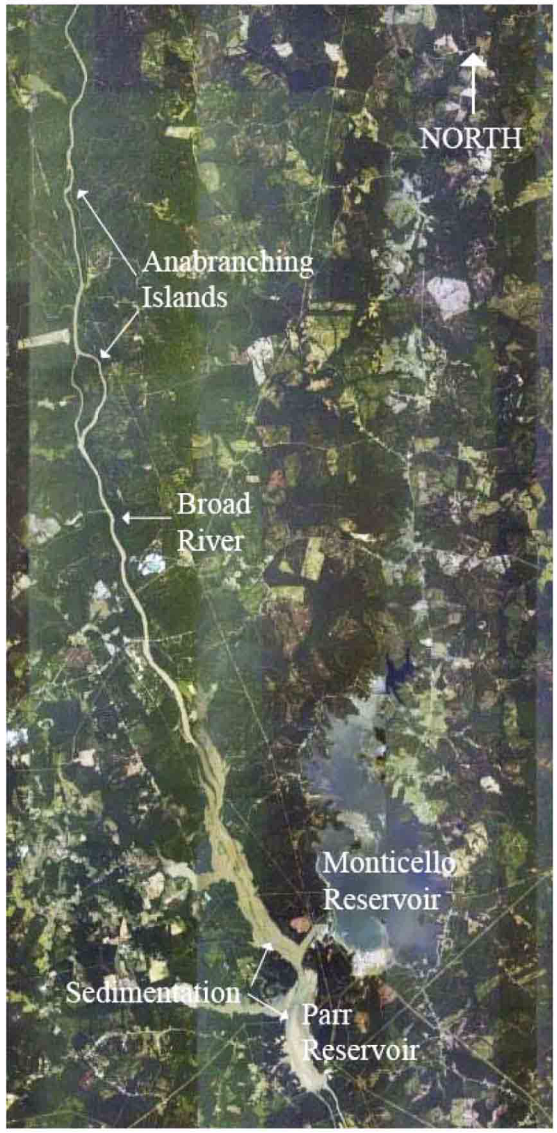


Figure 2.3-17. Backwater Effects from Parr Reservoir Extend Thirteen Miles Upstream

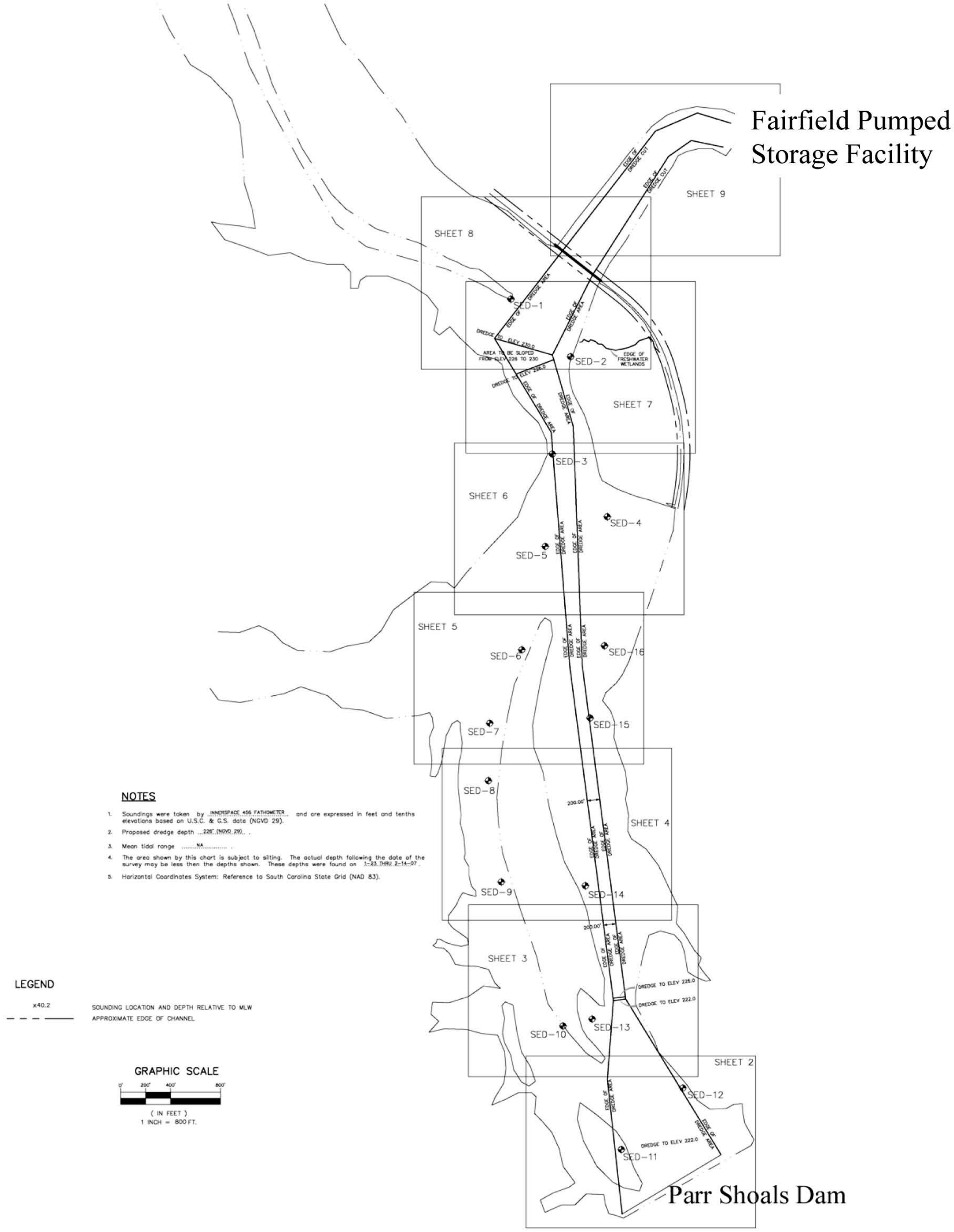
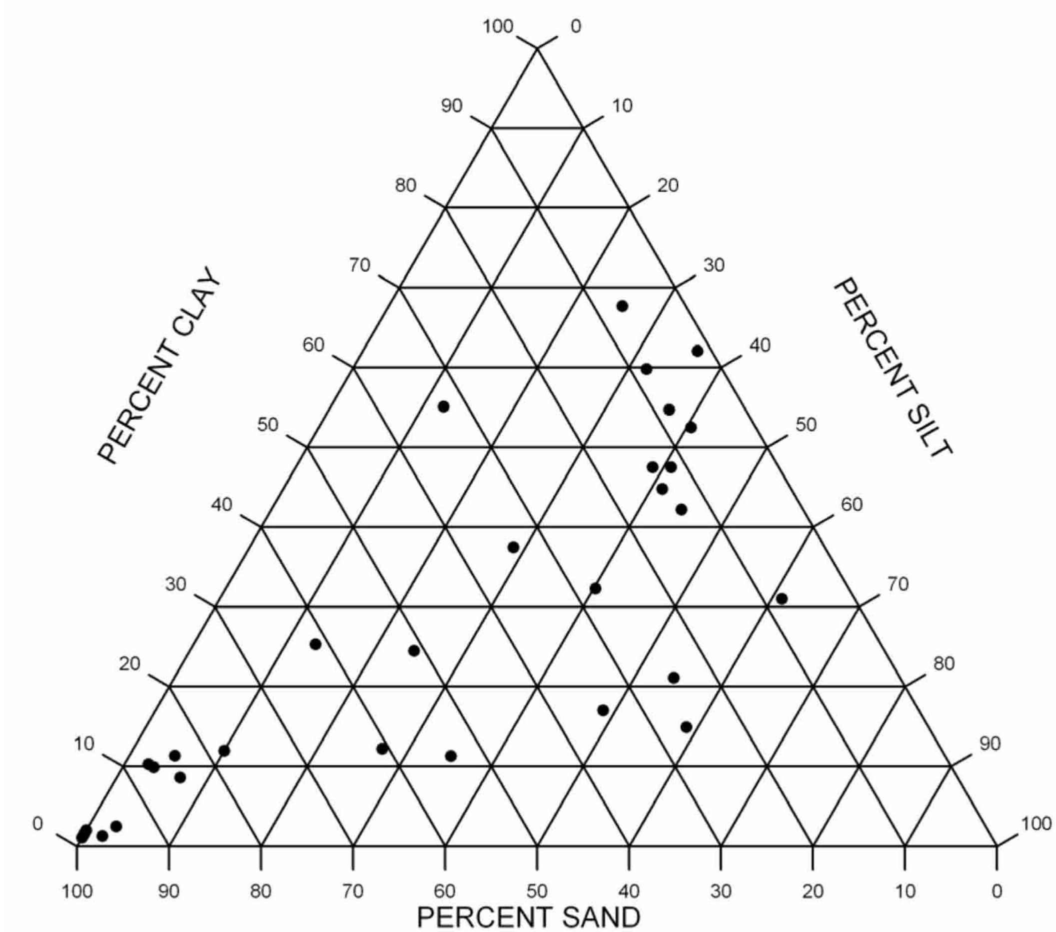


Figure 2.3-18. SCE&G Sediment Sampling Sites from January 2007



(The sediment gradations indicate the predominant sediment distribution in Parr Reservoir includes (i) clay and clay-silt fractions and (ii) sand and sand-silt fractions)

Figure 2.3-19. Ternary Diagram Showing the Sediment Gradations for Parr Reservoir Sediment Sampling

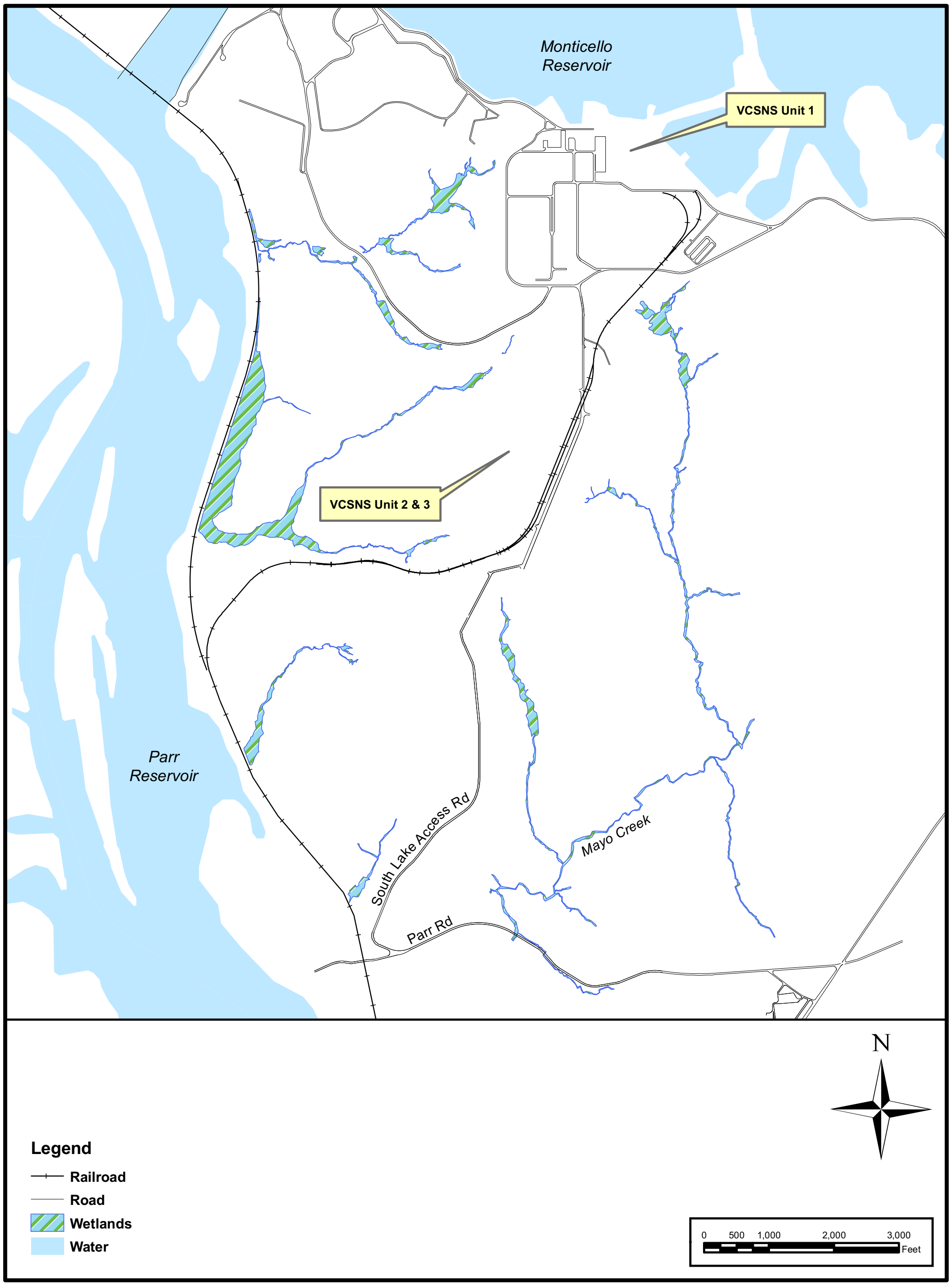


Figure 2.3-20. Mapped Wetlands

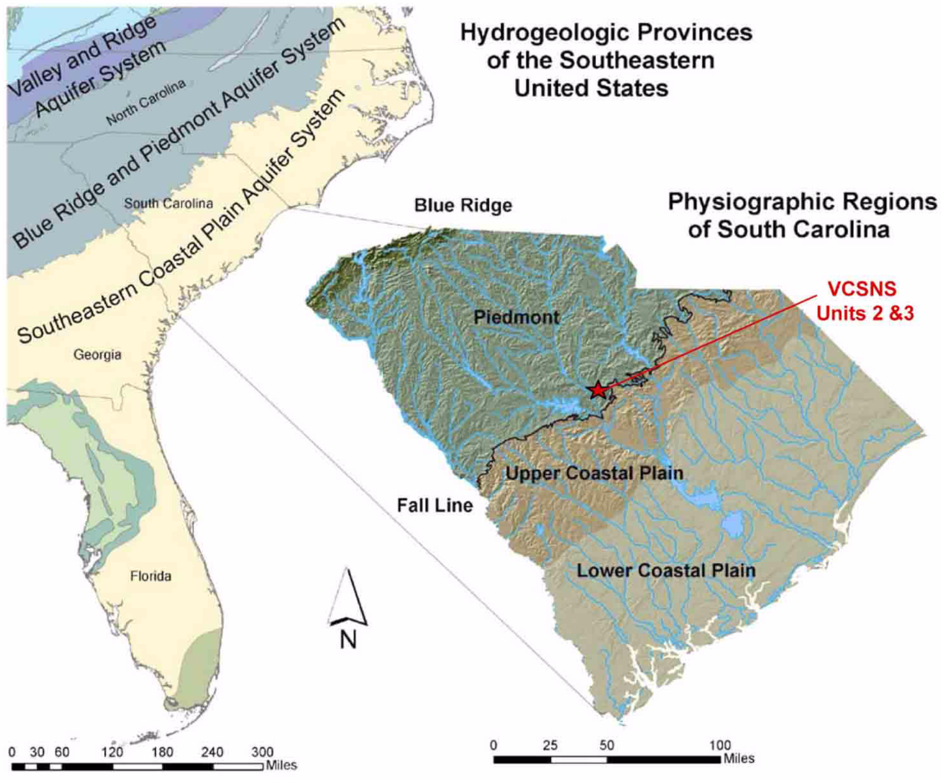


Figure 2.3-21. Hydrogeologic Provinces and Associated Physiographic Provinces in South Carolina (Childress and Butler 2006)

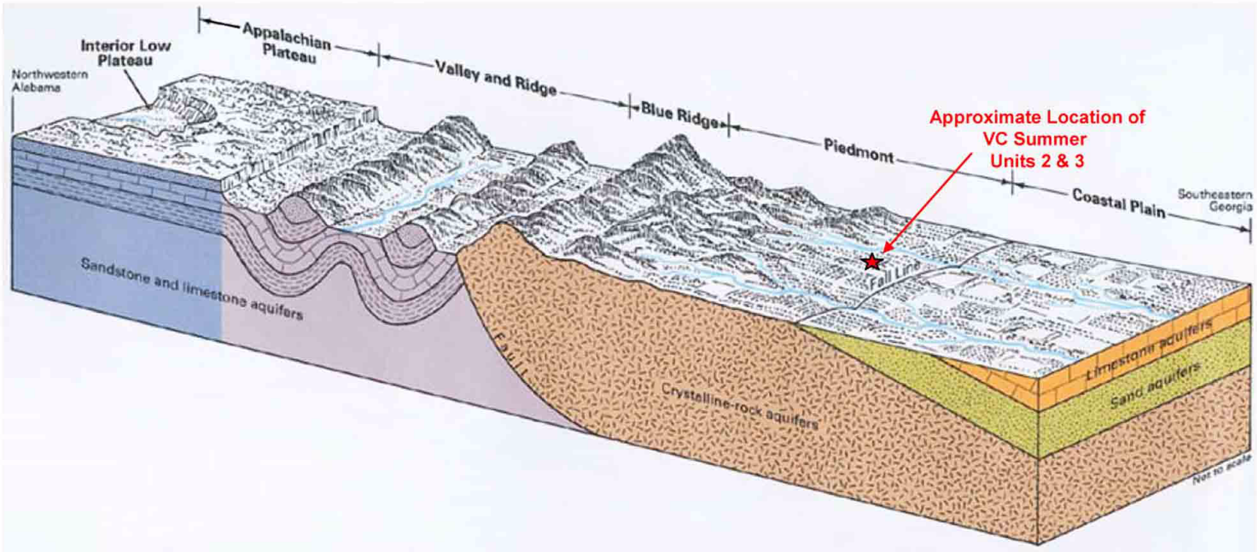


Figure 2.3-22. Geologic Cross Section of the Regional Physiographic Provinces and Associated Aquifer Systems (Miller 1990)

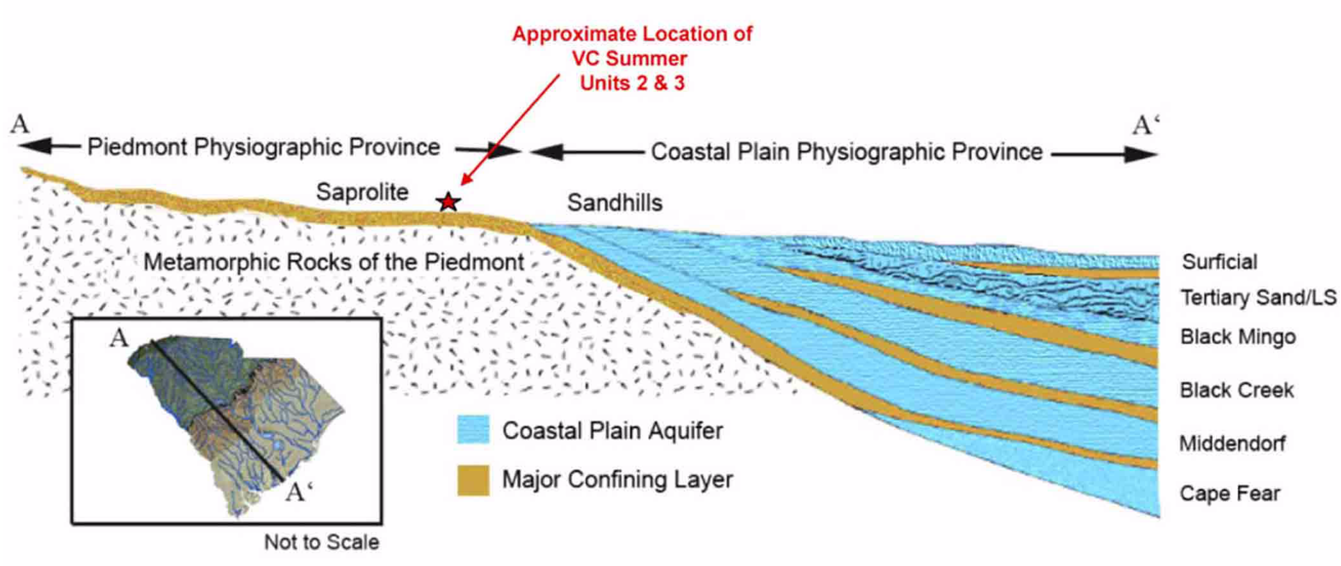


Figure 2.3-23. Hydrogeologic Cross Section of South Carolina (Childress and Butler 2006)

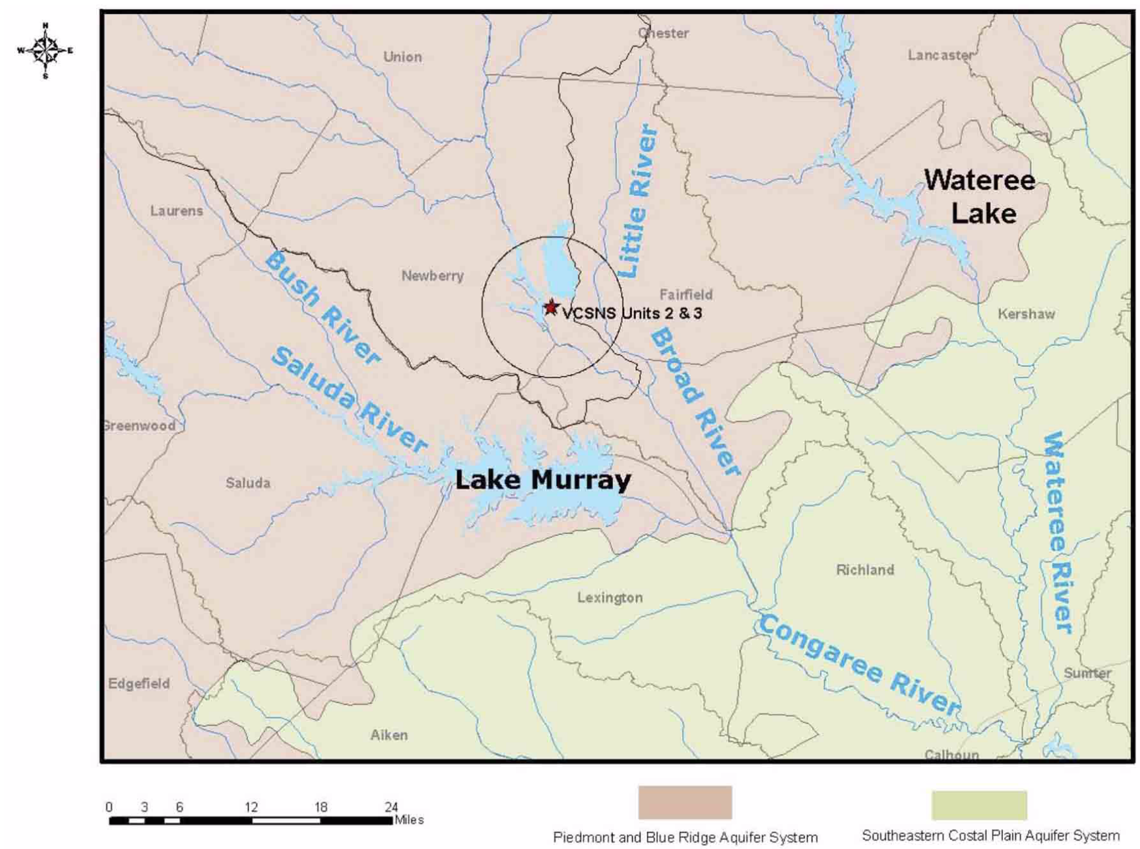


Figure 2.3-24. Regional Aquifer Systems

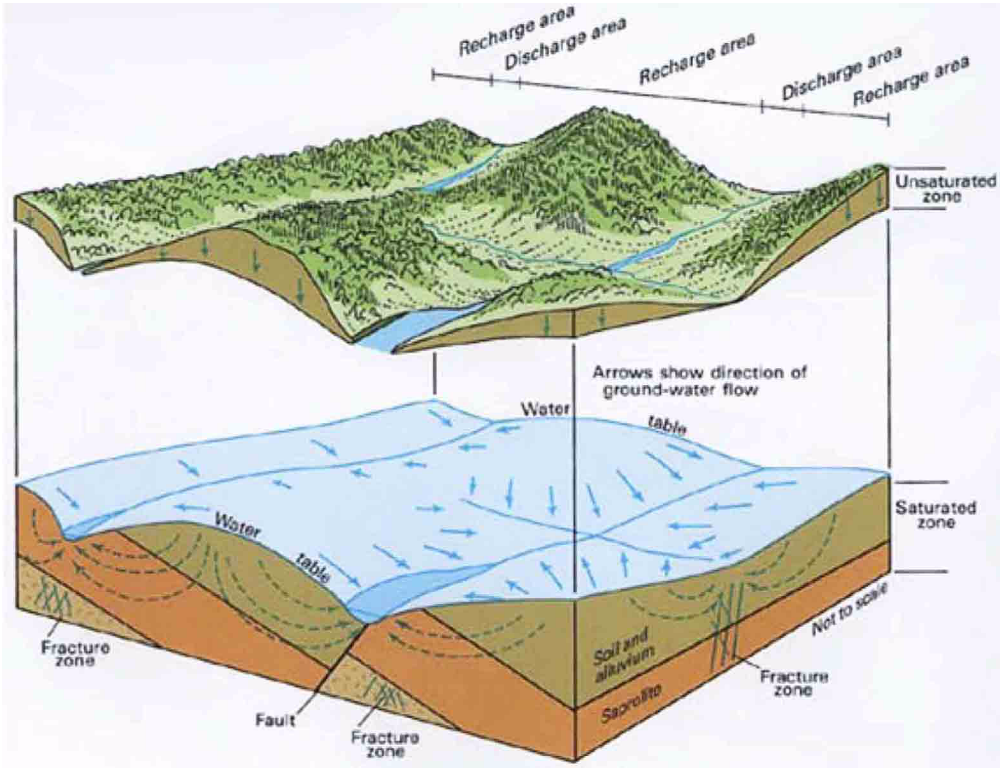


Figure 2.3-25. Groundwater Flow in the Piedmont/Blue Ridge Aquifer System (Miller 1990)

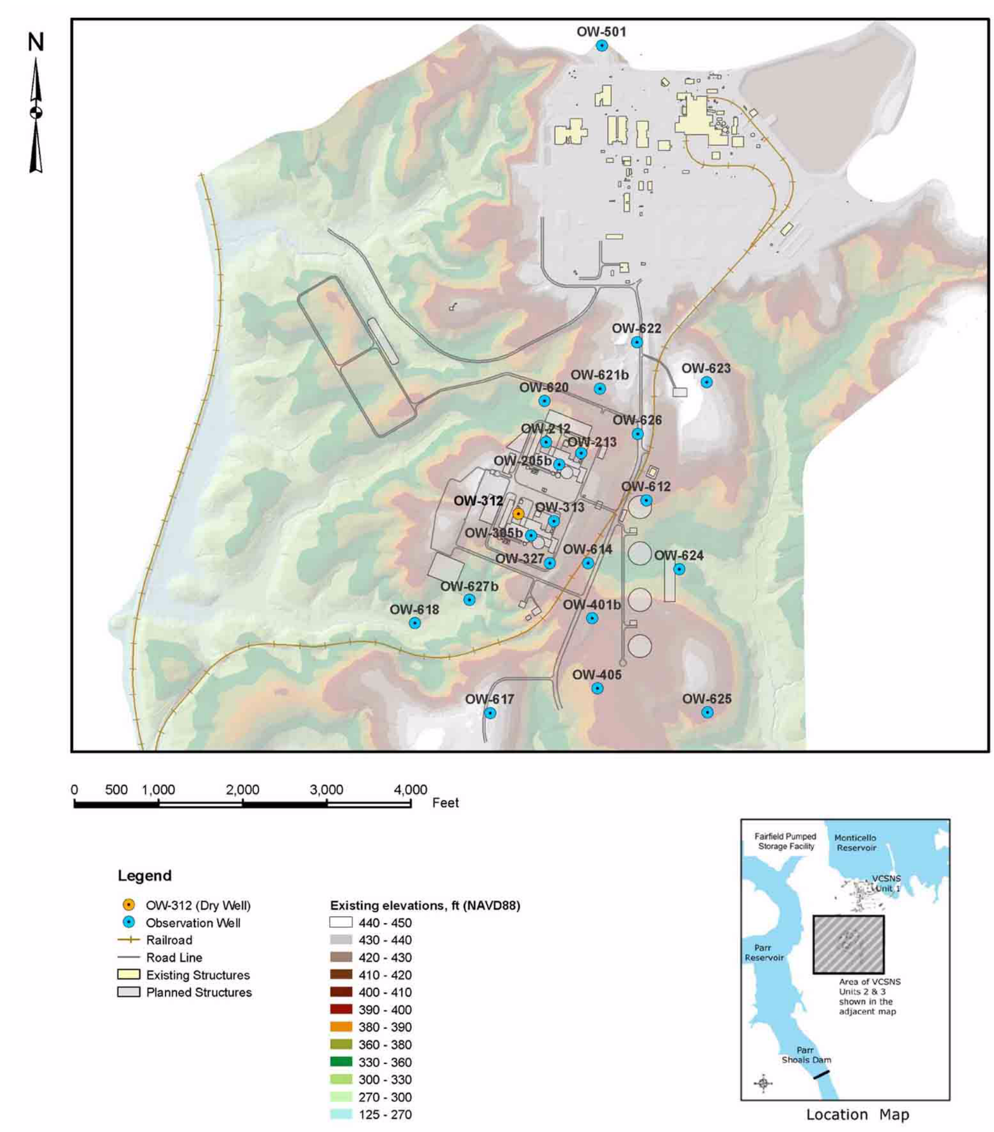


Figure 2.3-26. Observation Well Locations in the Saprolite/ Shallow Bedrock Zone

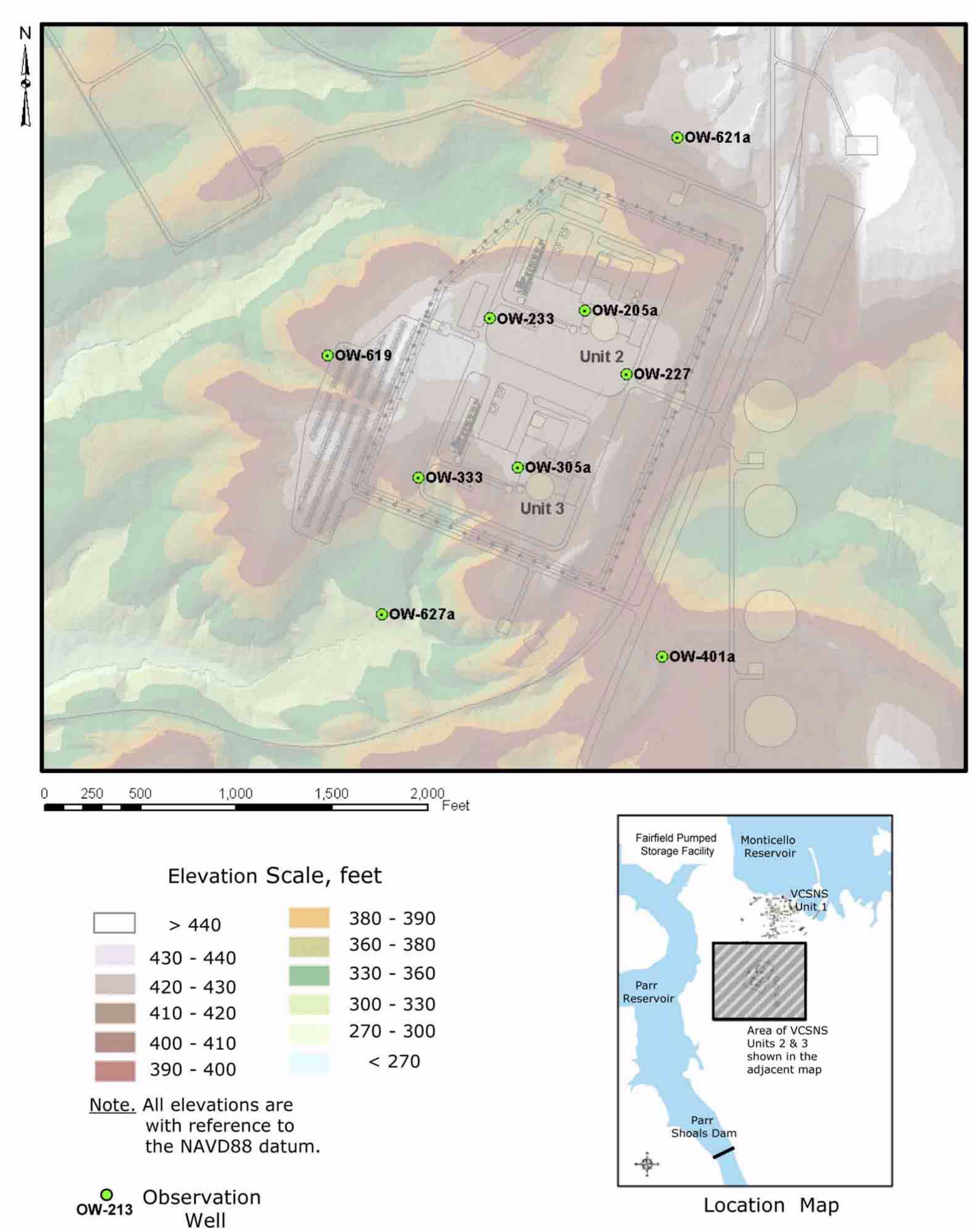


Figure 2.3-27. Deep Bedrock Zone Observation Well Locations

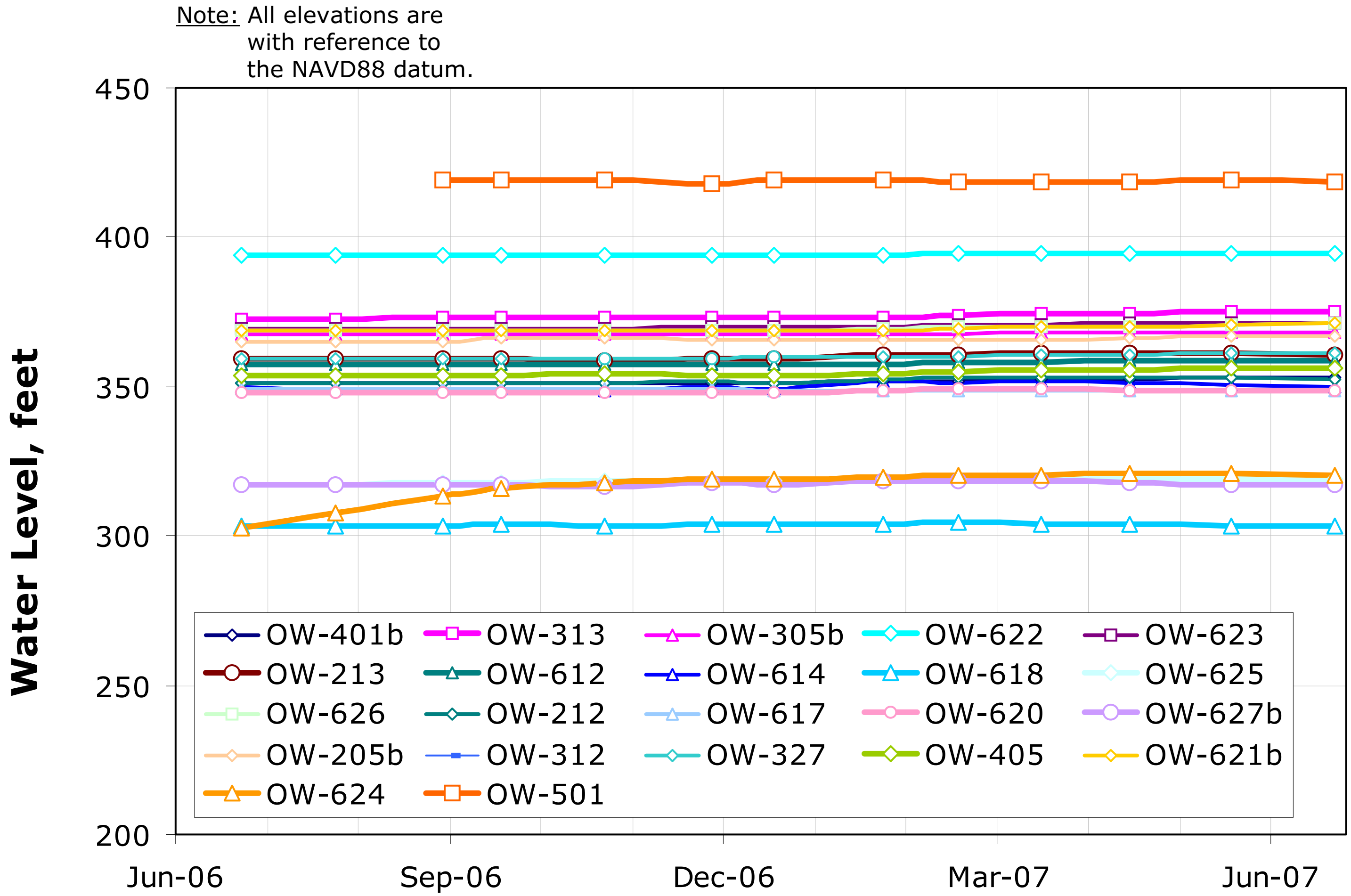


Figure 2.3-28. Hydrographs for Saprolite/Shallow Bedrock Hydrostratigraphic Zone VCSNS Observation Wells, June 2006–June 2007

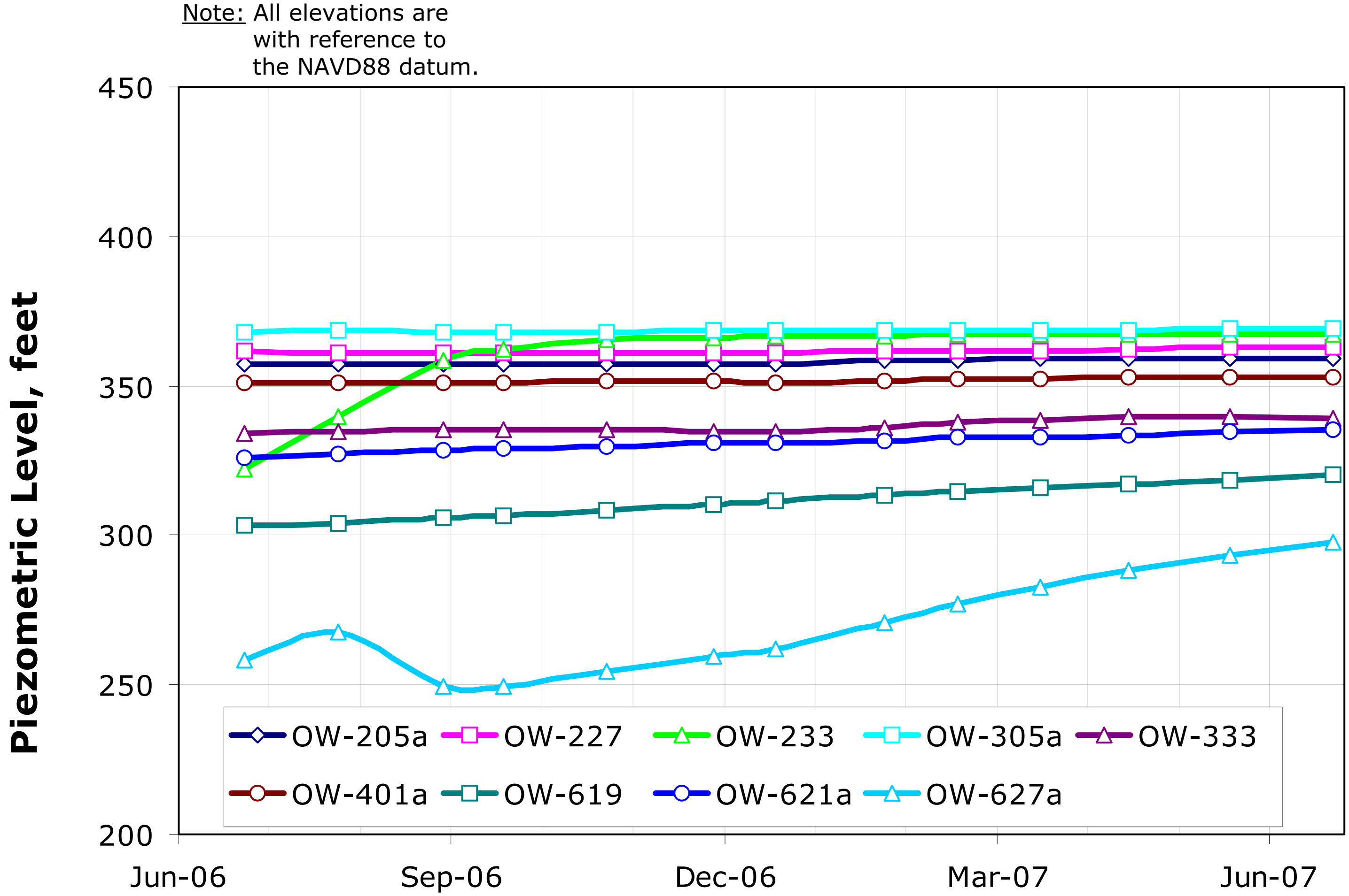


Figure 2.3-29. Hydrographs for Deep Bedrock Hydrostratigraphic Zone VCSNS Observation Wells, June 2006–June 2007

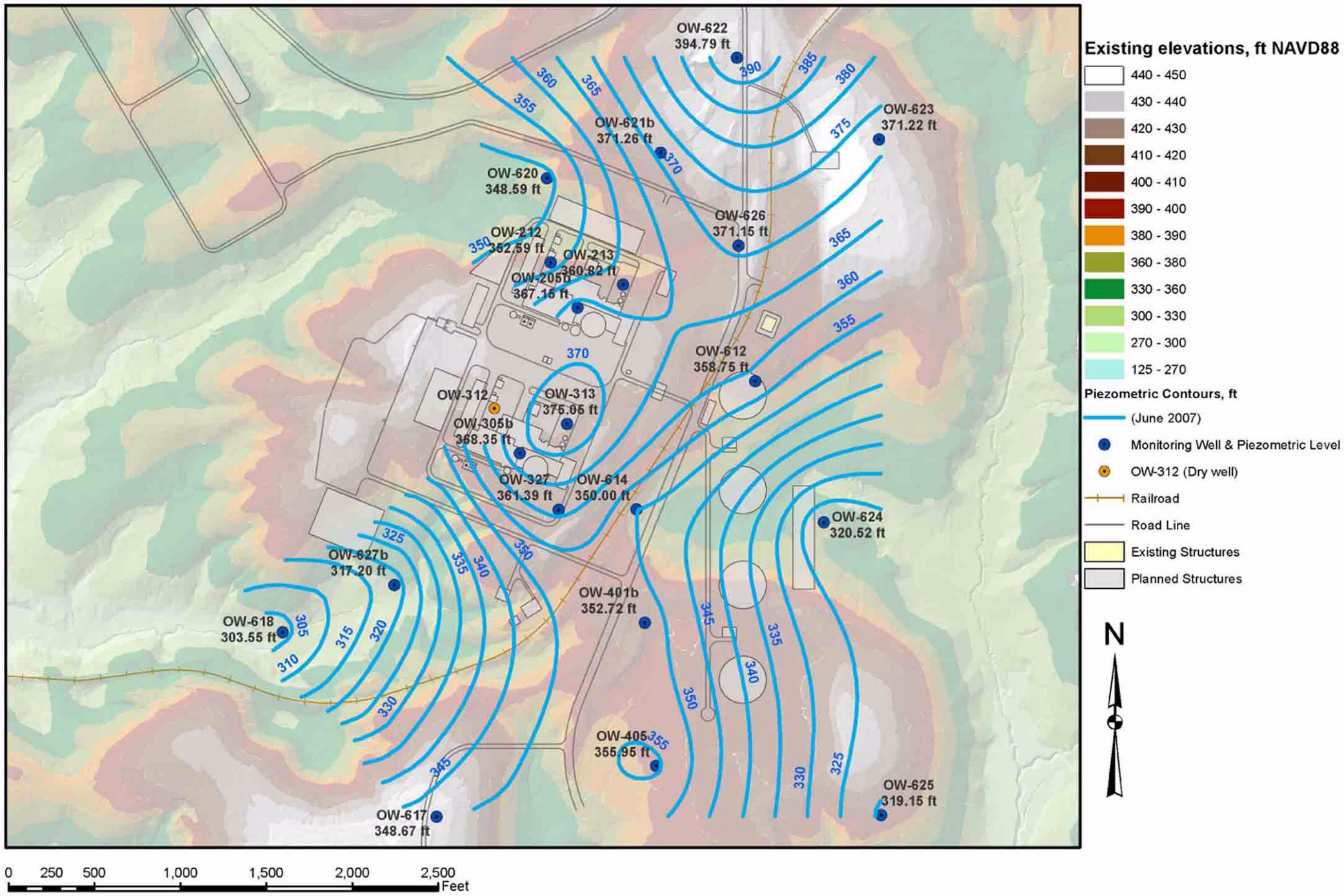


Figure 2.3-30. Piezometric Contour Map in the Saprolite/Shallow Bedrock Zone, June 2007

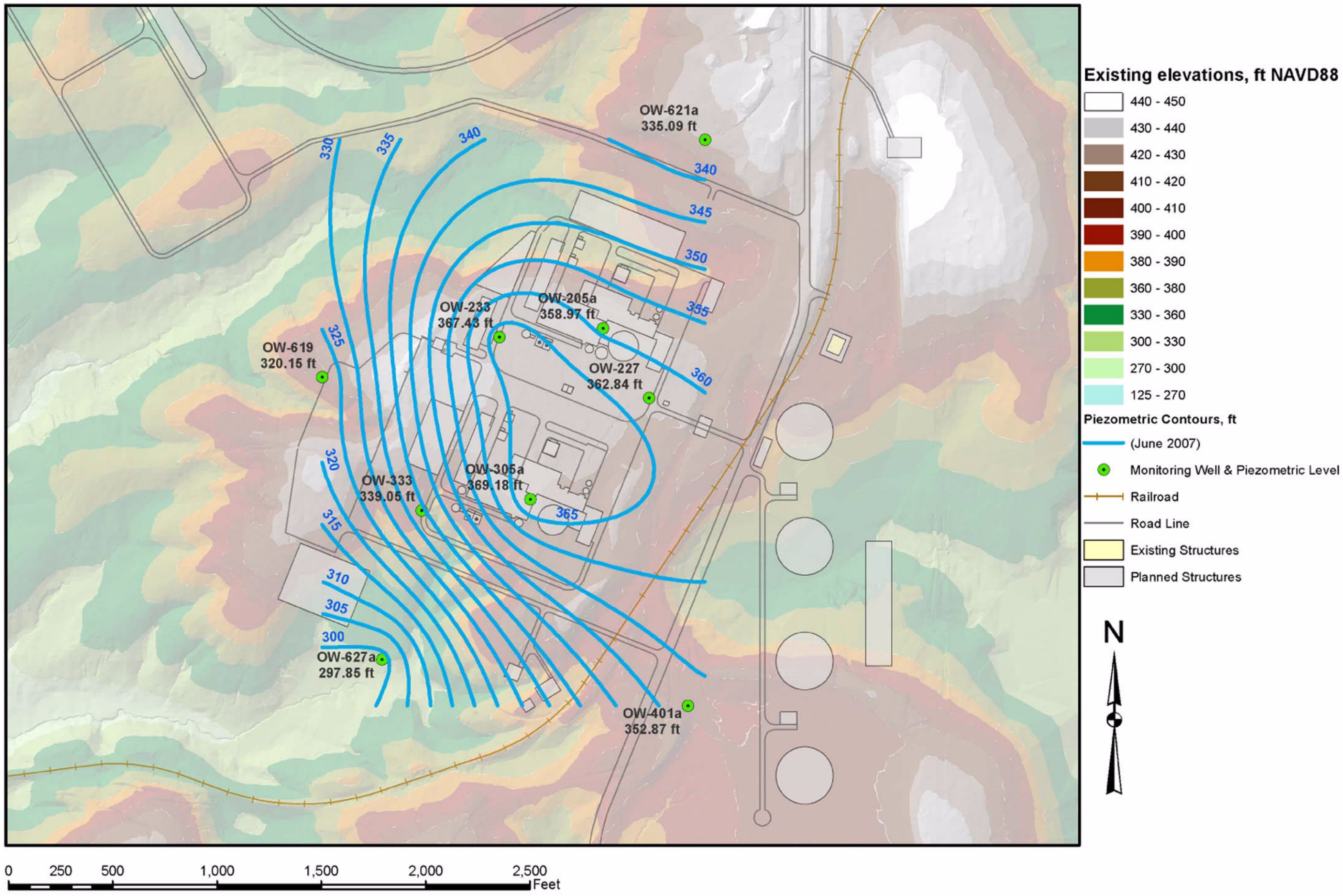


Figure 2.3-31. Piezometric Contour Map in the Deep Bedrock Zone, June 2007

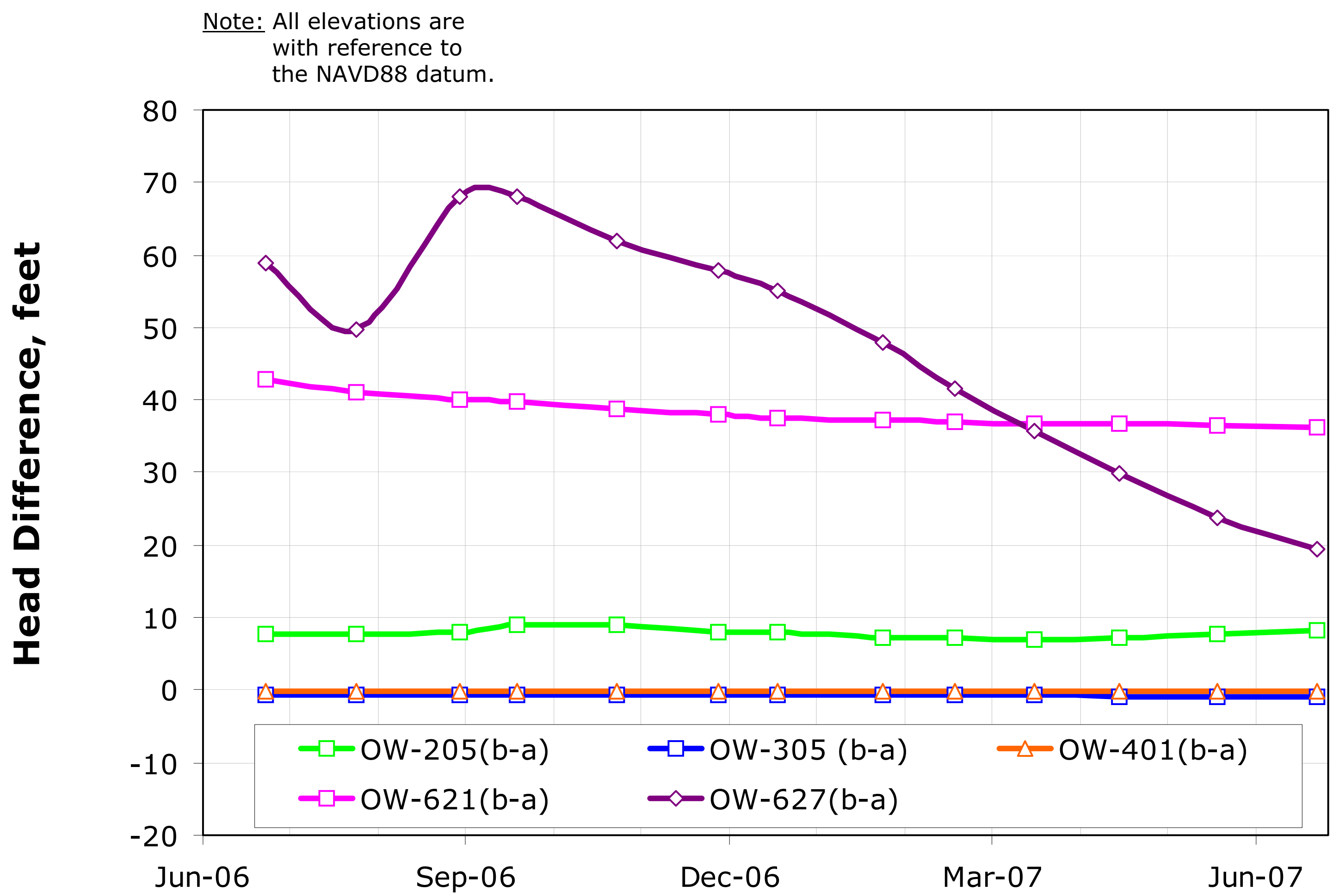


Figure 2.3-32. Head Differential between the Saprolite/Shallow Bedrock Hydrostratigraphic Zone and the Deep Bedrock Hydrostratigraphic Zone based on Well Pairs

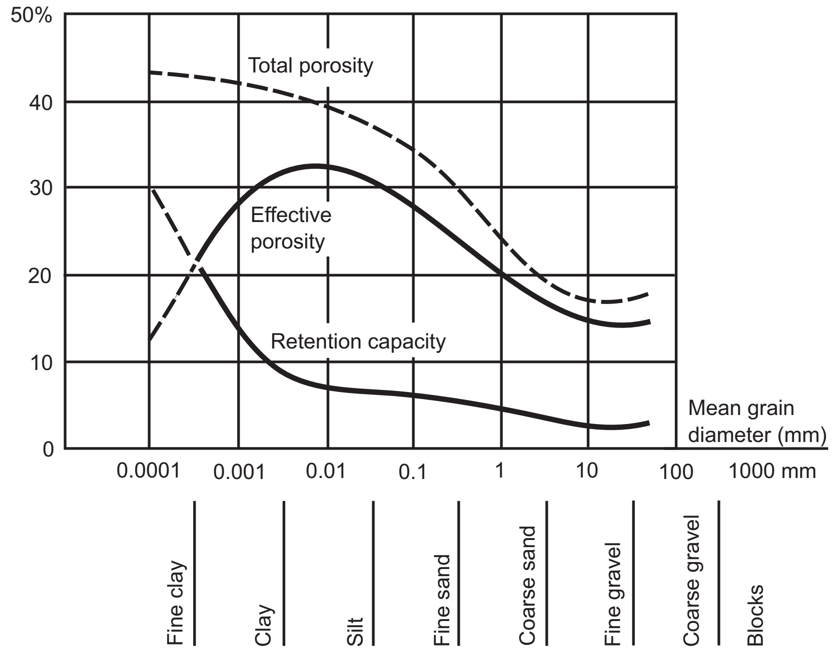


Figure 2.3-33. Porosity components as a Function of Grain Size (de Marsily, 1986)

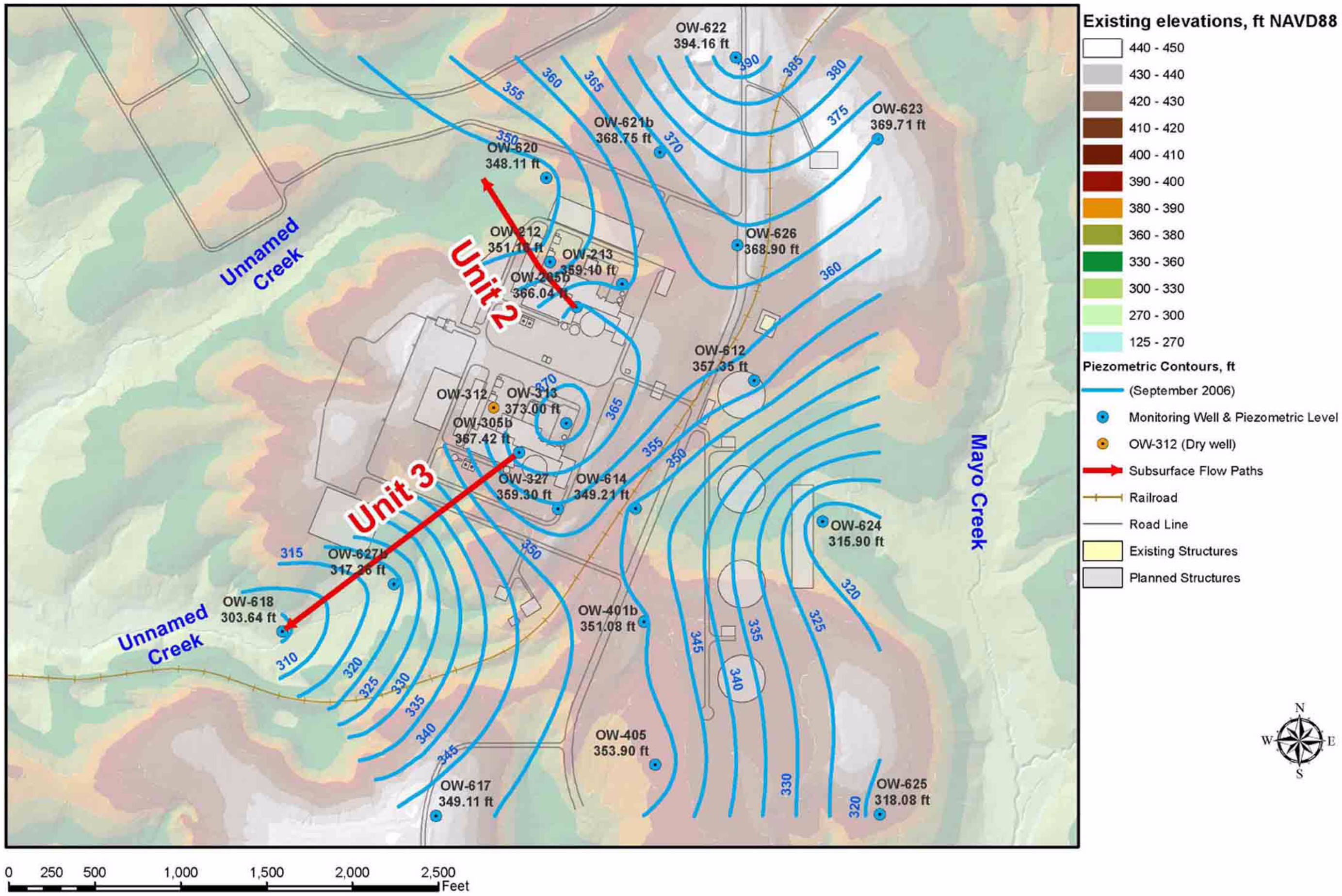


Figure 2.3-34. Plan View of Subsurface Groundwater Pathways for Units 2 and 3 to the Unnamed Creeks (Saprolite/ Shallow Bedrock Zone)

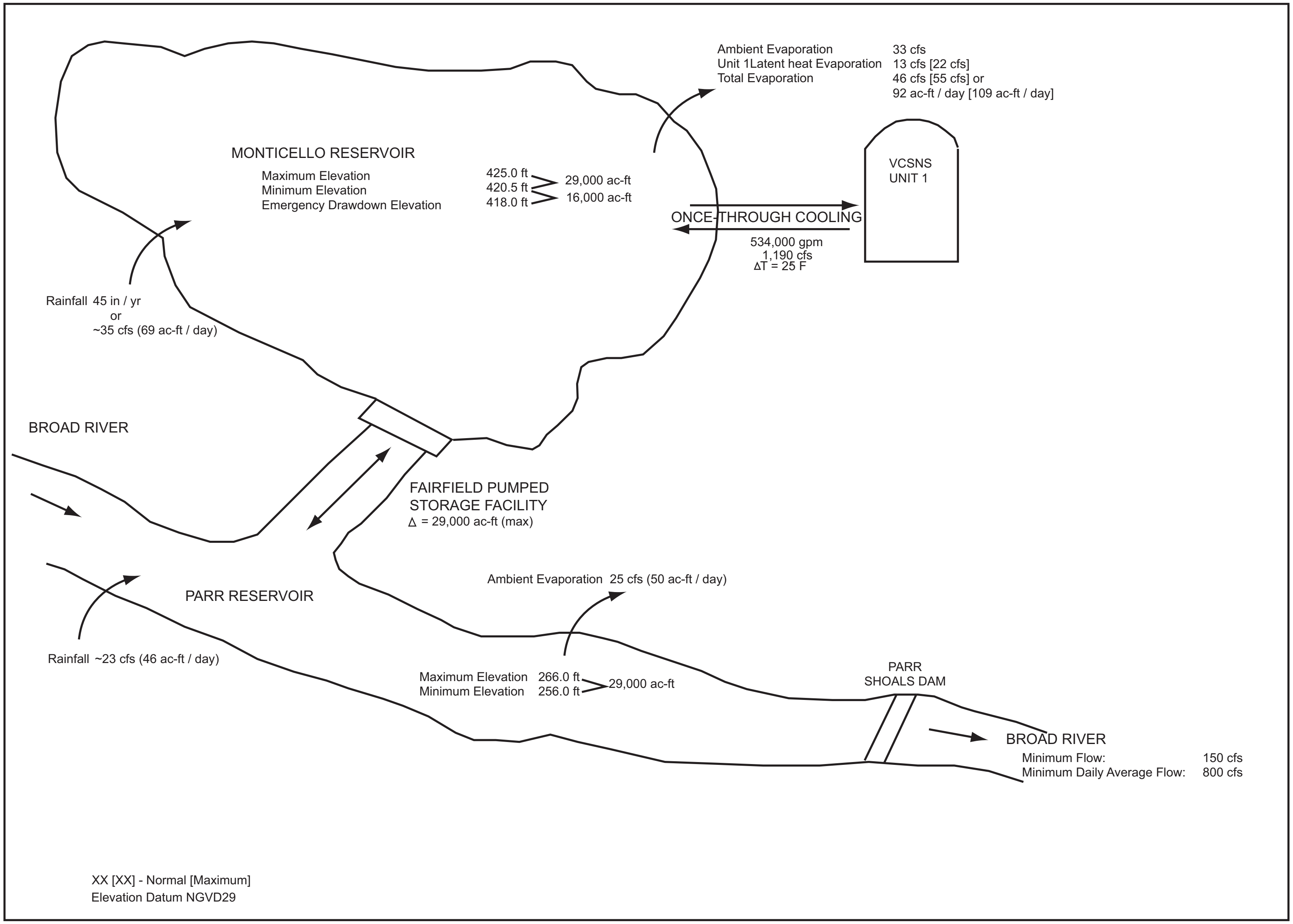


Figure 2.3-35. Diagram of Broad River, Parr Reservoir, and Monticello Reservoir System

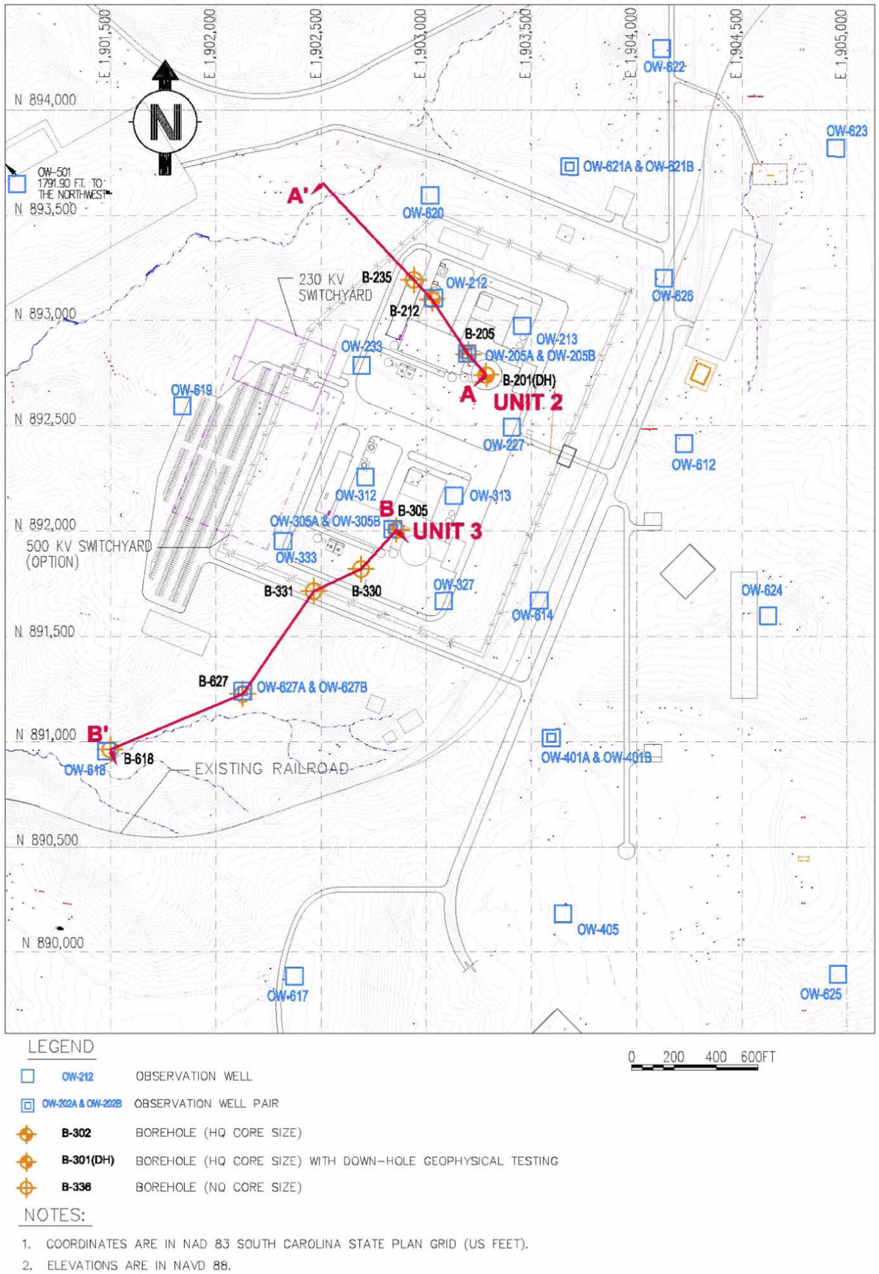
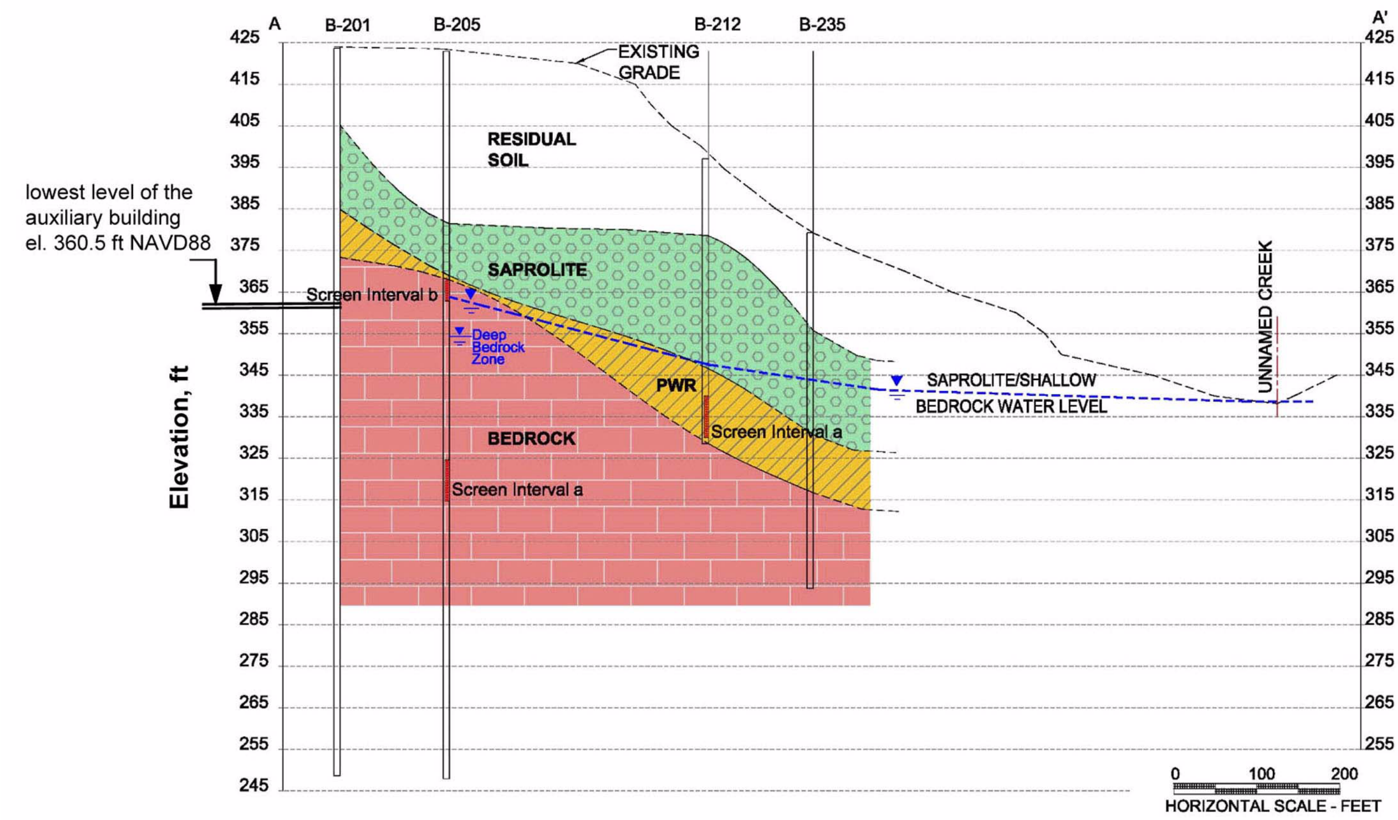
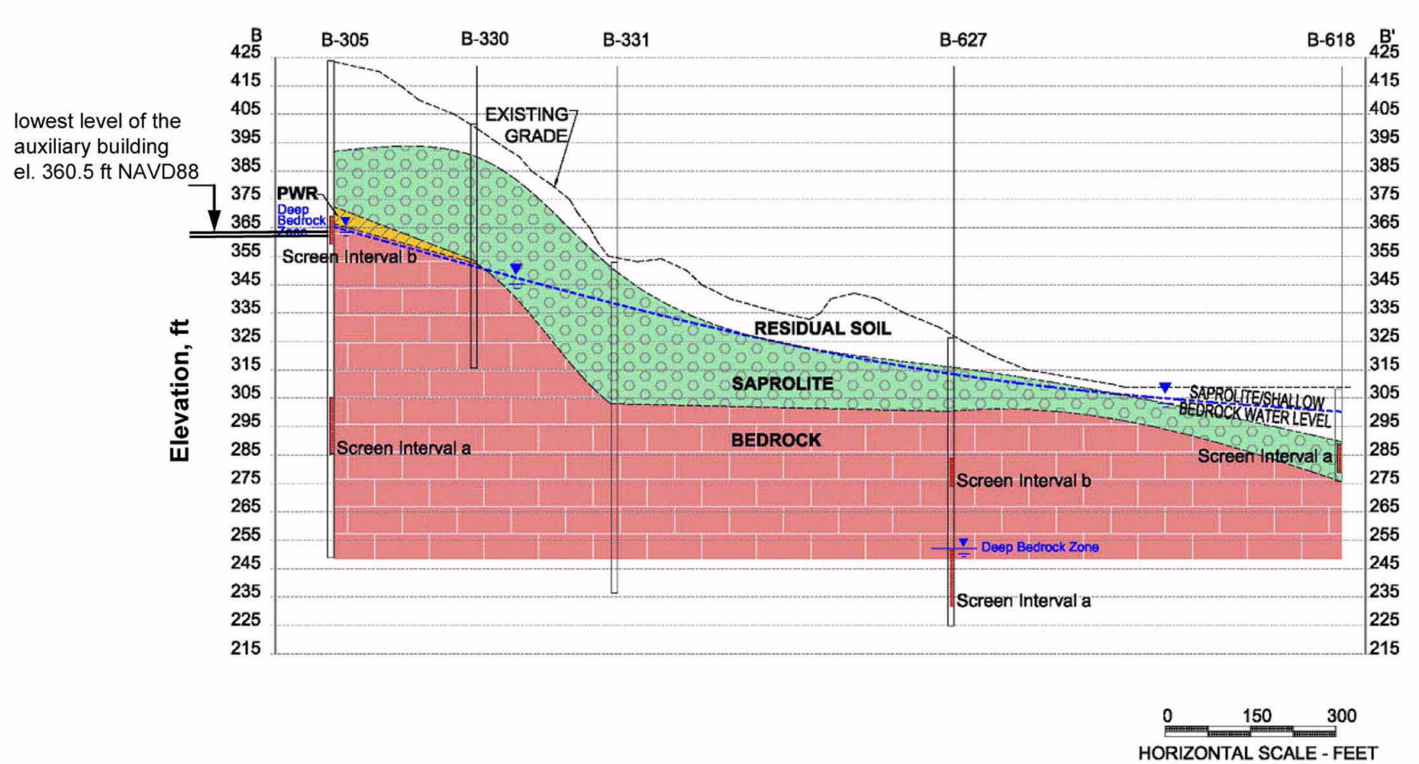


Figure 2.3-36. Plan View Showing Locations of Cross Sections for Unit 2 and Unit 3 Pathways



Note: PWR — Partially Weathered Rock

Figure 2.3-37. Cross Section Along the Subsurface Contaminant Pathway for Unit 2



Note: PWR — Partially Weathered Rock

Figure 2.3-38. Cross Section Along the Subsurface Contaminant Pathway for Unit 3

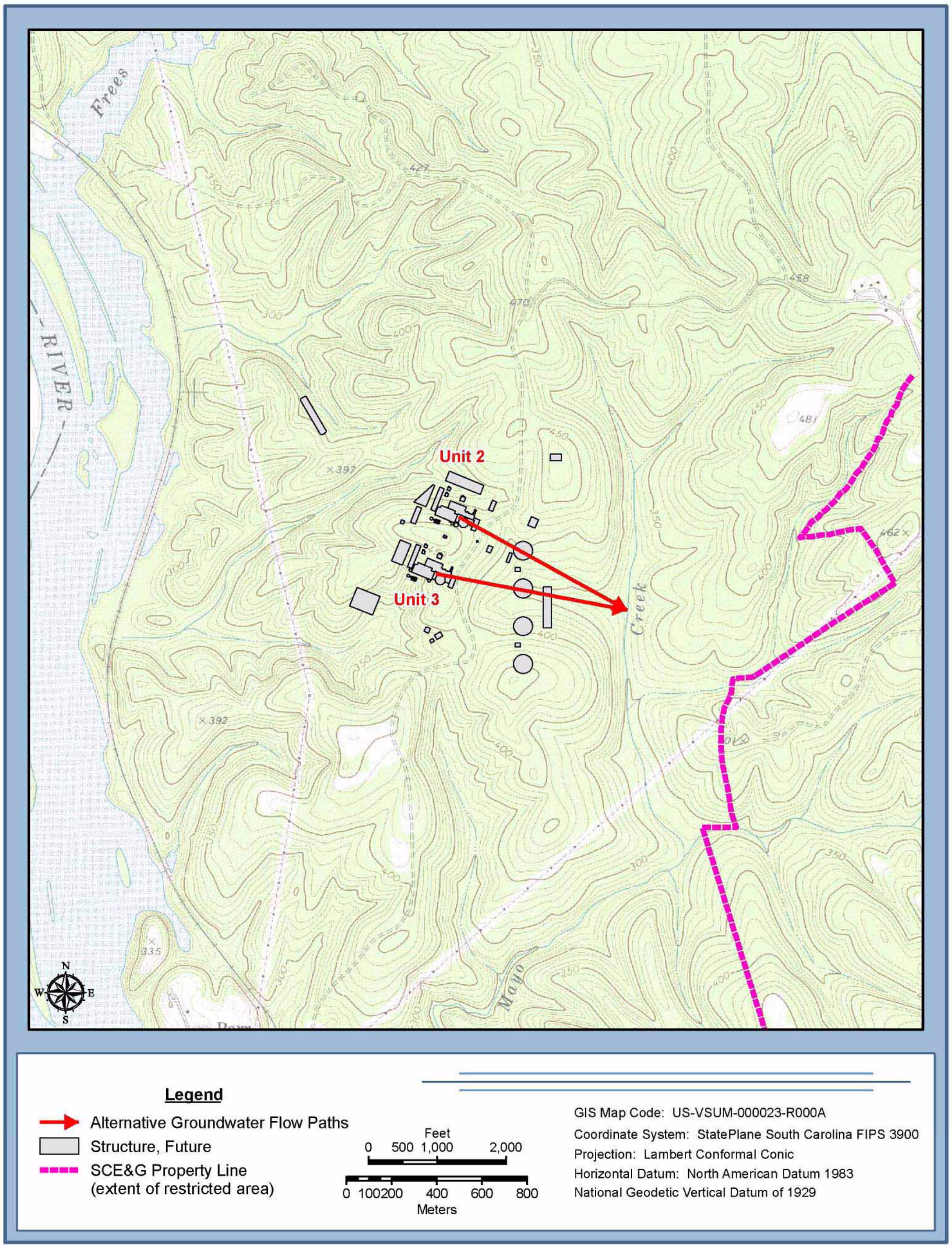


Figure 2.3-39. Alternative Groundwater Pathways to Mayo Creek (Saprolite/ Shallow Bedrock and Deep Bedrock Zones)

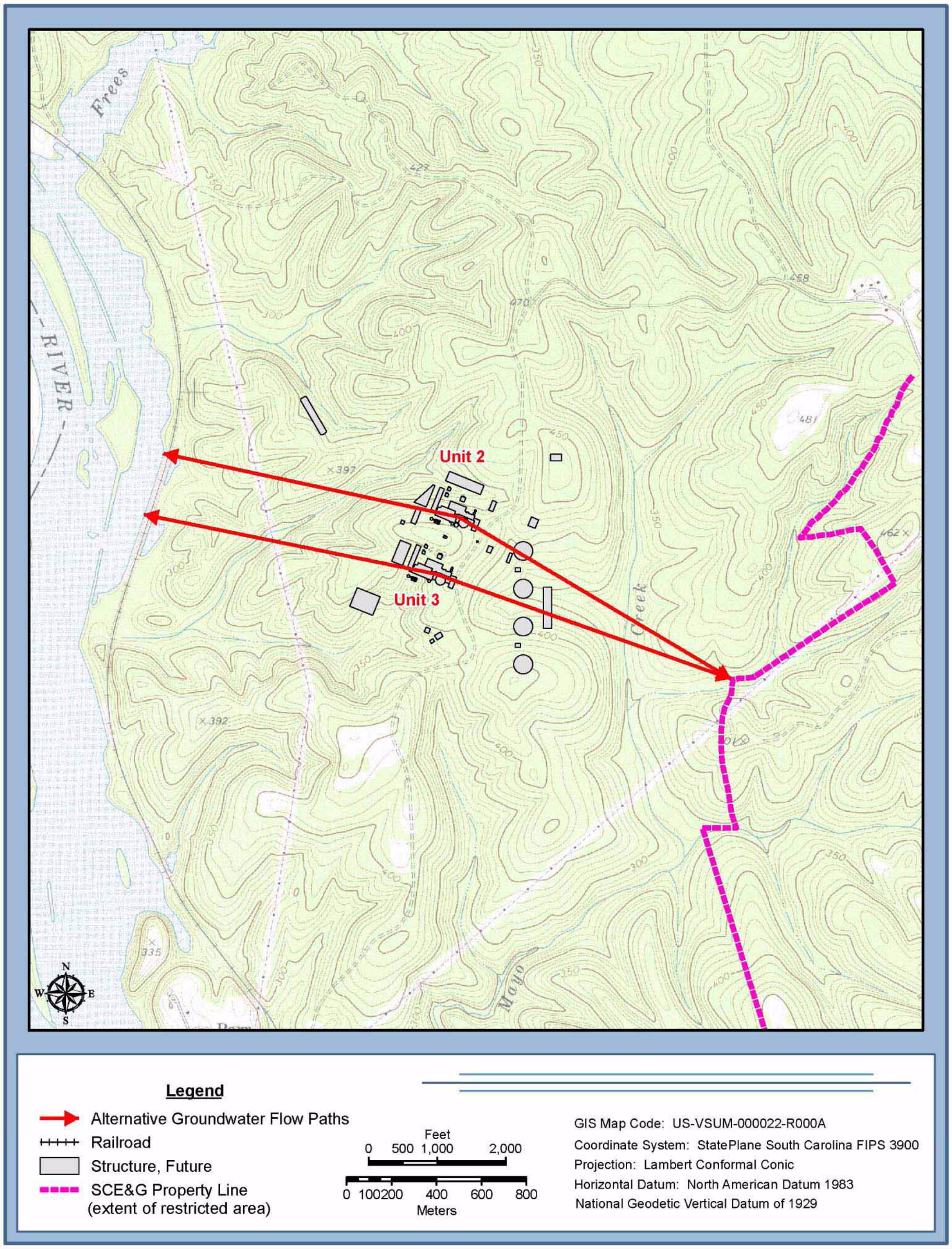


Figure 2.3-40. Alternative Groundwater Pathways to the Broad River and SCE&G Property Boundary (Deep Bedrock Zone)

2.4 ECOLOGY

An understanding of the ecological resources that have the potential to be impacted by the construction and operation of new nuclear units on the VCSNS site is essential to the evaluation of ecological impacts in Chapters 4 and 5. This section addresses resources for the two ecological environments, terrestrial, and aquatic.

2.4.1 TERRESTRIAL ECOLOGY

2.4.1.1 Site Description and Habitats

The VCSNS site (as defined in Subsection 2.2.1.1) is located within the Piedmont Physiographic Province and is just east of the Broad River. Piedmont terrain is characterized by gently rolling hills and broad, relatively shallow valleys. The VCSNS site lies within a sparsely populated, largely rural area, with the dominant land use being forests and small farms. Forests surrounding the VCSNS site consist of planted pines and second growth forests of hardwoods and mixed pine-hardwoods.

Current land use at the VCSNS site is discussed in Section 2.2 and shown in Figure 2.2-1. Approximately 370 acres of the VCSNS site consists of generation and maintenance facilities, laydown areas, parking lots, roads, cleared areas, and mowed grass associated with Unit 1, and approximately 125 acres consist of transmission line corridors. No preexisting stresses or stressors to wildlife are known.

The forests at the VCSNS site are characteristic of Piedmont forests, with a variety of canopy types. Most of the canopies are dominated by loblolly pine or are mixed pine/hardwood stands of second growth forest. The majority of the pine forests are managed pine "plantations." Some hardwood forest occurs, especially on slopes and along streams. No forest on the VCSNS site is a virgin or near-virgin stand.

Native pines dominate the northern portion of the area in which the cooling towers would be located. Hardwoods dominate the central portions of the proposed cooling tower area and a portion of the construction offices/parking area (Figure 2.4-1). Canopy species consist of yellow poplar, American holly, Florida maple, chalk maple, white oak, southern red oak, ash, mockernut hickory, and loblolly pine. Subcanopy species include redbud, pawpaw, red buckeye, Russian olive, muscadine, red mulberry, and hornbeam. Herbaceous plants include bloodroot, wild geranium, fly-poison, wild ginger, mayapple, ebony spleenwort, black cohosh, crown-beard, elephant's-foot, and wild comfrey. The upper portion of a small intermittent stream extends slightly into the area in which the cooling towers would be located.

The proposed switchyard construction area is primarily planted and natural loblolly pines. The proposed spoils areas are planted and native loblolly pines or cleared areas. The southern portion of the area in which the cooling towers would be located, as well as the area to the immediate south where the proposed batch plant and two construction laydown areas would be located, is largely old fields and young planted pine. Persisting native vegetation in this area is scarce, but includes blackberries, goldenrod, rabbit-tobacco, black cherry, winged sumac, poison ivy, and several weeds.

The headwater of a south-flowing tributary to Mayo Creek is located just west of the proposed batch plant within a fairly steep forested ravine. This area is outside the area that would be cleared during construction activities (Figure 2.4-1). The forest in this area consists of loblolly pine, with hardwoods (especially American beech) present along the stream.

Most of the area in which the proposed power block would be located consists of planted loblolly pines. However, some portions of this area consist of canopy-sized native loblolly pine, red maple, sweetgum, yellow poplar, white oak, black oak, and black gum. Subcanopy woody plants include considerable amounts of dogwood as well as Russian olive. Just southwest of the power block, the forests slope rapidly to the south and west, and a narrow streamhead drains its more southern regions (toward the west). The stream and associated wetland are located north of the proposed blowdown line and are outside the area that would be disturbed by construction activities (Figure 2.4-1). In general, the area along the stream features black willow, cottonwoods, various sedges (especially Carex), heal-all, rushes, and chain-fern. Exotic Vietnam grass is abundant.

The proposed blowdown line would be adjacent to an existing railroad spur that traverses areas of planted loblolly pines as well as hardwoods of the same species as mentioned above.

Proposed construction facilities would be located in the southeastern portion of the site (Figure 2.4-1). These areas are composed of mixed pine-hardwood forests or planted and native pines.

Wetlands at VCSNS site are associated with small streams. With the exception of the Mayo Creek and in drainages where beavers have created semipermanent ponds, the streams can be dry during periods of dry weather. The only named stream is Mayo Creek, which empties into the Broad River approximately 1.3 miles south of the proposed blowdown discharge area, slightly downstream from the Parr Shoals Dam that forms Parr Reservoir (Figure 2.1-3). Other than Monticello Reservoir and a few beaver ponds, there are no natural or man-made ponds on the site. All streams in the area ultimately drain into Parr Reservoir or to the Broad River downstream from the Parr Shoals Dam. Streamside management zones at the VCSNS site are protected in accordance with best management practices established by the South Carolina Forestry Commission.

Parr Reservoir provides some limited freshwater marsh habitat in shallow backwaters, around low-lying islands, and in an area east of the Fairfield Pumped Storage Facility tailrace that was used in the 1970s for the disposal of dredge spoil. These marshes and adjacent shallows are used by migrating dabbling ducks, including mallard, black duck, and teal. Monticello Reservoir also provides resting areas for wintering waterfowl and year-round habitat for nonmigratory Canada geese. SCE&G has been recognized by the South Carolina Wildlife Federation for its efforts in establishing a self-sustaining, nonmigratory population of Canada geese on Parr and Monticello Reservoirs (SCE&G 2002a).

The Monticello Reservoir Waterfowl Management Area and the Parr Reservoir Waterfowl Management Area encompass Monticello Reservoir and Parr Reservoir, respectively. Public waterfowl hunting is managed in these two areas by the South Carolina Department of Natural Resources (SCDNR).

SCE&G has sited the proposed facilities and infrastructure to minimize impacts to wetlands. The upper portion of one small intermittent stream and its associated wetland extend slightly into the area in which the cooling towers would be located. The new main access road would cross Mayo Creek and its associated narrow wetland. Otherwise, no streams or wetlands are located in areas in which facilities or structures would be located. Boundaries of the impacted wetlands have been surveyed and a jurisdictional determination has been received from the U.S. Army Corps of Engineers (USACE 2009).

2.4.1.1.1 Terrestrial Wildlife

Wildlife species found in the forested portions of the VCSNS site are those typically found in Piedmont forests of South Carolina, and are discussed below.

Birds

Observations of birds on the VCSNS site were made during several site visits by biologists in 2002, 2006, 2007, and 2008 (Table 2.4-3). These site visits were not designed exclusively as bird surveys and thus, did not include systematic point counts or transects. Instead, avian species were documented by biologists while conducting endangered species surveys, small mammal trapping, or general wildlife and habitat surveys. Birds were identified by direct observation and calls and songs as biologists performed other surveys in the areas shown in color in Figure 2.4-2. Surveys were made in winter, spring, summer, and fall. Sixty avian species were observed during the various surveys (Table 2.4-3). Thirty-nine of the 60 species observed are present year-round in the region and could breed on or near the site. Ten species are present only during the breeding season, and 11 species are present only in winter (Table 2.4-3). Species such as the American crow, blue jay, Carolina chickadee, mourning dove, black vulture, turkey vulture, American robin, dark-eyed junco, Northern cardinal, tufted titmouse, Northern mockingbird, and red-bellied woodpecker were considered common or abundant at the site.

Mammals

Mammal species either observed or indicated by tracks and other signs on the site during the same periods during which birds were recorded (see Table 2.4-3) include whitetail deer, beaver, raccoon, opossum, gray squirrel, Eastern cottontail, bobcat, Eastern mole, hispid cotton rat, house mouse, Eastern woodrat, Eastern harvest mouse, and white-footed mouse. Other mammals typically found in Piedmont forests of South Carolina, such as the gray fox, spotted skunk, and coyote undoubtedly exist at the site, as do smaller mammals such as shrews and a variety of mice and voles.

SCE&G conducted surveys for small mammals at VCSNS in October 2008 (TtNUS 2008) and Spring 2009 (TtNUS 2009a). In both trapping events, 20 Sherman™ live traps were placed along each of 11 transects (Figure 2.4-3). Transect locations were selected to cross various habitat types that would be disturbed by construction of Units 2 and 3. In the October 2008 survey, traps were initially placed and baited on October 27, and were checked each morning for four consecutive days (October 28 through 31). Thus, the study period consisted of 880 "trap nights" (20 traps/transect x 11 transects x 4 nights). Three mammals were captured during the October 2008 study: a cotton rat, a house mouse, and a white-footed mouse (TtNUS 2008).

In the Spring 2009 survey, traps were initially opened and baited on April 27, and were checked each morning for four consecutive days (April 28 through May 1). Thus, the 2009 survey also consisted of 880 trap nights. Thirty-nine mammals were captured during the 2009 study; these consisted of 24 cotton rats, six *Peromyscus spp*. (white-footed mice or cotton mice), five house mice, one Eastern woodrat, one Eastern harvest mouse, one least shrew, and one juvenile Eastern cottontail (TtNUS 2009a).

Mammal trapping studies were conducted at VCSNS prior to construction of Unit 1 and were reported in the Operating License Environmental Report (SCE&G 1974). Small mammals were trapped using snap traps, pit traps, and live traps during June 1971, September 1971, January 1972, and March 1972 in five areas. Habitats in the study areas in 1971 and 1972 were generally similar to those in the 2008 and 2009 surveys. Small mammals trapped during the four study periods in 1971 and 1972 consisted of 35 cotton mice, 12 cotton rats, 11 house mice, eight Eastern harvest mice, seven short-tailed shrews, seven Southeastern shrews, three least shrews, three golden mice, one pine vole, and one white-footed mouse (SCE&G 1974).

The difference between the high number of mammals captured in 1971 and 1972 relative to the lower numbers captured in 2008 and 2009 is at least partially due to the more intensive effort in the earlier surveys. A second probable factor in the difference in results between the 1971–1972 surveys and the 2008–2009 surveys is that a large portion of the study area was thinned in 2008 as part of forest management activities, and the thinned areas are largely devoid of groundcover vegetation; such areas lack desirable conditions of cover and food for many small mammal species.

The 39 captures in the Spring 2009 survey stand in sharp contrast to the three captures in the October 2008 survey, especially considering the same level of effort (880 trap nights using the same trap and bait types) in 2009 as in 2008. The trapping methodology was similar in the 2008 and 2009 surveys, except that traps were prebaited during the 2009 survey. Prebaiting consisted of placing the traps in position approximately one week prior to opening the traps' doors and depositing a handful of bait (rolled oats) beside each trap. The purpose of prebaiting was to increase the probability of captures by providing several nights for small mammals in the vicinity to find and consume the bait, and then develop a habit pattern of returning to the trap during subsequent nights. Differences in capture rates between the Spring 2009 and October 2008 surveys were probably due to prebaiting of traps in 2009, revised transect locations in 2009, and seasonal factors. The species captured in 2008 and 2009 are typical for the region and generally reflect the species captured in the 1971 and 1972 surveys at VCSNS prior to construction of Unit 1.

Reptiles and Amphibians

Reptiles and amphibians encountered during sampling events (Table 2.4-3) included green anole, Eastern fence lizard, ground skink, broad-headed skink, Eastern box turtle, red-bellied watersnake, yellow-bellied slider, and pickerel frog. Reptiles and amphibians were recorded as they were encountered during endangered species surveys, small mammal trapping, and general wildlife and habitat surveys. The species noted above undoubtedly represent only a portion of the reptiles and amphibians on the VCSNS site, particularly along Parr Reservoir.

2.4.1.1.2 Endangered and Threatened Species

The U.S. Fish and Wildlife Service (USFWS) is responsible for designating areas of “critical habitat” for federally listed endangered and threatened terrestrial species. Such areas are considered essential to the species’ conservation, and may require special management and protection. No areas designated by the USFWS as critical habitat exist at or near the VCSNS site. “Critical habitat” or similarly defined classifications do not exist for state-listed species in South Carolina.

A survey for federally and state-listed species classified as threatened or endangered was conducted in May 2002 at the VCSNS site to support license renewal for Unit 1 (SCE&G 2002b). Although the survey was conducted for Unit 1 license renewal, a large portion of the area that would be disturbed during construction of Units 2 and 3 was included in the 2002 survey (Figure 2.4-2). Terrestrial surveys for federally and state-listed species classified as threatened or endangered were also conducted in June and September 2006 (Nelson 2006), April 2007, and October 2007 (Nelson 2007) in areas that would be disturbed by proposed construction of Units 2 and 3 (Figure 2.4-2). These reports (Nelson 2006; 2007) are specific to plants (not animals), but a wildlife biologist present during the plant surveys conducted searches for federally and state-listed terrestrial animals. The plant and animal surveys were conducted throughout the areas shown in Figure 2.4-2.

No animals federally listed as threatened or endangered were observed during the 2002, 2006, and 2007 surveys, and the bald eagle was the only state-listed animal species observed during the surveys. The bald eagle is state-listed as endangered (SCDNR 2006). The bald eagle was federally listed as threatened at the time of the 2002 survey, but in 2007 the U.S. Fish and Wildlife Service removed the bald eagle from the federal list of threatened and endangered species. At the federal level, the bald eagle is still protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act (USFWS 2007a). Juvenile and adult bald eagles were observed during the surveys along the Fairfield Pumped Storage Facility tailrace canal and along the eastern shoreline of Parr Reservoir. Bald eagles are commonly observed along Monticello Reservoir, the Fairfield Pumped Storage Facility tailrace canal, Parr Reservoir, and on the Broad River downstream of Parr Shoals Dam. There are seven known eagle nests within 5 miles of the VCSNS site. The nearest eagle nest is located near the entrance road to Unit 1, approximately 1 mile northeast of the new reactor units. Another eagle nest is located on the north end of the jetty in Monticello Reservoir, approximately 1.7 miles north of the proposed new reactor units. There is also an eagle nest on the west side of Parr Reservoir approximately 1.8 miles northwest of the proposed new reactor units (Figure 2.4-1).

No federally or state-listed plants were found during the 2002, 2006, and 2007 surveys, which were conducted by Dr. John B. Nelson, Chief Curator of the A. C. Moore Herbarium at the University of South Carolina. Prior to the surveys, Dr. Nelson determined that of the 23 plant species recorded in South Carolina that are federally listed as endangered or threatened or are formal candidates for such listing, five species might occur at VCSNS, based on proximity to known populations elsewhere in South Carolina. These consist of pool-sprite (*Amphianthus pusillus*), smooth coneflower (*Echinacea laevigata*), Schweinitz's sunflower (*Helianthus schweinitzii*), black-spored quillwort (*Isoetes melanospora*), and Georgia aster (*Symphyotrichum georgianum*) (Nelson 2006). However, the surveys revealed that appropriate habitats for pool-sprite, smooth coneflower, Schweinitz's sunflower, and black-spored quillwort do not exist in the areas that would be disturbed by construction (Nelson, 2006, 2007). Georgia aster can occur in a variety of soils and habitats, such as dry open woods, roadsides, transmission line corridors, and other openings, so habitat for this species exists at VCSNS (Nelson 2006). It can be readily identified and distinguished from other asters when flowering, which occurs in September and October. All areas that would be disturbed by construction of Units 2 and 3 were surveyed in September 2006 or October 2007, and no evidence of the Georgia aster was encountered (Nelson 2006, 2007).

Endangered, threatened, and other special status species known to exist in Fairfield County are listed in Table 2.4-1. Special status species, indicated in Table 2.4-1 as occurring in Fairfield County (in which VCSNS is located), were taken from county records maintained by the USFWS (2008) and the SCDNR (SCDNR 2006). However, SCE&G recognizes that the USFWS and SCDNR's databases reflect only recorded occurrences, and the possibility exists that other (unrecorded) special status species might exist in Fairfield County. Similarly, although the bald eagle was the only special status species observed during the 2002, 2006, and 2007 biological surveys, SCE&G recognizes that the possibility of special-status plants or animals in the area that would be disturbed by construction can never be totally ruled out. This is true especially for animals, some of which are mobile, secretive, and rarely observed even when present. The biological surveys were conducted during seasons that encompassed plants that bloom in the spring/summer and those that bloom in the fall, and the conclusion derived from the surveys is that federally or state-listed plants are not likely to exist in the areas that would be disturbed by the Units 2 and 3 project. Overall, the biological surveys provide a high degree of confidence that special-status plants and animal species (with the exception of foraging bald eagles along the Parr and Monticello Reservoir shorelines) do not exist in the area that would be disturbed. SCE&G biologists at VCSNS are familiar with special-status species in South Carolina.

2.4.1.1.3 Other Important Species and Habitats

Important species are defined in NUREG-1555 (U.S. NRC 1999) as those that are federally or state-listed as threatened or endangered, proposed for listing as threatened or endangered, commercially or recreationally valuable, essential to the maintenance or survival of species that are rare or commercially or recreationally valuable, critical to the structure and function of the local terrestrial ecosystem, or that serve as biological indicators. Game species fall within the "commercially or recreationally valuable" species category. The primary game species at the VCSNS site are whitetail deer, gray squirrel, Eastern cottontail, Northern bobwhite, mourning dove, wild turkey, and waterfowl. No "travel corridors" for game species cross the VCSNS site, with the exception that migratory waterfowl use Parr and Monticello Reservoirs during migration. With the possible exceptions of the area where the blowdown line would discharge into Parr Reservoir, the proposed raw water intake, and the proposed water treatment plant intake and waste discharge to Monticello Reservoir, areas that would be disturbed by construction activities do not provide foraging habitat for the bald eagle. In summary, the site does not provide habitat for threatened or endangered species; it consists largely of planted pines where plant species diversity is low and does not provide significant habitat for commercially or recreational valuable species.

NUREG-1555 defines important habitats as wildlife sanctuaries, refuges, or preserves; habitats identified by state or federal agencies as unique, rare, or of priority for protection, wetlands, floodplains, or other resources specifically protected by federal or state regulations or Executive Order; or land areas identified as critical habitat for threatened or endangered species. The Monticello Reservoir Waterfowl Management Area and the Parr Reservoir Waterfowl Management Area could be considered wildlife refuges. Parr Reservoir is approximately 3,000 feet from the proposed power block and Monticello Reservoir is approximately 4,000 feet from the proposed power block. With the exceptions of the two waterfowl management areas and wetlands along stream drainages and reservoirs, no "important habitats" as defined by NUREG-1555 exist at VCSNS.

Although the VCSNS site has ticks and mosquitoes, no vector-borne diseases have been reported.

2.4.1.1.4 Summary and Conclusions: Site Habitats and Wildlife

Based on field surveys conducted in 2002, 2006, and 2007, forested portions of areas that would be disturbed by construction of Units 2 and 3 are characteristic of Piedmont forests and do not contain any old growth timber, unique or sensitive plant communities, or threatened or endangered species (with the exception of bald eagles that forage along nearby waterbodies). Timber harvesting in several areas resulted in isolated patches of forest separated by large clearcut areas. Much of the VCSNS site consists of planted pines where plant species diversity is low. Remaining areas of hardwood forest and mixed pine-hardwood forest are used by wildlife species common to the area, but use of the site by wildlife is not significant given the large amount of similar habitat in the vicinity (as defined in Subsection 2.2.1.2, the area within approximately 6 miles of VCSNS).

NUREG-1555 guidance calls for at least one full year of data in order to determine impacts to terrestrial ecosystems. However, NUREG-1555 also states that "The depth and extent of the input to the EIS should be governed by the kinds of terrestrial ecological resources that could be affected by plant construction or operation and by the nature and magnitude of the expected impacts to these resources" (NUREG-1555, page 2.4.1-6). With this in mind, the following facts are germane:

- The proposed VCSNS site is not a "greenfield" site; instead, it is a previously disturbed site (from construction of Unit 1 and subsequent cycles of tree harvesting) in close proximity to existing structures and activities associated with Unit 1.

- Forested areas that would be disturbed by construction of Units 2 and 3 consist of scattered, isolated tracts left by logging operations, where animal diversity is low. Forested portions of the proposed construction and support areas are characteristic of Piedmont forests and do not contain any unique or sensitive plant communities.

- With the exception of wetlands, the area that would be disturbed by construction of Units 2 and 3 does not contain any important habitats as defined by NUREG-1555. Less than one acre of wetlands would be impacted by construction of Units 2 and 3.

- The site does not provide habitat to any known species federally listed as endangered or threatened. The site does not provide habitat to any known species state-listed as endangered or threatened, with the exception of the bald eagle, and potential impacts to the eagle from construction-related activities are expected to be small. With the exception of common game species and the bald eagle, the site does not contain any important species as defined by NUREG-1555.

Information presented in this section indicates that available data are sufficient to meet the intent of NUREG-1555 guidance; specifically, that "…the ecological information is adequate to serve as a basis for assessment of the impacts of design and siting of the plant, and plant construction and operation" (NUREG-1555, page 2.4.1-6). Because available data are sufficient to characterize terrestrial habitats and species at the proposed site, additional herpetological, or endangered and threatened species surveys were not conducted.

2.4.1.2 Transmission Corridor Habitats and Communities

As discussed in Subsection 2.2.2.2, SCE&G and Santee Cooper have conducted siting studies for the new transmission lines (SCE&G 2008, Santee Cooper 2008, Santee Cooper 2009). Much of the probable routes for the new lines follow existing rights of way. The description of the ecology expected in the new transmission corridors can be found in the two siting studies.

Electric transmission corridors that originate at the Unit 1 switchyard pass through forested and agricultural lands typical of central South Carolina. Land use along the existing transmission corridors is presented in Table 2.2-2. No areas designated by the USFWS as critical habitat for endangered species exist within or adjacent to associated transmission corridors. The Summer-to-Newberry transmission line and the Summer-to-Graniteville transmission line cross the Parr Reservoir Waterfowl Management Area in a single shared corridor. Otherwise, the transmission corridors do not cross any state or federal parks, wildlife refuges or preserves, or wildlife management areas.

Surveys for federally and state-listed species classified as threatened or endangered were conducted during May, June, July, and August 2002 along VCSNS-associated transmission line corridors (SCE&G 2002b). No federally or state-listed plants or animals were found on the transmission corridors.

Endangered and threatened species known to occur in the counties crossed by existing transmission lines (Aiken, Edgefield, Newberry, Fairfield, Saluda, and Richland) are listed in Table 2.4-1. Endangered and threatened species indicated in Table 2.4-1 as occurring in counties crossed by the transmission lines were taken from county records maintained by USFWS (2008) and SCDNR (2006). However, SCE&G recognizes that the USFWS and the SCDNR's databases reflect only recorded occurrences, and the possibility exists that unrecorded special status species might exist in counties crossed by the transmission lines. Similarly, although no endangered or threatened species were observed during the 2002 surveys of the transmission lines (SCE&G 2002b), SCE&G recognizes that the possibility of special status plants or animals along the transmission corridors cannot be ruled out entirely, particularly in light of some animals that are mobile, secretive, and rarely observed even when present.

As discussed in Subsection 2.2.2, the specific routes for all of the proposed new transmission lines have not been determined, but likely will cross twelve counties (Aiken, Chester, Colleton, Dorchester, Fairfield, Hampton, Lancaster, Lexington, Newberry, Orangeburg, Richland, and Saluda). Special status species in these counties are listed in Table 2.4-2. Land use in these counties is presented in Table 2.2-4.

Transmission line corridors are maintained in accordance with established procedures to prevent woody growth from reaching the transmission lines (SCE&G 2006, Santee Cooper 2006). The removal of woody species can provide outstanding grassland and marsh habitat for many rare plant species dependent on open conditions.

SCE&G and Santee Cooper participate with the U.S. Department of Agriculture–Natural Resources Conservation Service, the SCDNR, and other organizations in a wildlife management program for transmission corridors. The "Power for Wildlife" program is designed to help landowners whose property is crossed by transmission lines convert transmission corridors into productive habitat for wildlife. The program offers grant money and wildlife management expertise to landowners who commit to participating in the program for five years (SCE&G 2002a).

2.4.2 AQUATIC ECOLOGY

The surface water bodies of interest, those that could potentially be affected by construction and operation of new units at the VCSNS site are the Broad River, Parr Reservoir, Monticello Reservoir, the Monticello Sub-impoundment, and onsite streams, most notably Mayo Creek. The subsection that follows describes the aquatic communities of each of these water bodies.

2.4.2.1 Broad River and Associated Reservoirs

Parr Shoals Power Company (an SCE&G predecessor) created Parr Reservoir in 1914 when it built a low concrete dam across the Broad River at Parr Shoals for a small (now 14 MW) hydroelectric facility (Parr Hydro). The impounded stretch of the Broad River that extends approximately 7 miles upstream of the Parr Shoals Dam is known as Parr Reservoir (Figure 2.1-3). Parr Reservoir, a shallow (15 feet average depth) reservoir with an area of 4,400 acres, is hydraulically connected by Fairfield Pumped Storage Facility to Monticello Reservoir, a much deeper (59 feet average depth) reservoir with an area of 6,500 acres (Figure 2.1-1). The movement of water between Parr Reservoir and Monticello Reservoir is generally dictated by electrical demand, but pumpback operations may be constrained by low Broad River flows during drought periods. Subsection 2.3.2 ("Water Use") contains a more detailed description of FPSF operations.

2.4.2.1.1 Broad River and Parr Reservoir Aquatic Communities

The Broad River originates on the eastern slope of the Blue Ridge Mountains near Lake Lure, North Carolina, and flows south and southeast for approximately 150 miles before joining the Saluda River at Columbia, South Carolina. The Broad River basin encompasses an approximate 4,700-square-mile watershed drained by more than 5,000 miles of streams (NCDENR 2006; SCDHEC 2001). Major tributaries include the Pacolet, Tyger, and Enoree Rivers, all of which enter the Broad River from the west (Subsection 2.3.1). The Broad River basin in South Carolina is entirely within the Piedmont region, which is an area of gently rolling to hilly terrain with relatively broad stream valleys; elevations range from 375 to

1,000 feet above MSL (SCDHEC 1998). For most of its length in South Carolina, the Broad River flows through agricultural and forested land, including the Sumter National Forest, which bounds the river for some 30 miles above Parr Reservoir. Approximately 70% of the Broad River watershed is forested; less than 10% is developed or urban (SCDHEC 1998). However, the cities of Greenville and Spartanburg and a portion of the city of Columbia are in the Broad River basin.

As noted previously, Parr Reservoir was created in 1914 by erecting a 2,000-foot-long dam across the Broad River at Parr Shoals, which is approximately 26 miles upstream of the confluence of the Broad and Saluda Rivers at Columbia, South Carolina (SCE&G 2002a; Rizzo 2006). Before 1977, Parr Reservoir's surface area was 1,850 acres. In 1977, the level of Parr Reservoir was raised by 9 feet, which increased its surface area to approximately 4,400 acres (U.S. NRC 2004). This modification was necessary to support the development of Fairfield Pumped Storage Facility, which was built on Frees Creek, a small tributary of the Broad River. In addition, Monticello Reservoir was created to serve as the upper reservoir for Fairfield Pumped Storage Facility and the cooling water source for Unit 1. Parr Reservoir, which had historically been the source of water for Parr Hydro, assumed a dual function, providing a headwater pool for Parr Hydro and the lower reservoir for operation of Fairfield Pumped Storage Facility. Subsection 2.3.1 describes how water moves between the two reservoirs during generation and pumpback cycles. Generally speaking, water from Monticello Reservoir is released through the Fairfield Pumped Storage Facility penstocks and turbine-generators in the daytime and early evening when electrical demand is high; turbines are reversed to pump water uphill from Parr Reservoir to Monticello Reservoir in the early morning hours when electrical demand is low.

Parr Reservoir maintains an intermediate trophic state among reservoirs in South Carolina; its river-like flows and short retention time (approximately four days) produce high dissolved oxygen levels (in most months) and high turbidity in the reservoir (SCDHEC 1998, 2001). As discussed in "Water Quality" aquatic life and recreational uses are "fully supported" in Parr Reservoir according to SCDHEC, meaning that water quality is adequate to support a balanced indigenous community of organisms, with no restrictions on recreational users.

Aquatic/Wetland Vegetation

A survey of the aquatic plant community of Parr Reservoir was conducted by SCE&G biologists on October 30, 2008 (SCANA Services 2008b). Survey transects were established along seven east-west oriented transects that extend 600 yards north and 600 yards south of the proposed cooling tower discharge location. Survey transects were also established in three tributaries of Parr Reservoir: Hellers Creek (2 transects), Frees Creek, and Cannons Creek. To survey aquatic vegetation, biologists drove a small boat slowly along each transect and recorded all aquatic plants that were observed. A viewing tube facilitated observation of aquatic vegetation in shallow areas. Deeper-water areas were sampled by dragging a sampling rake across the bottom. The locations of transects and sampling areas were recorded using a hand-held GPS unit.

Eleven species of aquatic and wetland plants were observed at the various Parr Reservoir transects (Table 2.4-4) (SCANA Services 2008b). Alligatorweed *(Alternanthera philoxeroides)* and water primrose *(Ludwigia hexapetala)* were found at all transects. Bur-marigold *(Bidens laevis)*, bulrushes *(Scirpus* spp.*),* coontail *(Ceratophyllum demersum)*, lizard's tail *(Saururus cernuus)*, marsh pennywort *(Hydrocotyle umbellata),* pickerelweed *(Pontederia cordata),* and smartweed *(Polygonum persicaria)* were observed in the shallows at more than half of the sampling transects. Cattail *(Typha latifolia)* and rushes *(Juncus* spp.*)* were observed growing at 5 and 4 transects, respectively. No plants were collected from the deeper-water areas of the sampling transects.

All the aquatic and wetland plants found in Parr Reservoir are common species that are widely distributed across the southeastern United States. Two species, alligatorweed and (creeping) water primrose, are on the South Carolina Noxious Weed List (SCDNR undated). Alligatorweed is an emergent perennial plant native to South America that sometimes forms dense mats along shorelines and in canals (CAIP 2008). Water primrose, native to Florida but probably not South Carolina, is an emergent perennial that invades ponds, lakes, and reservoirs across the U.S. (Wood 2006). Both species displace native aquatic plants and can clog ditches and canals, creating problems for agricultural and industrial water users.

Benthic Macroinvertebrates

SCANA Services collected benthos samples from two locations in Parr Reservoir in June 2008, October 2008, January 2009, and April 2009 as part of a benthic macroinvertebrate community assessment (CBS 2008a, CBS 2008b, CBS 2009a, CBS 2009b). The objective of the assessment was to determine the condition of the macroinvertebrate community at the proposed cooling tower blowdown location relative to a control station at an upstream location. Benthic macroinvertebrates were collected with a petite-Ponar grab sampler from a station in the area of the proposed cooling tower blowdown discharge and from a control station located above Hellers Creek, approximately 9 kilometers upstream of the Parr Shoals Dam. Comparisons of macroinvertebrate communities were based on differences in taxonomic composition between the two sampling locations and on the known pollution tolerances and life histories of the organisms collected at the respective sites. Differences in taxonomic composition were determined using metrics outlined in Rapid Bioassessment Protocol III of the EPA's *Rapid Bioassessment Protocols for Use in Streams and Rivers* (Plafkin *et al.* 1989 *in* CBS 2008a) and SCDHEC's *Standard Operating and Quality Control Procedures for Macroinvertebrate Sampling* (SCDHEC 1999 *in* CBS 2008a).

A total of 400 macrobenthic organisms representing 26 taxa were collected at the two stations on June 18, 2008 (CBS 2008a). Total abundance of benthic organisms was significantly higher, based on a single-factor analysis of variance (ANOVA), at the proposed Parr Reservoir blowdown discharge location than at the Parr Reservoir control station. North Carolina Biotic Index (NCBI) and SCDHEC Bioclassification values were also significantly better at the proposed blowdown location than the control station. There were no significant differences between the two locations in taxa richness, Ephemeroptera-Plecoptera-Trichoptera (EPT) Index, EPT Abundance, or percentage of dominant taxon.

In September 2008, SCANA Services biologists collected 321 benthic macroinvertebrates representing 13 taxa at the two Parr Reservoir stations (CBS 2008b). The proposed blowdown discharge location had significantly higher EPT Index and EPT Abundance values than the control station. The percentage of the dominant taxon, higher values of which are normally associated with water quality impairment, was significantly higher at the Parr Reservoir control station.

In January 2009, 254 benthic macroinvertebrates representing 19 taxa were collected at the two Parr Reservoir locations (CBS 2009a). The proposed blowdown location had significantly lower NCBI values than the control station, indicative of better water quality. However, the proposed blowdown location also had a significantly higher percentage of the dominant taxon, indicative of poorer water quality.

In April 2009, 201 species representing 12 taxa were collected by SCANA Services at the two locations (CBS 2009b). There were no significant differences between blowdown and control stations in any of the metrics/bioindicators calculated.

In conclusion, the 2008–2009 benthic macroinvertebrate bioassessment showed "little, if any" difference between the benthic macroinvertebrate community in the area of the proposed blowdown discharge and the benthic macroinvertebrate community at a reference location (CBS 2009b).

There were significant differences between sampling dates (seasons) in the various metrics, however. At the proposed Parr Reservoir blowdown location, the EPT Index and EPT Abundance values were significantly higher in September 2008 than in June 2008, January 2009, and April 2009 (CBS 2009b). No significant differences were detected between seasons in total abundance of benthic organisms, taxa richness, NCBI values, or SCDHEC Bioclassification values. At the Parr Reservoir control station, taxa richness was significantly higher in January 2009 than other months, but NCBI and SCDHEC Bioclassification values were significantly lower and higher, respectively (lower NCBI values are associated with better water quality; higher SCDHEC Bioclassification scores are associated with better water quality). There were no significant differences among sampling dates (seasons) in total abundance of benthic organisms, EPT Index, or EPT Abundance. The author of the CBS (2009b) report summarized these seasonal differences as follows: at the proposed blowdown discharge location the September 2008 bioassessment was "slightly better" than the other three assessments, while at the control station the January 2009 bioassessment was "somewhat better" than the other three assessments.

Fish

SCDNR conducted an inventory of the aquatic resources of the Broad River over the 2000–2002 timeframe and created a Geographic Information System database for natural resource managers in the region. This work was supported by SCE&G, Duke Power, and Lockhart Power Company under the auspices of the Broad River Mitigation Trust Fund, whose Trustees are SCE&G, Duke Power, Lockhart Power, SCDNR, and the USFWS.

SCDNR used boat-mounted electrofishing gear to survey the fish of the Broad River between January 2001 and May 2002 at 10 sampling locations from Gaston Shoals (in Cherokee County, near the North Carolina state line) to Bookman Island, which is roughly midway between the Parr Shoals Dam and Columbia. Boat electrofishing was used to obtain baseline information of species that inhabit relatively deep pool and run habitats in the main channel of the river (Bettinger, Crane, and Bulak 2003). In all, 6,916 fish representing 44 species were collected from these mid-channel transects. Overall, redbreast sunfish (23.1% of the total), bluegill (15.3%), and silver redhorse (12.2%) were the most abundant species, comprising more than 50% of the total number of fish collected. Gizzard shad, whitefin shiner, sandbar shiner, and brassy jumprock were also relatively common, each representing more than 5% of all fish collected.

Nine fish species were collected at all 10 sampling sites: redbreast sunfish, bluegill, silver redhorse, gizzard shad, whitefin shiner, brassy jumprock, redear sunfish, largemouth bass, and snail bullhead. Some species had a more limited distribution in the river. For example, white perch, white bass, pumpkinseed, yellow perch, yellowfin shiner, and longnose gar were collected only in the lower half of the river, while V-lip redhorse and northern hogsucker were collected only in the upper half of the river.

Backpack electrofishing was employed at 10 sites to obtain information on fish from shallow riffle, run, and shoreline habitats. A total of 9,836 fish representing 38 species were collected by electrofishing in the three habitat types (Bettinger, Crane, and Bulak 2003). Three species made up more than 50% of fish collected: whitefin shiner (29.9% of the total), redbreast sunfish (14.5% of the total), and spottail shiner (9.0% of the total). Sandbar shiner, snail bullhead, and thicklip chub were also relatively common; each made up more than 5% of the total.

Fifty-one species of fish representing 9 families were collected from the Broad River over the course of the study (Bettinger, Crane, and Bulak 2003). Three species not previously documented from the Broad River were collected: an undescribed species similar to the highfin carpsucker, smallmouth buffalo, and Santee chub. Hybrid bass were also collected for the first time. The family Cyprinidae contributed the most species (14), followed by Centrarchidae (10), and Catastomidae (10). Overall, the species most commonly collected were redbreast sunfish, whitefin shiner, and silver redhorse. Species richness was comparable to that observed in other Broad River studies and similar-sized rivers in South Carolina.

The Broad River offers typical Piedmont sport fishing opportunities, with a variety of centrarchid (*e.g.*, largemouth bass, redbreast sunfish) and ictalurid (*e.g.*, channel catfish, white catfish) species. The Broad River also supports an expanding smallmouth bass fishery, unique to Piedmont rivers in South Carolina

(Bettinger, Crane, and Bulak 2003). Smallmouth bass were introduced in 1984, and have developed into a “small but unique” fishery that is drawing local and regional attention. Bettinger, Crane, and Bulak (2003) documented spawning of smallmouth bass at three Broad River sites, all upstream of Neal Shoals and well upstream of Parr Reservoir.

The Broad River in the area of VCSNS was characterized (before the operation of Fairfield Pumped Storage Facility and Unit 1) by a high silt load, high dissolved oxygen levels, high suspended solids levels, and low buffering capacity (U.S. NRC 1981). Parr Reservoir, a narrow, shallow, run-of-the-river reservoir, had lotic rather than lentic characteristics. Turbidity and flows appeared to limit the production of phytoplankton, and as a consequence they appeared to contribute only marginally to productivity. Zooplankton were also of limited importance. Benthic macroinvertebrates showed very little diversity, but relatively high measures of biomass due to the presence of high densities of the Asiatic clam, *Corbicula*. Fish collections before operation of Fairfield Pumped Storage Facility were dominated by sunfish (bluegill, in particular) and gizzard shad, a forage species. Largemouth bass and white catfish also made up a significant proportion of biomass in collections (U.S. NRC 1981).

SCE&G monitored water quality and aquatic communities in the Broad River, Parr Reservoir, and Monticello Reservoir from mid-1978 through 1984 to assess the impacts of Fairfield Pumped Storage Facility and Unit 1 operations. This represented more than three years of preoperational data and two years of operational data. These studies, summarized in a final report submitted to SCDHEC in April 1985 as part of Clean Water Act Section 316(a) Demonstration (Dames & Moore 1985), are a useful source of information on the biotic communities of the Broad River in the 1970s and 1980s.

Parr Reservoir fish collections were dominated numerically in 1983 and 1984 by common warm water species. Approximately 44% of fish collected were centrarchids (*e.g.,* bluegill, pumpkinseed, redear sunfish, largemouth bass), while 43% were clupeids (gizzard shad and threadfin shad). Gizzard shad and bluegill accounted for the greatest biomass, with 20.9 and 3.4 kilograms/hectare, respectively (Dames & Moore 1985). Species composition was essentially the same in preoperational (1978–1982) and operational (1983–1984) periods, with collections dominated by centrarchids (sunfish), clupeids (shad), and ictalurids (catfish and bullheads). The species composition was typical of warm, shallow southeastern reservoirs. The fish community of Parr Reservoir appeared to be largely unaffected by operations of VCSNS.

SCDNR assessed the largemouth bass fishery in the early 1990s and determined that there were fewer largemouth bass per acre in Parr Reservoir than other reservoirs in Fisheries Region III (Hayes 1999). Mean lengths and weights of Parr Reservoir largemouth bass were also lower. Parr Reservoir largemouth bass grew slowly, with fish reaching a minimum harvestable size of 12 inches at age three (Hayes 1999).

No creel survey has ever been conducted on Parr Reservoir to quantify angler effort, harvest, or success (Hayes 1999). Anecdotal reports and casual interviews of fishermen suggest that catfish, crappie, and largemouth bass are the most often targeted species. The extreme water level fluctuations in the reservoir make navigation difficult at times (water levels can be extremely low after pump-back operations) and appear to limit fishing pressure (Hayes 1999).

SCE&G commissioned Normandeau Associates to conduct surveys of Parr Reservoir fish community in the fall of 2006 and spring of 2007. Fish were collected at three locations in the lower reservoir. Three gear types (electrofishing, gill nets, hoop nets) were employed, but all (476) fish were collected by electrofishing and gill netting (Normandeau 2007). Four groups dominated collections: Ictaluridae (33.8 percent of total; 3 species), Moronidae (24.8 percent; one species), Centrarchidae (17.6 percent; 6 species), and Catastomidae (6.7 percent; 2 species). Seventeen fish species, all relatively common Piedmont species, were collected. Channel catfish (26.1% of the total), white perch (24.8% of the total), gizzard shad (12.6% of the total), largemouth bass (7.8% of the total), blue catfish (7.1% of the total), and bluegill (7.1% of the total) were the species most often collected (Normandeau 2007).

Normandeau collected additional samples at the same three locations in July 2008 and February 2009 using electrofishing gear and gill nets (Normandeau 2008, Normandeau 2009). Hoop nets, which were ineffective collecting fish in 2006-2007, were not used in 2008. Collections in July 2008 were dominated by gizzard shad (52.4 percent of total). Substantial numbers of bluegill (14.3 percent), white perch (7.6 percent), largemouth bass (6.1 percent), blue catfish (4.3 percent), and channel catfish (3.7 percent) were also collected (Normandeau 2008). The numerical dominance of gizzard shad in July 2008 samples reflects the fact that large numbers of small (50-100 mm TL) gizzard shad were present. Gizzard shad young-of-the-year grow rapidly, but are heavily preyed upon by a variety of predatory fish species including largemouth bass, crappies, and catfishes (Michaletz 1997). Thus, large numbers of young shad are typically present in summer (most spawning occurs in April and May), but numbers tend to decline in fall and winter as predation takes its toll. Gizzard shad are also prone to sudden die-offs in late summer (Mettee *et al.* 1996).

In February 2009, as predicted, gizzard shad made up a relatively small percentage (6.9 percent) of fish collected from Parr Reservoir (Normandeau 2009). Bluegill ranked first in abundance in winter 2009 samples, comprising 33.6 percent of the total. Bluegill were followed in abundance by largemouth bass (9.2 percent of total), spottail shiner (9.2 percent of total), channel catfish (9.2 percent of total), and blue catfish (8.4 percent of total). This was essentially the same group that dominated previous quarterly surveys, with one exception: white perch were noticeably less abundant in winter 2009 samples than in previous quarterly sampling rounds. This is probably a reflection of the species' schooling behavior rather than an actual reduction in numbers. A gregarious species, white perch tend to be collected in substantial numbers or not at all.

The Normandeau surveys, although limited in scope, suggest that the Parr Reservoir's fish community has been substantially altered since the 1980s by introductions of non-native fish species. Two non-native species—white perch and blue catfish—made up 21.8% of all fish collected from Parr Reservoir during the 2006–2009 Normandeau surveys. When Parr Reservoir fish population data from 1983-1984 are compared to data collected over the 2006-2009 timeframe there appears to be a pronounced shift in community structure. As described earlier in this section, fish collections in 1983-1984 were numerically dominated by centrarchids and clupeids, with smaller numbers of ictalurids present. Collections in 2006, 2007, 2008, and 2009 suggest that centrarchids currently represent a smaller proportion of the fish community, while moronids (the so-called "temperate basses," and in particular, the white perch) have become a major component of the Parr Reservoir fishery. Ictalurids (catfish) also appear to have become relatively more abundant, due in part to the appearance of a new, non-native catfish species, the blue catfish, which became established in recent years. No blue catfish were collected from Parr Reservoir (or any other Broad River station) by Dames and Moore biologists in the 1980s or by SCDNR biologists conducting the Broad River Aquatic Resources Inventory surveys in 2001-2002 (Bettinger, Crane, and Bulak 2003). Five years later, the blue catfish has become firmly established in Parr Reservoir and, one presumes, upstream and downstream in the Broad River drainage. The State Management Plan for Aquatic Invasive Species in South Carolina (SCAIS Task Force 2006) notes that white perch have become established throughout the state, and compete with native white and black crappies. White perch have displaced white bass (also nonnative, but generally more highly regarded by fishermen) in some upstate reservoirs. With regard to the blue catfish, the State Management Plan notes that this species has become established in several Coastal Plain rivers and has "…negatively affected a previously popular fishery for native catfish and redbreast sunfish" (SCAIS Task Force 2006).

SCE&G sampled fish in the vicinity of the proposed cooling tower discharge quarterly over the October 2007–July 2008 period to determine if this location supported a typical assemblage of Parr Reservoir fishes and to rule out the presence of any special-status fish species (SCANA Services 2008a). A total of 422 fish representing 22 species were collected over the study period. Four species (blue catfish, bluegill, largemouth bass, and notchlip redhorse) were collected in every quarter. Threadfin shad ranked first in abundance (37 percent of total), despite the fact that they were collected only during the fall 2007 sampling event. Bluegill (18.7 percent), spottail shiner (7.6 percent), shorthead redhorse (6.6 percent), notchlip redhorse (6.1 percent), and largemouth bass (5.5 percent) were also frequently collected (SCANA Services 2008a).

No state or federally listed fish species and no fish species designated "species of concern" by SCDNR were collected from Parr Reservoir by Normandeau or SCE&G in 2006, 2007, 2008, or 2009. All fish collected were common Piedmont species, with one exception. SCE&G collected a single robust redhorse (*Moxostoma robustum*) at the proposed cooling tower blowdown discharge in July 2008 (SCANA Services 2008a). Normandeau also collected a single robust redhorse in July 2008 at Parr Reservoir Station 1, in the Fairfield Pumped Storage

Facility tailrace canal (Normandeau 2008). The robust redhorse is a large, long-lived member of the redhorse sucker family. In 1995, a group of concerned stakeholders composed of state and federal agencies, electric utilities, and conservation organizations signed a Memorandum of Understanding creating the Robust Redhorse Conservation Committee (SCANA Services 2008a). The Committee, which includes a representative from SCE&G, is committed to restoring the robust redhorse throughout its former range. From 2004 to 2007, SCDNR stocked a total of 21,872 fingerling robust redhorse in the Broad River above the Parr Shoals Dam (SCANA Services 2008a). Five robust redhorse suckers have been captured in the Broad River drainage in 2008 by various state and private entities conducting fish research and monitoring.

2.4.2.1.2 Monticello Reservoir Aquatic Communities

Unit 1 lies on the south shore of Monticello Reservoir (Figure 2.1-3), which serves as its cooling water source and heat sink. Monticello Reservoir was formed by damming Frees Creek, a small tributary of the Broad River that flowed into Parr Reservoir about 1.2 miles upstream of the Parr Shoals Dam. As previously discussed, Monticello Reservoir was designed to serve both as a cooling pond for Unit 1 and the upper pool for Fairfield Pumped Storage Facility, with an enlarged Parr Reservoir serving as the lower pool. Water flow from the Frees Creek watershed into the newly created Monticello Reservoir was negligible, and the Fairfield Pumped Storage Facility's pumps were used initially to fill the reservoir with water from Parr Reservoir (U.S. NRC 1981). Monticello Reservoir's small watershed drains an area of only 11,000 acres, including the reservoir and its subimpoundment (discussed later in this section).

Monticello Reservoir (excluding the Sub-impoundment) is approximately 6 miles long with a surface area of 6,500 acres. The average depth is 59 feet and the maximum depth is approximately 126 feet (SCDHEC 2001). Fairfield Pumped Storage Facility operations can cause water levels in Monticello Reservoir to fluctuate as much as 4.5 feet daily, from 420.5 feet above MSL to 425.0 feet above MSL (NAVD29; U.S. NRC 2004). Daily elevation changes vary, depending on system needs. Long-term eutrophication studies indicate that Monticello Reservoir's trophic condition is improving (SCDHEC 1998; SCDHEC 2001). It is one of the least eutrophic reservoirs in South Carolina, and is characterized by low nutrient (total phosphorus and total nitrogen) concentrations (NRC 2004).

Aquatic/Wetland Vegetation

A survey of Monticello Reservoir aquatic vegetation was conducted on November 6, 2008. Survey locations were established in the vicinity of two public boat landings (north and east shore of the reservoir), an SCE&G private boat landing (west shore of the reservoir), the proposed raw water intake, the proposed water treatment intake, and a control station on the northwest shore of the reservoir. To survey aquatic vegetation, biologists drove a small boat slowly along each transect and recorded all aquatic plants that were present. A viewing tube facilitated observation of aquatic vegetation in shallow areas. Deep water areas were sampled by pulling a sampling rake across the bottom. The locations of transects and sampling areas were recorded using a hand-held GPS unit. No aquatic plants were observed growing in the shallow water of the six sampling locations at Monticello Reservoir. Stonewort *(Nitella* spp) was collected from a deeper-water area offshore of the public boat landing on the eastern shore of the reservoir. Stonewort, which appears to be a submerged vascular plant, is actually a branched, multi-cellular algae (TAES 2008). It is typically found in lakes and reservoirs in the Carolinas, where it forms a layer on the bottom that may be thin or very heavy, depending on the trophic state of the waterbody (Stager and Cahoon 1987; Aulbach 2007). Small bait fish often congregate over these patches of *Nitella*.

Benthic Macroinvertebrates

SCANA Services collected benthos samples from three locations in Monticello Reservoir in June 2008, October 2008, January 2009, and April 2009 as part of a benthic macroinvertebrate community assessment (CBS 2008a, CBS 2008b, CBS 2009a, CBS 2009b). Benthic macroinvertebrates were collected with a petite-Ponar grab sampler from stations in the area of the proposed raw water intake, the proposed water treatment intake, and from a control station on the west side of the reservoir, approximately 5 kilometers north of VCSNS Unit 1. The objective of the assessment was to determine the condition of the macroinvertebrate communities at the proposed water treatment and raw water intake relative to conditions at a control station. Comparisons of macroinvertebrate communities were made based on differences in taxonomic composition among the three sampling locations and on the known pollution tolerances and life histories of the organisms collected. Differences in taxonomic composition were determined using metrics outlined in Rapid Bioassessment Protocol III of the EPA's *Rapid Bioassessment Protocols for Use in Streams and Rivers* (Plafkin *et al.* 1989 *in* CBS 2008a) and SCDHEC's *Standard Operating and Quality Control Procedures for Macroinvertebrate Sampling* (SCDHEC 1999 *in* CBS 2008a).

A total of 341 macrobenthic organisms representing 27 taxa were collected at the three Monticello Reservoir stations on June 18, 2008 (CBS 2008a). EPT abundance at both the proposed water treatment intake station and proposed raw water intake were significantly higher than the control station based on a single-factor analysis of variance (ANOVA). The proposed water treatment intake station had significantly higher NCBI and SCDHEC Bioclassification scores than either the proposed raw water intake station or the control station.

In September 2008, SCANA Services biologists collected 262 benthic macroinvertebrates representing 24 taxa at the three Monticello Reservoir stations (CBS 2008b). Taxa richness and taxa abundance were significantly lower at the proposed water treatment intake station than at the proposed raw water intake station or control station. Likewise, EPT Abundance was significantly lower at the water treatment intake station than the other two stations. The raw water intake station had significantly better NCBI and SCDHEC Bioclassification scores than either of the other two stations.

In January 2009, 277 benthic macroinvertebrates representing 16 taxa were collected at the three Monticello Reservoir stations (CBS 2009a). Only two of the bioassessment metrics showed significant differences. EPT Index and EPT Abundance values were significantly higher at the proposed raw water intake location than at the other two locations.

In April 2009, SCANA Services biologists collected 405 benthic macroinvertebrates representing 24 taxa at the three Monticello Reservoir stations (CBS 2009b). There were significant differences in four of the bioassessment metrics. Taxa richness was significantly higher at the proposed water treatment intake station than at the raw water intake or control stations. EPT Index and EPT Abundance values were significantly higher at the proposed raw water intake station. SCDHEC Bioclassification values were significantly lower at the control station than the other two stations.

A review of results from four quarters of macroinvertebrate sampling on Monticello Reservoir suggests that there are no meaningful differences among the three stations. No clear-cut patterns emerged with respect to the relative complexity of benthic communities at the three locations or the degree of impairment. For example, taxa richness was lowest at the proposed water treatment intake location in September 2008, but was highest at the same location in April 2009. The CBS study concludes that "Monticello Reservoir…showed few differences among the control, water treatment intake, or raw (water) intake points" (CBS 2009b). With respect to differences among sampling dates at a given station (seasonal differences), the CBS study concludes that "none of the assessments showed any large differences across time."

Fish

The most complete source of information on the fishes of Monticello Reservoir is a series of reports prepared in support of a Clean Water Act Section 316(a) Demonstration for Unit 1 and summarized in a final report (Dames & Moore 1985) submitted to SCDHEC and NRC in April 1985.

Biologists using gill nets and electrofishing gear collected 32 species of fish representing eight families from Monticello Reservoir in 1983 and 1984 (Dames & Moore 1985), the last two years that sampling was conducted in support of the station’s Section 316(a) Demonstration. The Monticello Reservoir fish community in 1983–1984 was dominated by centrarchids (55% of fish captured) and clupeids (28% of fish captured) (Dames & Moore 1985). Smaller numbers of ictalurids (7%), catastomids (5%), and percids (3%) were also captured. The species composition and relative abundance of Monticello Reservoir fish changed very little from 1978 through 1984. In all preoperational and operational years, centrarchids ranked first in abundance and clupeids ranked second. There was no indication that Unit 1 operations had an effect on fish populations in Monticello Reservoir.

Based on cove rotenone studies conducted by SCDNR in 1987, 1988, 1995, and 1996, the fish community of Monticello Reservoir remains balanced and diverse, comprised of warmwater species common to the southeastern United States (Nash, Christie, and Stroud 1990; Christie and Stroud 1996, 1997). Three catfish species (blue catfish, channel catfish, and white catfish) made up a substantial proportion (56%, by weight) of the reservoir's standing stock in 1996 and provided an important recreational fishery, particularly in summer months. Other species more traditionally regarded as gamefish (largemouth bass, black crappie, and white bass) contribute less to the reservoir's standing stocks, but considerable angler effort is directed toward these species in winter, spring, and fall.

In addition to the fish species that are normally sought and harvested by anglers, Monticello Reservoir contains a variety of game and nongame species including clupeids (threadfin shad and gizzard shad, which provide important forage for predators), cyprinids (*e.g.,* common carp, golden shiner, whitefin shiner), catastomids (*e.g.,* silver redhorse, shorthead redhorse, river carpsucker), ictalurids (brown bullhead, flat bullhead, and snail bullhead), centrarchids (*e.g.,* bluegill, redear sunfish, redbreast), and percids (yellow perch and tesselated darter) (Nash, Christie, and Stroud 1990; Christie and Stroud 1996, 1997). All of these species are common to ubiquitous in South Carolina streams, ponds, and reservoirs.

There have been a number of changes in the Monticello Reservoir fish community since Unit 1 began operating in 1982, none attributable to station operations. Two species (blue catfish and white perch) that now make up a major portion of the recreational catch first appeared in SCDNR samples in 1995. These species may have been introduced by fisherman or transferred into Monticello Reservoir from Parr Reservoir by pump-back operations. The blue catfish in particular "exploded" in numbers and importance in the reservoir between 1995 and 1996 (Christie and Stroud 1997). In an annual report on the status of fisheries in SCDNR Region IV, Christie and Stroud (1997) voiced concern about the booming population of blue catfish in Monticello Reservoir, noting that Monticello Reservoir has a "…relatively low prey base… and the unfortunate introduction of blue catfish may lead to competition for forage between catfish and game species." Concern about competition with native sport fishes has led states including Maryland and Florida to propose or enact laws restricting the sale, possession, importation, and/or transportation of blue catfish (Maryland DNR 2006; FWC 2006).

The white perch, a semi-anadromous species native to the southeastern coast, is regarded as a nuisance species by many inland fisheries managers. It is a species known for its high reproductive potential (high fecundity rate and high hatching rate), slow rate of growth, and long lifespan (up to 17 years), characteristics that tend to create crowded populations of stunted white perch in reservoirs (Wisconsin Sea Grant 1999; Marcy et al. 2005; NCWRC undated). White perch are known to depress populations of other, more desirable gamefish species, such as walleye and white bass, by competing for limited forage and by feeding heavily on walleye and white bass eggs (Wisconsin Sea Grant 1999).

A number of other fish species (brook silverside, swallowtail shiner, and green sunfish) appeared for the first time in SCDNR's Monticello Reservoir cove rotenone samples in 1995 (Christie and Stroud 1996). These species were known to occur in other water bodies in the Santee-Cooper drainage basin (which includes the Broad River), but had not been collected previously in Monticello Reservoir by SCDNR. None of these species is expected to have a noticeable effect on the reservoir‘s fisheries, beyond some minor contribution to the forage base.

SCE&G commissioned Normandeau Associates to conduct surveys of the Monticello Reservoir fish community in the fall of 2006 and spring of 2007. A total of 820 fish representing 21 species were collected in 2006–2007 (Normandeau 2007). As was the case in the 1980s (Dames & Moore 1985), collections were dominated by centrarchids (chiefly bluegill) and gizzard shad. More than 52% of all fish collected in 2006 and 2007 were bluegill and gizzard shad. The most notable change in the fish community since surveys were last conducted in the 1980s was the presence of the two nonnative species—blue catfish and white perch—already discussed at length in this section. These two nonnative species comprised 11.0% and 9.5%, respectively, of all fish collected (Normandeau 2007). Although no statistical tests of significance were performed, a comparison of “before” (Dames and Moore 1985) and “after” (Normandeau 2007) relative abundance data suggests that the appearance and subsequent increase in abundance of blue catfish in Monticello Reservoir may be associated with the corresponding decline in abundance of the native white catfish.

Monticello Reservoir fish were sampled by Normandeau Associates again in July 2008 and February 2009 to obtain additional information on possible seasonal differences in the reservoir's fish populations. A total of 782 fish were collected in July 2008 using gill nets and electrofishing gear. Three species—gizzard shad (42.2 percent), bluegill (23.2 percent), and blue catfish (20 percent)—made up more than 85 percent of all fish captured. Smaller numbers of white perch (3.6 percent), channel catfish (2.6 percent), largemouth bass (1.4 percent), and white catfish (1.4 percent) were also collected. Relatively high numbers of gizzard shad in Parr and Monticello Reservoir collections in July 2008 reflect the fact that large numbers of small (50-100 mm TL) gizzard shad were present. Gizzard shad young-of-the-year grow rapidly, but are subject to high rates of mortality. Thus, it is understandable that large numbers of young are present in summer, but these numbers decline in fall and winter.

A total of 461 fish representing 20 species were collected from Monticello Reservoir in February 2009 (Normandeau 2009). Bluegill (33.4 percent of total), white perch (21.5 percent), largemouth bass (7.6 percent), gizzard shad (6.7 percent), and channel catfish (5.6 percent) were the five species most often collected. Bluegill, whitefin shiner, and white perch dominated electrofishing collections, while white perch dominated gill net samples. Almost 40 percent of all fish in gill nets were white perch. When July 2008 and February 2009 Monticello Reservoir data were combined, gizzard shad (29.0 percent of total), bluegill (27.0 percent), blue catfish (13.7 percent), and white perch (10.2 percent) ranked first, second, third, and fourth in abundance, respectively. The 2008–2009 sampling results essentially mirrored the results of 2006-2007 sampling, with the two non-native species (white perch and blue catfish) making up a slightly higher percentage of the total in 2008–2009.

Although somewhat less productive than other older reservoirs in the region, Monticello Reservoir continues to provide fishermen in the South Carolina Midlands and Upstate with a variety of fishing opportunities. Roving creel surveys in 1997–1998 and 1998–1999, that included interviews of selected anglers, revealed that roughly half (51% in 1997–98, 42% in 1998–99) of all fishing effort in Monticello Reservoir was directed at catfish (Christie and Stroud 1999). Less effort was expended fishing for black crappie (15% in 1997–98, 5% in 1998–99), largemouth bass (12% in 1997–98, 10% in 1998–99), and other species (bluegill, carp, white bass, white perch). The creel surveys indicated that fishing effort (number of hours fished per annum) had increased substantially since the late 1980s. They also showed that fishing pressure (hours fished per acre) was lower on Monticello Reservoir than on other reservoirs in the region (Christie and Stroud 1999).

Excluding blue catfish and white perch, no undesirable nonnative fish species appeared in Monticello Reservoir after it was created and no nuisance species appeared to be favored by its operational thermal regimes. There have been no outbreaks of fish diseases, beyond the occasional appearance of *Aeromonas* (*Aeromonas hydrophila*; a bacterium) infections in spawning largemouth bass in the spring. Fish with infections are generally individuals that have been caught and released by anglers. Handling stresses these fish and removes the protective slime/mucous coating, which results in *Aeromonas* infection.

In the late 1980s, a number of limited fish kills (generally involving small catfish) occurred in the Unit 1 discharge bay in late summer and early fall. SCE&G set up a monitoring program to help identify the cause of the fish kills. Investigations revealed that the fish kills were associated with relatively high discharge temperatures and Monticello Reservoir drawdowns (through the operation of Fairfield Pumped Storage Facility). It was determined that reservoir drawdown reduced the inflow of cooler water (from the main body of the reservoir) along the bottom of the discharge canal and into the discharge bay. Reduction or loss of this inflow allowed water temperatures to rise rapidly and kill fish inhabiting the discharge bay. Since the reservoir level was subject to daily fluctuation with the operation of Fairfield Pumped Storage Facility, fish kills recurred as high reservoir levels (following pumpback operations) allowed more cool water inflow and recolonization of the discharge canal and bay.

SCE&G took several actions over the 1991–1993 period to reduce the frequency and severity of fish kills (SCE&G 2002a). In 1991, an elevated area (an old roadbed) was removed from the discharge canal by dredging. This initially appeared to have solved the problem, but a fish kill in August 1992 indicated that removal of the roadbed had not completely eliminated the kills. In September 1992, the Monticello Reservoir drawdown was temporarily limited to 422.5 feet MSL to prevent further fish kills.

SCE&G dredged the entire length of the discharge canal in July and August of 1993 to allow more cool water inflow at low reservoir levels. The dredging of the discharge canal altered circulation patterns and increased cool water inflow such that temperature at the bottom of the discharge bay in summer remained significantly (10° to 15°) cooler than “end-of-pipe” discharge temperatures (SCE&G 2002a). Fish kills ceased once the dredging of the discharge canal was completed. The discharge bay and canal were monitored intensively over the summers of 1994 and 1995, and no fish kills were observed (SCE&G 2002a). None have been observed since that time.

The Generic Environmental Impact Statement for license renewal of nuclear plants (U.S. NRC 1996) briefly discusses the fish kills in the VCSNS discharge bay and mentions SCE&G‘s investigations on the specific causes of the kills. It concludes that “these fish kills were localized; they do not appear to have had any adverse effect on the cooling pond (fish) population.”

2.4.2.1.3 Monticello Subimpoundment Aquatic Communities

Monticello Reservoir is hydraulically connected by a conduit to a smaller 300-acre body of water known as the Monticello Sub-Impoundment (Figure 2.1-3). This smaller sub-impoundment is managed for recreational boating and fishing by SCE&G and SCDNR. SCE&G maintains the property, which includes boat launch, swimming, and picnic facilities; SCDNR manages the sub-impoundment's fisheries by setting creel and size limits on fish. SCDNR has also sunk fish attractors in several places in the sub-impoundment to provide habitat for sunfish, crappie, and largemouth bass and improve fishing. Fishing is permitted on Wednesdays and Saturdays only.

Comprehensive surveys of the sub-impoundment’s fishery were last conducted in 1984 (Dames & Moore 1985). At that time, the fish community of the sub-impoundment was characterized by relatively low species richness (12 species collected in 1983 and 1984), with collections dominated by gizzard shad and centrarchids (*e.g.,* bluegill, redear sunfish, black crappie, largemouth bass) (Dames & Moore 1985).

SCDNR periodically collects data on condition and size structure of the sub-impoundment’s largemouth bass in order to better manage the population and provide quality fishing (Osier 2006). Based on this data, the population appears to be dominated by intermediate-size fish (10-14 inches total length) that are probably two to four years old. The average weight, length, and condition of largemouth bass collected from the subimpoundment were slightly lower in 2005 than 2003, but small sample sizes did not allow statistical comparisons.

The sub-impoundment had a reputation in the region as a producer of trophy largemouth bass in the 1980s, but appears to have passed its peak and is no longer the producer of large bass that it once was. Small ponds and reservoirs tend to be most productive in the 5 to 10 years after impoundment, then move through a predictable series of successional changes as they slowly fill with sediment and aquatic vegetation becomes more abundant in shallows. Once vegetation becomes established, nutrients tend to be absorbed by these vascular plants rather than by phytoplankton, which are the base of the food chain. When phytoplankton densities decrease, zooplankton populations decline, larval fish growth and survival is affected, and the entire fish community begins to show reduced growth rates and smaller average sizes. This appears to have been the case at the sub-impoundment which historically had abundant growth of algae and native macrophytes, and in recent years has been invaded by water primrose, an exotic (native to South America) aquatic perennial that grows along pond and lake margins, forming floating mats that crowd out more desirable aquatic plants. Once established, this nuisance species is notoriously difficult and expensive to control.

2.4.2.2 Onsite Streams

Mayo Creek is the only stream in the project area that offers substantial year-round flow and habitat adequate to support reasonably diverse assemblages of benthic macroinvertebrates and fish. Several other unnamed drainages that appear on U.S. Geological Survey topographic maps as streams flowing into the Parr Reservoir immediately north and south of the project site are either intermittent streams (known locally as “wet weather” streams) or small perennial streams that may be only inches wide in late summer.

In some places, these small streams are dammed by snags and leafpack, creating pools that may be six to eight feet wide after heavy rains. Based on a July 2006 reconnaissance conducted by SCE&G and Tetra Tech NUS biologists, these pools serve as refuges for fish, crayfish, and aquatic insects during droughts and low-water periods (TtNUS 2007). The importance of these “pool refugia” to fish and aquatic insects in intermittent streams is well known (Labbe and Fausch 2000; Magoulick 2000). Pools with relatively stable hydrology (water levels) in intermittent streams are associated with successful reproduction, population growth, low rates of extinction, and immigration of fish, whereas pools with more variable hydrology (drying completely or nearly so) tend to be characterized by population declines and emigration (Magoulick and Kobza 2003; Love 2004).

Mayo Creek is approximately 3 miles long and drains an area of about 4 square miles (TtNUS 2007). It rises a half-mile southeast of the Unit 1 generating facilities, flows south for approximately 1 mile then curves to the southwest before emptying into the Broad River at Hampton Island, just below the Parr Shoals Dam (Figure 2.1-3). For much of its length, it moves through a mixed hardwood forest, and is almost completely shaded by a well-developed tree canopy. The tree canopy (shade) apparently moderates water temperatures in summer, which ranged from 23° to 25°C (74° to 76°F) on July 20, 2006, when stream levels were low and ambient temperatures approached 100°F (TtNUS 2007). Fish are found in all stream reaches, but are most numerous in middle and upper reaches that contain a mix of substrate and habitat types. The lower portion of Mayo Creek, immediately above its confluence with the Broad River, is noticeably wider and deeper than the upper portion, as Broad River water backs into the stream. The stream bottom here has a thick covering of silt, and habitat for fish and invertebrates is marginal at best.

Although the Mayo Creek drainage is largely forested and there has been no logging in its floodplain, it nevertheless carries a heavy silt load (TtNUS 2007). For reasons that may be related to characteristics of the watershed and the stream’s morphology, it is subject to flash floods after heavy rains. These floods have eroded and undercut the stream's banks along much of its length and covered the stream bottom in many places with a heavy layer of silt.

Mayo Creek aquatic surveys were first conducted in July and November 2006 (TtNUS 2007). The aquatic surveys were designed to gather baseline information on the stream's fish and mussel communities, supporting the assessment of construction impacts in this Environmental Report. The surveys were also intended to identify any special status species that might be present, ensuring that protection of any such species be factored into project planning. The Mayo Creek was selected for surveys because it is the only substantial stream in the project area, and the only one likely to contain significant numbers of fish and macrobenthos. Other streams in the project area are assumed to support smaller, less diverse aquatic communities that are a subset of the Mayo Creek communities, with species predominating that are able to tolerate high levels of turbidity and high summer water temperatures.

A total of 495 fish representing 14 species were collected during the 2006 Mayo Creek study, using a backpack electrofisher and minnow traps. Collections were dominated by Cyprinids (minnows), and Lepomids (sunfish). Bluehead chub (37.2% of the total), yellowfin shiner (18.2% of the total), sandbar shiner (16.4% of the total), and creek chub (8.1% of the total) were the species most often collected (TtNUS 2007). Collectively, these four Cyprinid species made up 79.9% of all fish collected during the study. Other species commonly collected were redbreast sunfish, brassy jumprock, tessellated darter, seagreen darter, and bluegill. Species collected were those typically associated with small, undisturbed streams in the Upper Coastal Plain and Piedmont of the Carolinas and Georgia (TtNUS 2007). Measures of abundance (catch per unit effort) and species richness/ species diversity were markedly higher in Transects 2 and 3, a portion of the stream with a well-developed canopy and relatively stable streambanks, than in Transect 1, which had less stable streambanks and a heavier silt load.

Additional surveys of Mayo Creek fish were conducted in February and April 2009 to ensure that community attributes were characterized for all four seasons (TtNUS 2009b). A total of 312 fish representing 10 species were collected in February and April 2009. Collections were dominated by Cyprinids (minnows; four species), which made up 75.6 percent of all fish collected. Yellowfin shiner (45.8 percent of total), bluehead chub (22.8 percent), and redbreast (12.8 percent) were the species most often collected. In 2006, bluehead chub ranked first in collections, comprising 37.2 percent of fish collected, and yellowfin shiner was second (18.2 percent). Creek chubs and sandbar shiners were relatively common in 2009, but were noticeably less abundant than they were in 2006. In general, the fish community in 2009 looked very much like the fish community in 2006—numerically dominated by two minnow species (bluehead chub and yellowfin shiner), with substantial numbers of redbreast sunfish, smaller numbers of other minnows, small suckers, and darters.

Two previously unobserved species were collected in 2009, the Northern hogsucker (*Hypentelium nigricans*) and the redear sunfish (*Lepomis* *microlophus*). The Northern hogsucker is found on the Atlantic slope from New York to Georgia, mostly above the Fall Line. In South Carolina, it occurs mostly in the Piedmont and Blue Ridge portions of the Savannah and Santee river drainages, including the Saluda, Broad, Congaree, Catawba, and Wateree rivers (Rohde et al. 2009). This species normally inhabits riffles and rapids of clear creeks and rivers, and is thought to be relatively intolerant of siltation and pollution (Rohde et al. 2009). The redear sunfish is found across the southeastern U.S., from the Carolinas to Texas. It occurs throughout South Carolina, from the Coastal Plain to the Blue Ridge, where it is found in a wide range of habitats, from swamps to farm ponds to rivers to large U.S. Army Corps of Engineers impoundments (Rohde et al. 2009).

Surveys of Mayo Creek in 2006 and 2009 revealed a surprisingly diverse assemblage of fishes (16 species) dominated numerically by Cyprinids (minnows). Five minnow species comprised almost 81 percent of all fish collected in 2006; four minnow species made up almost 76 percent of fish collected in 2009. Four centrarchid (sunfish) species and three percid (darter) species were also present, but tended to be less abundant. Smaller numbers of catastomids (suckers; two species) and ictalurids (catfish; two species) were also present. No state or federally listed fish species were collected. No species designated "species of concern" by the state of South Carolina or USFWS were collected. Several uncommon fish species were collected, but none has been afforded state or federal protection.

Several species of freshwater mussel and the non-native clam *Corbicula* are found in the lower Broad River (Bettinger, Crane, and Bulak 2003) into which Mayo Creek flows. However, it appears that conditions in Mayo Creek and its tributaries are not conducive to survival and/or propagation of bivalves. Although systematic surveys of mussels and clams were not conducted, biologists were instructed to note their presence and collect specimens if any were discovered. No live mussel specimens and no shells were observed in Mayo Creek or its tributaries. Small numbers of *Corbicula* shells were seen at Transect MC-2 in February 2009 (TtNUS 2009b).

Carnagey Biological Services, under contract to SCE&G, conducted benthic macroinvertebrate community assessments of Mayo Creek in July 2008, October 2008, January 2009, and April 2009 (CBS 2008c, CBS 2008d, CBS 2009c, CBS 2009d). These assessments were intended to gauge the condition of the stream's macroinvertebrate community and establish a baseline for impact assessment and monitoring purposes. Benthic macroinvertebrates were collected at three representative locations in the middle reaches of Mayo Creek.

Station 1, which was intended to serve as a control, was located approximately 1.5 kilometers upstream of Parr Road below the confluence of a small unnamed tributary (CBS 2008c). Station 2 was located approximately 170 meters upstream of Parr Road. Station 3 was established approximately 50 meters downstream of Parr Road. Substrates at all three locations consisted mainly of sand, with some gravel, cobble, and boulders present.

Benthic macroinvertebrates were collected at the three locations with a D-frame dipnet and by hand picking organisms from the substrate with forceps (CBS 2008c). All habitats were sampled and specimens pooled to form a single composite sample. Macroinvertebrates were sorted from debris in the laboratory with the aid of stereomicroscope. Specimens were counted and identified to the lowest positive taxonomic level with the aid of a microscope, standard references, and taxonomic keys.

Comparisons of the macroinvertebrate communities were based on the known pollution tolerances and life histories of the organisms collected and on differences in taxonomic composition between sampling stations. Differences in taxonomic composition were determined using metrics outlined in Rapid Bioassessment Protocol III of the EPA's *Rapid Bioassessment Protocols for Use in Streams and Rivers* (Plafkin *et al.* 1989 *in* CBS 2008c) and SCDHEC's *Standard Operating and Quality Control Procedures for Macroinvertebrate Sampling* (SCDHEC 1999 *in* CBS 2008c).

Results of the July 2008 benthic macroinvertebrate assessment indicated that Mayo Creek's macroinvertebrate community was stressed at all three stations, presumably because of a prolonged drought (CBS 2008c). The NCBI ratings for Stations 1 and 3 were "good-fair," while the rating for Station 2 was "good" (Table 2.4-5). Stations 1 and 3 had SCDHEC Bioclassification ratings of "fair," and Station 2 was rated "good-fair." The dominant benthic organism at all three stations was the mayfly *Caenis* (Table 2.4-6), a widely distributed Ephemeropteran that tolerates less-than-optimal water quality.

The October 2008 benthic macroinvertebrate assessment indicated that Mayo Creek was "somewhat stressed" at all three stations (CBS 2008d). Although the NCBI and SCDHEC Bioclassification scores showed little change from July to October (Table 2.4-5), EPT Abundance and EPT/Chironomid Abundance values were indicative of improved water quality. As in July, *Caenis* sp. were numerically dominant at all three stations (Table 2.4-6).

The January 2009 benthic macroinvertebrate assessment was indicative of a marked improvement in conditions (CBS 2009c). The EPT Index was noticeably higher than in previous quarters (Table 2.4-5). The NCBI rating was better at all three stations, while the SCDHEC Bioclassification score was better at two of three stations. Better ratings and scores were associated with winter rains and higher stream flows. *Maccaffertium modestum* (aka *Stenonema modestum*) and *Caenis* sp. were the dominant taxa (Table 2.4-6). Like *Caenis*, *M. modestum* is a common, fairly pollution-tolerant mayfly.

The April 2009 benthic macroinvertebrate assessment showed, for the first time, no impairment at any of the three stations (CBS 2009d). All three of the Mayo Creek stations had NCBI ratings of "excellent" and SCDHEC bioclassification scores of "good" (Table 2.4-5). Taxa richness was higher at all three stations in April 2009 than in July 2008, October 2008, and January 2009. EPT Index values were the highest observed over the course of the study, as were EPT Abundance values. *Caenis* sp. and *Acentrella* sp. dominated collections in April 2009

(Table 2.4-6). *Acentrella* is a somewhat less pollution-tolerant mayfly. Its appearance in samples (in January) coincided with higher stream flows and improvements in most of the bioassessment metrics.

The progressive improvement in the various metrics (bioindicators) observed over the course of the 2008–2009 study was almost certainly associated with increased rainfall and higher stream flows in 2009. Water quantity, rather than quality, appeared to drive the improvement. Water quality in Mayo Creek was consistently good, even in July 2008, when the drought had substantially reduced stream flows. In July 2008, when stream flows were the lowest observed during the study, water temperatures were surprisingly low (20.9 to 22.6°C) and dissolved oxygen levels relatively high (6.5 to 7.2 mg/L) (CBS 2008c). Water quality measurements in all four seasons met water quality standards for Class FW ("Freshwaters") waters in South Carolina (CBS 2008c, 2008d, 2009c, 2009d). Waterbodies classified as Freshwaters should be "suitable for fishing and the survival and propagation of a balanced indigenous community of fauna and flora" (S.C. Code of Regulations, Chapter 61-68).

2.4.3 IMPORTANT AQUATIC RESOURCES

The NRC requires applicants for construction and operating licenses to consider impacts to “important species” including rare species and commercially or recreationally valuable species (U.S. NRC 1999). Rare species include species listed by the USFWS or National Marine Fisheries Service as threatened or endangered, species proposed for listing by these agencies, species that are candidates for listing by these agencies, and species that are listed as threatened or endangered by the state in which the proposed facilities are located. Although diadromous (migratory) fish are not one of the groups designated by the NRC as “important,” it is clear from the instructions to NRC staff (U.S. NRC 1999) that migratory fish must be considered in any impact assessment. Moreover, SCDNR and the USFWS have committed to restoring diadromous fish stocks in South Carolina, and have worked closely with both SCE&G and Santee Cooper in the past to protect and restore runs of fish affected by power plant operations (SCDNR 2005a; SCDNR 2006).

2.4.3.1 Rare/Sensitive Species

Construction and operation of proposed new units at the VCSNS site could potentially impact aquatic populations, including sensitive species, in Parr Reservoir (Newberry and Fairfield Counties), Monticello Reservoir (Fairfield County), onsite streams (Fairfield County), and the Broad River downstream of Parr Shoals Dam (Fairfield and Richland Counties). Consequently, SCE&G reviewed SCDNR and USFWS county lists to identify sensitive aquatic species in these three counties. Sensitive species in this context are federally or state-listed species, species that are candidates for federal listing, and species proposed for listing by the USFWS.

The shortnose sturgeon (*Acipenser brevirostrum*), a federally endangered species, is known to occur in Richland County (USFWS 2008). Small numbers of shortnose sturgeon ascend the Congaree River from the Santee-Cooper system (Lake Moultrie, Lake Marion, and Rediversion Canal) to spawn near Columbia, South Carolina, approximately 40 miles upstream of Lake Marion (Collins et al. 2003). These sturgeon have historically been prevented from moving from the Congaree River into the Broad River by the Columbia Diversion Dam, which is associated with a hydroelectric facility (Columbia Canal Hydro). SCE&G, in consultation with state and federal resource agencies, built a fish passage facility at the Columbia Diversion Dam in 2006 that gives migratory fish species access to 25 miles of the Broad River from which they were previously excluded. This could, in theory, allow shortnose sturgeon to move from the Congaree River into the Broad River, and then upstream as far as Parr Shoals. Given that sturgeon return to natal streams and established spawning areas with a fairly high degree of spawning site fidelity, there is no reason to believe that Santee-Cooper/Congaree River sturgeon would abandon historical spawning areas in the Congaree River to spawn in the Broad River. However, this cannot be ruled out as a possibility.

The Charleston Ecological Services office of the USFWS lists the Carolina heelsplitter (*Lasmigona decorata*), a federally endangered mussel, as possibly occurring in Fairfield, Newberry, and Richland Counties (USFWS 2008). The species was historically known from the Catawba and Pee Dee river systems in North and South Carolina and the Savannah River system in South Carolina. Until 2004, only eight populations of this rare mussel were thought to survive, four in North Carolina and four in South Carolina (Price 2005). In 2005, two more populations were discovered in tributaries of the Catawba River in Chester County (Price 2005). Although apparently once found in large rivers and streams, the Carolina heelsplitter is now found in only cool, shallow, heavily shaded streams of moderate gradient with stable streambanks. Where present, they are found in small numbers (Price 2005). It is unclear why the USFWS lists the species as possibly occurring in Fairfield, Newberry, and Richland Counties. SCDNR (2006) does not show the Carolina heelsplitter occurring in these counties. Although the Carolina heelsplitter may once have occupied the Saluda River drainage, there is no evidence to suggest that the species was ever found in the Broad River drainage.

The Charleston Ecological Services office lists the Carolina darter (*Etheostoma collis*) as existing in Fairfield and Richland Counties (USFWS 2008). The Carolina darter is shown on the Charleston Ecological Services records as a *Species of Concern*, a classification that has no official status but is taken into consideration by the Service during project reviews. The Saluda crayfish (*Distocambarus youngineri*), also listed by the Charleston Ecological Services office as a *Species of Concern*, is known to exist in Newberry County (USFWS 2008).

As discussed previously, the SCDNR surveyed the fish of the Broad River between January 2001 and May 2002 at 10 sample sites from Gaston Shoals to Bookman Island, which is below the Parr Shoals Dam. Although some rare species such as fantail darter (*Etheostoma flabellare*) were collected, no state or federally listed species were found (Bettinger, Crane, and Bulak 2003). As part of the same study, SCDNR biologists surveyed freshwater mussels at six Broad River sites in the summer of 2002. Seven distinct “shell forms” were found that were presumed to represent seven different species. Of these seven shell forms, only two, Eastern elliptio (*Elliptio complanata*) and Eastern creekshell (*Villosa delumbis*), could be identified with certainty. The other shell forms likely belonged to the "*Elliptio lanceolata* group," and resembled *E. gracilentus*, *E. angustata*, and *E. perlatus*. The other two shell forms collected resembled *E. icterina* and *Uniomerus cariolanus*. None of these are listed by the state of South Carolina or the USFWS (SCDNR 2006; USFWS 2008) as rare species. *Elliptio complanata*, the species most often collected, is widespread within South Carolina, occurring in river systems from the Savannah to the Pee Dee (Bogan and Alderman 2004). It is known for its ability to tolerate low dissolved oxygen levels and survive droughts that take a heavy toll on other freshwater mussel species (Johnson et al. 2001).

SCE&G, along with several state and federal resource agencies and three other electric utilities, is involved in the restoration of the robust redhorse (*Moxostoma robustum*), a large catastomid believed to be extinct until 1991, when it was "rediscovered" in the Oconee River in Georgia (Bailey 2005). Nearly 19,000 robust redhorse fingerlings were stocked in the Broad River below two SCE&G hydroelectric facility dams (Neal Shoals Dam and Parr Shoals Dam) in 2004 (Self and Bettinger 2005); additional fish were stocked in the Broad River above Columbia in 2005 (SCDNR 2005b). Stockings are expected to continue until a self-sustaining population is achieved (Self and Bettinger 2005). Although this species is not state or federally listed, its range has been severely reduced by habitat loss (impoundment of native rivers) and habitat degradation (water quality problems associated with land development in watersheds). SCE&G is one of the signatories of the Memorandum of Understanding that established a Robust Redhorse Conservation Committee "actively committed to the restoration of the species throughout its known range" (RRCC 1995; Bailey 2005).

2.4.3.2 Diadromous Species

Based on a literature review, the Clean Water Act 316(a) and (b) studies for Unit 1 conducted in the 1980s, and extensive fish surveys conducted by the SCDNR in 2001 and 2002, SCE&G concludes that no diadromous populations (or landlocked descendents of once-diadromous populations) survive in the Broad River system. There are several semi-anadromous species, such as white perch and white bass, that make spawning runs within the Broad River system, but no representatives of species that move between freshwater and saltwater to spawn.

No anadromous fish have ascended the Broad River from the Atlantic Coast of South Carolina since the 1820s, when the Columbia Canal was built to connect the Broad River and the Congaree River. This canal, actually a lock and dam system, allowed river boats to circumnavigate shoals at the confluence of the Broad and Congaree rivers and move upstream into a deeper stretch of the Broad River. The Columbia Diversion Dam, which lies at the head of the Columbia Canal, was the main barrier to upstream movement of migratory fish. South Carolina Power Company, which was later to become SCE&G, built a small hydroelectric plant on the Columbia Canal in the 1880s to supply power to a textile mill, the first electrically powered textile mill in the world.

SCE&G completed work on a fishway (fish passage facility) at the Columbia Diversion Dam in 2006 that gives migratory fish species access to 25 miles of the Broad River from which they were previously excluded (American Rivers 2006). Plans for the fishway were developed by SCE&G in consultation with SCDNR, USFWS, and the National Marine Fisheries Service as part of the Federal Energy Regulatory Commission relicensing of the Columbia Canal Hydro (Moak 2004). The fishway consists of a series of pools arranged in stairstep fashion that will allow fish to negotiate the 14-foot high dam. The fishway was specifically designed to accommodate upstream passage of American shad and blueback herring, which were documented downstream of the dam in studies associated with the relicensing of the project (Moak 2004).

Now that the Columbia Diversion Dam fishway is operational, it is possible for anadromous species such as American shad and blueback herring to move from the Atlantic Ocean to the base of the Parr Shoals Dam via the Santee River, the St. Stephen Dam and fish lift, Lake Moultrie, the Diversion Canal that connects Lake Moultrie to Lake Marion, Lake Marion, the Congaree River, the Columbia Canal, the new fishway, and a 25-mile stretch of the Broad River. Some shad, herring, and eels will undoubtedly make this long and arduous journey, but the probability of large numbers of fish doing so appears remote.

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Table 2.4-1
Protected Species in Fairfield County and in Counties Crossed by Existing Transmission Lines

Scientific Name	Common Name	Federal Status[(a)]	State Status[(b)]	County[(b)]
Birds				
Haliaeetus leucocephalus	Bald eagle	—	E	Aiken, Edgefield, Fairfield, Newberry, Richland, Saluda
Picoides borealis	Red-cockaded woodpecker	E	E	Aiken, Edgefield, Richland, Saluda
Mycteria americana	Wood stork	E	E	Aiken, Newberry
Mammals				
Corynorhinus rafinesquii	Rafinesque's big-eared bat	—	E	Aiken, Richland
Reptiles				
Clemmys guttata	Spotted turtle	—	T	Aiken
Gopherus polyphemus	Gopher tortoise	—	E	Aiken
Amphibians				
Hyla andersonii	Pine barrens treefrog	—	T	Richland
Plethodon websteri	Webster's salamander	—	E	Edgefield, Saluda
Rana capito capito	Carolina gopher frog	—	E	Aiken
Fish				
Acipenser brevirostrum	Shortnose sturgeon	E	E	Aiken, Richland
Invertebrates				
Lasmigona decorata	Carolina heelsplitter	E	E	Edgefield, Saluda
Vascular Plants				
Amphianthus pusillus	Pool sprite, little amphianthus	T	T	Saluda
Aster georgianus	Georgia aster	C	-	Edgefield, Fairfield, Saluda
Echinacea laevigata	Smooth coneflower	E	E	Aiken, Richland
Lysimachia asperulifolia	Rough-leaved loosestrife	E	E	Richland
Oxypolis canbyi	Canby's dropwort	E	E	Richland
Ptilimnium nodosum	Harperella	E	E	Aiken, Saluda
Ribes echinellum	Miccosukee gooseberry	T	T	Edgefield
Trillium reliquum	Relict trillium	E	E	Aiken, Edgefield

a) Source: USFWS (2008)
b) Source: SCDNR (2006), USFWS (2008)

E = Endangered, T = Threatened, C = Candidate, — = Not listed

Table 2.4-2 (Sheet 1 of 2)
Protected Species in Counties Crossed by Proposed Transmission Lines

Scientific Name	Common Name	Federal Status[(a)]	State Status[(a)]	County[(b)]
Birds				
Charadrius melodus	Piping plover	T	—	Colleton
Charadrius wilsonia	Wilson’s plover	—	T	Colleton
Elanoides forficatus	American swallow-tailed kite	—	E	Dorchester
Haliaeetus leucocephalus	Bald eagle	—	E	Aiken, Chester, Colleton, Dorchester, Fairfield, Hampton, Lancaster, Lexington, Newberry Orangeburg, Richland, Saluda
Picoides borealis	Red-cockaded woodpecker	E	E	Aiken, Chester, Colleton, Dorchester, Hampton, Lexington, Newberry Orangeburg, Richland, Saluda
Mycteria americana	Wood stork	E	E	Aiken, Colleton, Dorchester, Hampton
Sterna antillarum	Least tern	—	E	Colleton
Mammals				
Corynorhinus rafinesquii	Rafinesque’s big-eared bat	—	E	Aiken, Colleton, Dorchester, Hampton, Orangeburg, Richland
Reptiles				
Caretta caretta	Loggerhead sea turtle	T	T	Colleton
Chelonia mydas	Green sea turtle	T	—	Colleton
Clemmys guttata	Spotted turtle	—	T	Aiken, Colleton, Hampton
Dermochelys coriacea	Leatherback sea turtle	E	-	Colleton
Gopherus polyphemus	Gopher tortoise	—	E	Aiken, Colleton, Dorchester, Hampton
Lepidochelys kempii	Kemp’s ridley sea turtle	E	-	Colleton
Amphibians				
Ambystoma cingulatum	Flatwoods salamander	T	E	Orangeburg
Hyla andersonii	Pine barrens treefrog	—	T	Richland

Table 2.4-2 (Sheet 2 of 2)
Protected Species in Counties Crossed by Proposed Transmission Lines

Scientific Name	Common Name	Federal Status[(a)]	State Status[(a)]	County[(b)]
Amphibians (continued)				
Plethodon websteri	Webster’s salamander	—	E	Saluda
Pseudobranchus striatus	Dwarf siren	—	T	Hampton, Orangeburg
Rana capito capito	Carolina gopher frog	—	E	Aiken, Dorchester, Hampton, Orangeburg
Invertebrates				
Lasmigona decorata	Carolina heelsplitter	E	E	Chester, Lancaster, Saluda
Fish				
Acipenser brevirostrum	Shortnose sturgeon	E	E	Aiken, Colleton, Dorchester, Hampton, Lexington, Orangeburg, Richland
Vascular Plants				
Amphianthus pusillus	Pool sprite, little amphianthus	T	T	Lancaster, Saluda
Aster georgianus	Georgia aster	C	—	Chester, Fairfield. Richland, Saluda
Echinacea laevigata	Smooth coneflower	E	E	Aiken, Lancaster, Lexington, Richland
Isoetes melanospora	Black-spored quillwort	E	—	Lancaster
Helianthus schweinitzii	Schweinitz’s sunflower	E	E	Lancaster, Lexington
Lindera melissifolia	Pondberry	E	E	Colleton, Dorchester
Lysimachia asperulifolia	Rough-leaved loosestrife	E	E	Richland
Narthecium americanum	Bog asphodel	C	—	Dorchester
Oxypolis canbyi	Canby’s dropwort	E	E	Colleton, Dorchester, Hampton, Orangeburg, Richland
Trillium reliquum	Relict trillium	E	E	Aiken
Ptilimnium nodosum	Harperella	E	E	Aiken, Saluda

a) Source: USFWS (2008)
b) Source: SCDNR (2006), USFWS (2008)

E = Endangered; T = Threatened; C = Candidate; — = Not listed

Table 2.4-3 (Sheet 1 of 3)
Avian Species Recorded During Surveys at the VCSNS Site

Species	Status[c]	Survey Period[a] and Abundance[b]							
		May 2002	Dec 2002	Jun–Jul 2006	Sep 2006	Apr 2007	Oct 2007	Aug 2008	Oct 2008
Wading Birds, Shorebirds, and other Water Birds									
Blue-winged teal (*Anas discors*)	W	—	Occ	—	—	—	—	—	—
Mallard (*Anas platyrhynchos)*	W	—	Occ	—	—	—	Occ	—	—
Black duck (*Anas rubripes)*	W	—	Occ	—	—	—	—	—	—
Great egret (*Ardea alba*)	Y	Occ	Occ	Occ	—	Occ	—	—	—
Great blue heron (*Ardea herodias*)	Y	Occ	-	Occ	Occ	Occ	Occ	Occ	Occ
Canada goose *(Branta canadensis)*	Y	Occ	Occ	Com	Occ	Occ	Occ	Occ	Com
Green heron (*Butorides virescens*)	Y	Occ	—	Occ	—	—	—	—	—
Killdeer (*Charadrius vociferus*)	Y	—	—	Occ	—	Occ	—	—	Occ
Little blue heron (*Egretta caerulea*)	Y	—	—	Occ	—	Occ	—	—	—
Herring gull *(Larus argentatus)*	W	—	Occ	—	—	—	—	—	Occ
Double-crested cormorant (*Phalacrocorax auritus*)	Y	Occ	Occ	Com	Com	Occ	Occ	—	—
Birds of Prey and Soaring Birds									
Cooper's hawk (*Accipiter cooperii*)	Y	Occ	—	Occ	—	—	Occ	—	—
Red-tailed hawk (*Buteo jamaicensis*)	Y	Occ	Occ	Occ	Occ	Occ	—	Occ	Occ
Red-shouldered hawk (*Buteo lineatus*)	Y	Occ	Occ	Occ	Occ	Occ	Occ	—	Occ
Turkey vulture (*Cathartes aura*)	Y	Com	Com	Abu	Com	Com	Com	Com	Com
Black vulture (*Coragyps atratus*)	Y	Com	Occ	Com	Com	Occ	Abu	Occ	Occ
Bald eagle (*Haliaeetus leucocephalus*)	Y	Occ	—	—	Occ	Occ	Occ	—	Occ
Passerines and Other Birds									
Red-winged blackbird (*Agelaius phoeniceus*)	Y	Occ	—	Occ	—	—	—	—	—
Ruby-throated hummingbird (*Archilochus colubris*)	S	—	—	Occ	—	—	—	—	—
Great horned owl (*Bubo virginiana*)	Y	—	—	—	Occ	—	—	—	—
Northern cardinal (*Cardinalis cardinalis*)	Y	Com	Occ	Abu	Com	Com	Com	Com	Occ

Table 2.4-3 (Sheet 2 of 3)
Avian Species Recorded During Surveys at the VCSNS Site

Species	Status[c]	Survey Period[a] and Abundance[b]							
		May 2002	Dec 2002	Jun–Jul 2006	Sep 2006	Apr 2007	Oct 2007	Aug 2008	Oct 2008
Passerines and Other Birds (continued)									
Pine siskin (*Carduelis pinus*)	W	—	Occ	—	—	—	Occ	—	—
Northern bobwhite quail (*Colinus virginianus*)	Y	Occ	—	Occ	—	Occ	—	—	—
Yellow-billed cuckoo (*Coccyzus americanus*)	S	—	—	Occ	—	Occ	—	—	—
Northern flicker (*Colaptes auratus*)	Y	Occ	—	Occ	Occ	-	Occ	Occ	Occ
Eastern wood pewee (*Contopus virens*)	S	Occ	—	Occ	—	Occ	—	—	—
American crow (*Corvus brachyrhynchos*)	Y	Com	Occ	Abu	Com	Com	Occ	Com	Com
Blue jay (*Cyanocitta cristata*)	Y	Occ	Occ	Com	Com	Occ	Com	Com	Com
Yellow-rumped warbler (*Dendroica coronata*)	W	—	—	—	—	—	Occ	—	Occ
Prairie warbler (*Dendroica discolor*)	S	Com	—	Com	-	Com	—	—	—
Pine warbler (*Dendroica pinus*)	Y	Occ	—	Occ	Occ	—	Occ	Occ	Occ
Pileated woodpecker (*Dryocopus pileatus*)	Y	Occ	Occ	Occ	—	Occ	Occ	Occ	Occ
Dark-eyed junco (*Junco hyemalis*)	W	—	Occ	-	—	—	Occ	—	—
Loggerhead shrike (*Lanius ludovicianus*)	Y	Occ	—	Occ	—	—	—	—	—
Belted kingfisher (*Megaceryle alcyon)*	Y	Occ	Occ	Occ	—	—	Occ	—	—
Red-bellied woodpecker (*Melanerpes carolinus*)	Y	Com	Occ	Com	Com	Occ	Com	Occ	Com
Wild turkey (*Meleagris gallopavo*)	Y	Occ	—	Occ	Occ	Occ	Occ	Occ	Occ
Song sparrow (*Melospiza melodia*)	W	—	Occ	—	—	—	Occ	—	—
Northern mockingbird (*Mimus polyglottos*)	Y	Com	Occ	Com	Abu	Com	Com	Com	Com
Great crested flycatcher (*Myiarchus crinitus*)	S	Occ	—	Occ	—	—	—	—	—
Tufted titmouse (*Parus bicolor*)	Y	Com	Occ	Com	-	Com	Com	Occ	Com
Carolina chickadee (*Parus carolinensis*)	Y	Com	Occ	Com	Com	Com	Com	Occ	Com
Indigo bunting (*Passerina cyanea*)	S	—	—	Occ	—	—	—	—	—
Downy woodpecker (*Picoides pubescens*)	Y	Occ	—	Occ	—	—	Occ	—	Occ
Rufous-sided towhee (*Pipilo erythrophthalmus*)	Y	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ

Table 2.4-3 (Sheet 3 of 3)
Avian Species Recorded During Surveys at the VCSNS Site

Species	Status[c]	Survey Period[a] and Abundance[b]							
		May 2002	Dec 2002	Jun–Jul 2006	Sep 2006	Apr 2007	Oct 2007	Aug 2008	Oct 2008
Passerines and Other Birds (continued)									
Summer tanager (*Piranga rubra*)	S	Occ	—	Occ	—	Occ	—	—	—
Golden-crowned kinglet (*Regulus satrapa*)	W	—	—	—	—	—	Occ	—	Occ
Eastern phoebe (*Sayornis phoebe*)	Y	Occ	—	Occ	—	—	Occ	—	—
Eastern bluebird (*Siala sialis*)	Y	Occ	—	—	Occ	—	—	—	Occ
Brown-headed nuthatch (*Sitta pusilla*)	Y	—	Occ	Occ	—	—	—	Occ	Occ
Yellow-bellied sapsucker (*Sphyrapicus varius*)	W	—	—	—	—	—	Occ	—	Occ
Northern rough-winged swallow (*Stelgidopteryx serripennis*)	S	—	—	Occ	—	—	—	—	—
Barred owl (*Strix varia*)	Y	Occ	—	Occ	—	—	—	—	—
Carolina wren (*Thryothorus ludovicianus*)	Y	Occ	—	Occ	Occ	—	—	Occ	—
American robin (*Turdus migratorius)*	Y	Com	Occ	Occ	Com	Occ	Com	Com	Occ
Brown thrasher (*Toxostoma rufum*)	Y	Occ	—	—	Occ	Occ	—	—	—
White-eyed vireo (*Vireo griseus*)	S	Occ	—	Occ	—	Occ	—	—	—
Red-eyed vireo (*Vireo olivaceus*)	S	Occ	—	Occ	—	—	—	—	—
Mourning dove (*Zenaida macroura*)	Y	Com	Occ	Com	Occ	Com	Com	Com	Com
White-throated sparrow (*Zonotrichia albicollis*)	W	—	Occ	—	—	—	Occ	—	—

a) Survey periods were May 30-31, 2002; December 10, 2002; June 27 and July 20-21, 2006; September 18, 2006; April 5-6, 2007; October 4, 2007, August 22, 2008; October 14, 2008; and October 27-31, 2008.

b) Abundance classifications within expected habitats were subjectively based on observations relative to time surveyed; Abu = abundant; Com = common; Occ = occasional, uncommon, or rare; - indicates species was not observed.

c) Species occurrence in the region encompassing VCSNS, based on range maps (Peterson 1980): Y = present throughout the year; S = summer (breeding season); W = winter only.

Table 2.4-4
Aquatic and Wetland Plants Observed at Parr Reservoir in 2008

Species	Public Boat Landing on Hellers Creek	50 Yds Above the Mouth of Hellers Creek	50 Yds Above the Mouth of Frees Creek	Public Boat Landing on Cannons Creek	600 Yds Above Proposed Blowdown Location	200 Yds Above Proposed Blowdown Location	100 Yds Above Proposed Blowdown Location	Proposed Cooling Tower Blowdown Location	100 Yds Below Proposed Blowdown Location	200 Yds Below Proposed Blowdown Location	600 Yds Below Proposed Blowdown Location
Alligatorweed	X	X	X	X	X	X	X	X	X	X	X
Bulrushes	X	X			X	X	X	X	X	X	
Bur-Marigold			X		X	X	X	X	X	X	X
Cattail	X				X		X		X	X	
Coontail					X	X	X	X		X	X
Lizard’s Tail		X			X	X	X	X	X	X	X
Marsh Pennywort			X			X	X	X	X	X	
Pickerelweed	X		X			X	X	X	X	X	X
Rushes		X	X				X	X			
Smartweed	X			X	X	X	X	X	X	X	X
Water Primrose	X	X	X	X	X	X	X	X	X	X	X

Source: SCANA Services 2008b

Table 2.4-5
Rapid Bioassessment Metrics Calculated for the Three Sampling Stations on Mayo Creek, Fairfield County, South Carolina, 2008–2009

	July 2008 Station			October 2008 Station			January 2009 Station			April 2009 Station		
Metric	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	3
Taxa Richness	26	33	26	30	23	25	31	29	29	43	38	34
Number of Specimens	151	149	129	182	165	157	150	143	146	244	204	215
EPT Index	8	9	9	9	9	7	14	13	17	21	19	17
EPT Abundance	97	97	92	130	131	108	106	93	118	189	172	163
Chironomid Taxa	5	4	2	1	3	2	6	3	5	4	2	7
Chironomid Abundance	24	5	3	2	3	3	19	5	17	18	2	18
EPT/Chironomid Abundance	4.04	19.40	30.67	65.00	43.67	36.00	5.58	18.60	6.94	10.50	86.00	9.06
NC Biotic Index (rating)	6.17 (good-fair)	5.73 (good)	5.93 (good-fair)	5.52 (good)	5.81 (good-fair)	6.26 (good-fair)	5.12 (excellent)	5.21 (good)	5.46 (good)	4.59 (excellent)	4.19 (excellent)	4.36 (excellent)
SCDHEC Bioclassification (rating)	2.3 (fair)	2.8 (good-fair)	2.3 (fair)	2.8 (good-fair)	2.5 (good-fair)	2.2 (fair)	3.7 (good)	3.2 (good-fair)	3.3 (good-fair)	4.0 (good)	4.0 (good)	3.8 (good)
Percent of Dominant Taxon	23.84	22.15	41.86	24.18	44.85	40.76	20.67	17.48	27.40	12.70	31.37	18.14

Source: CBS 2008c, CBS 2008d, CBS 2009c, CBS 2009d

Table 2.4-6 (Sheet 1 of 2)
Dominant taxa (>5% of the collection) for the Three Sampling Stations on Mayo Creek, Fairfield County, South Carolina, 2008–2009

July 2008			October 2008			January 2009			April 2009		
Station 1 Taxon	**No.**	**Rel. Abd.**	**Station 1 Taxon**	**No.**	**Rel. Abd.**	**Station 1 Taxon**	**No.**	**Rel. Abd.**	**Station 1 Taxon**	**No.**	**Rel. Abd.**
Caenis sp.	36	23.84	*Caenis* sp.	44	24.18	*Maccaffertium modestum*	31	20.67	*Acentrella* sp.	31	12.70
Stenacron interpunctatum	19	12.58	*Cheumatopsyche* sp.	31	17.03	*Cheumatopsyche* sp.	18	12.00	*Ephemerella* sp.	30	12.30
Maccaffertium modestum	15	9.93	*Chimarra* sp.	22	12.09	*Acentrella ampla*	17	11.33	*Caenis* sp.	25	10.25
Cheumatopsyche sp.	15	9.93	*Maccaffertium modestum*	13	7.14	*Simulium mixtum*	11	7.33	*Maccaffertium modestum*	23	9.43
Microtendipes pedellus	12	7.95				*Cricotopus* sp.	10	6.67	*Isoperla sp.*	14	5.74
						Ephemerella catawba	9	6.00			
Station 2 Taxon	**No.**	**Rel. Abd.**	**Station 2 Taxon**	**No.**	**Rel. Abd.**	**Station 2 Taxon**	**No.**	**Rel. Abd.**	**Station 2 Taxon**	**No.**	**Rel. Abd.**
Caenis sp.	33	22.15	*Caenis* sp.	74	44.85	*Maccaffertium modestum*	25	17.48	*Caenis* sp.	64	31.37
Cheumatopsyche sp.	18	12.08	*Cheumatopsyche* sp.	19	11.52	*Simulium mixtum*	22	15.38	*Ephemerella* sp.	20	9.80
Maccaffertium modestum	14	9.40	*Maccaffertium modestum*	13	7.88	*Acentrella ampla*	19	13.29	*Agnetina* sp.	17	8.33
Isonychia sp.	12	8.05	*Isonychia* sp.	11	6.67	*Caenis sp.*	13	9.09	*Maccaffertium modestum.*	12	5.88
Triaenodes ignitus	10	6.71				*Ephemerella catawba*	11	7.69	*Isonychia* sp.	12	5.88
						Cheumatopsyche sp.	10	6.99	*Telogonopsis deficiens*	11	5.39

Table 2.4-6 (Sheet 2 of 2)
Dominant taxa (>5% of the collection) for the Three Sampling Stations on Mayo Creek, Fairfield County, South Carolina, 2008–2009

July 2008			October 2008			January 2009			April 2009		
Station 3 Taxon	**No.**	**Rel. Abd.**	**Station 3 Taxon**	**No.**	**Rel. Abd.**	**Station 3 Taxon**	**No.**	**Rel. Abd.**	**Station 3 Taxon**	**No.**	**Rel. Abd.**
Caenis sp.	54	41.86	*Caenis* sp.	64	40.76	*Caenis* sp.	40	27.40	*Caenis* sp.	39	18.14
Maccaffertium modestum	11`	8.53	*Cheumatopsyche* sp.	24	15.29	Acentrella ampla	17	11.64	*Baetis intercalaris*	25	11.63
Stenacron interpunctatum	8	6.20	*Hydrachna* sp.	9	5.73	*Cheumatopsyche* sp.	16	10.96	*Acentrella* sp.	19	8.84
Hydrachna sp.	7	5.43	*Corbicula fluminea*	9	5.73	*Maccaffertium modestum*	15	10.27	*Agnetina* sp.	14	6.51
			Cambaridae *(unidentified crawfish)*	8	5.10	*Orthocladius sp.*	11	7.53	*Simulium ubiquitum*	13	6.05
			Isonychia sp.	8	5.10				*Isonychia* sp.	12	5.58
									Amphinemura sp.	12	5.58
									Maccaffertium modestum	11	5.12
									Ephemerella sp.	11	5.12

Source: CBS 2008c, CBS 2008d, CBS 2009c, CBS 2009d

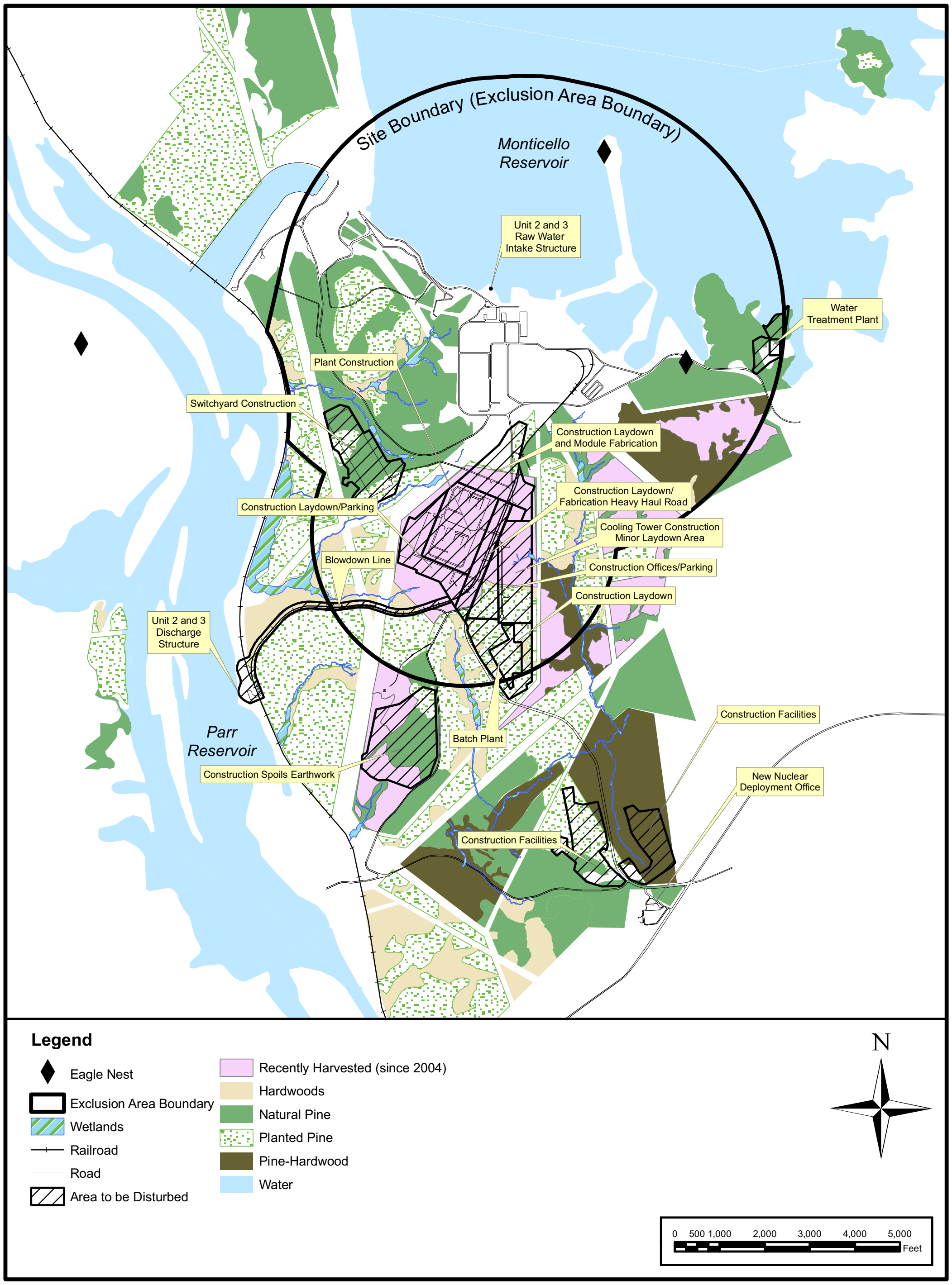

Figure 2.4-1. Habitats and Areas That Will Be Disturbed During Construction of Units 2 and 3

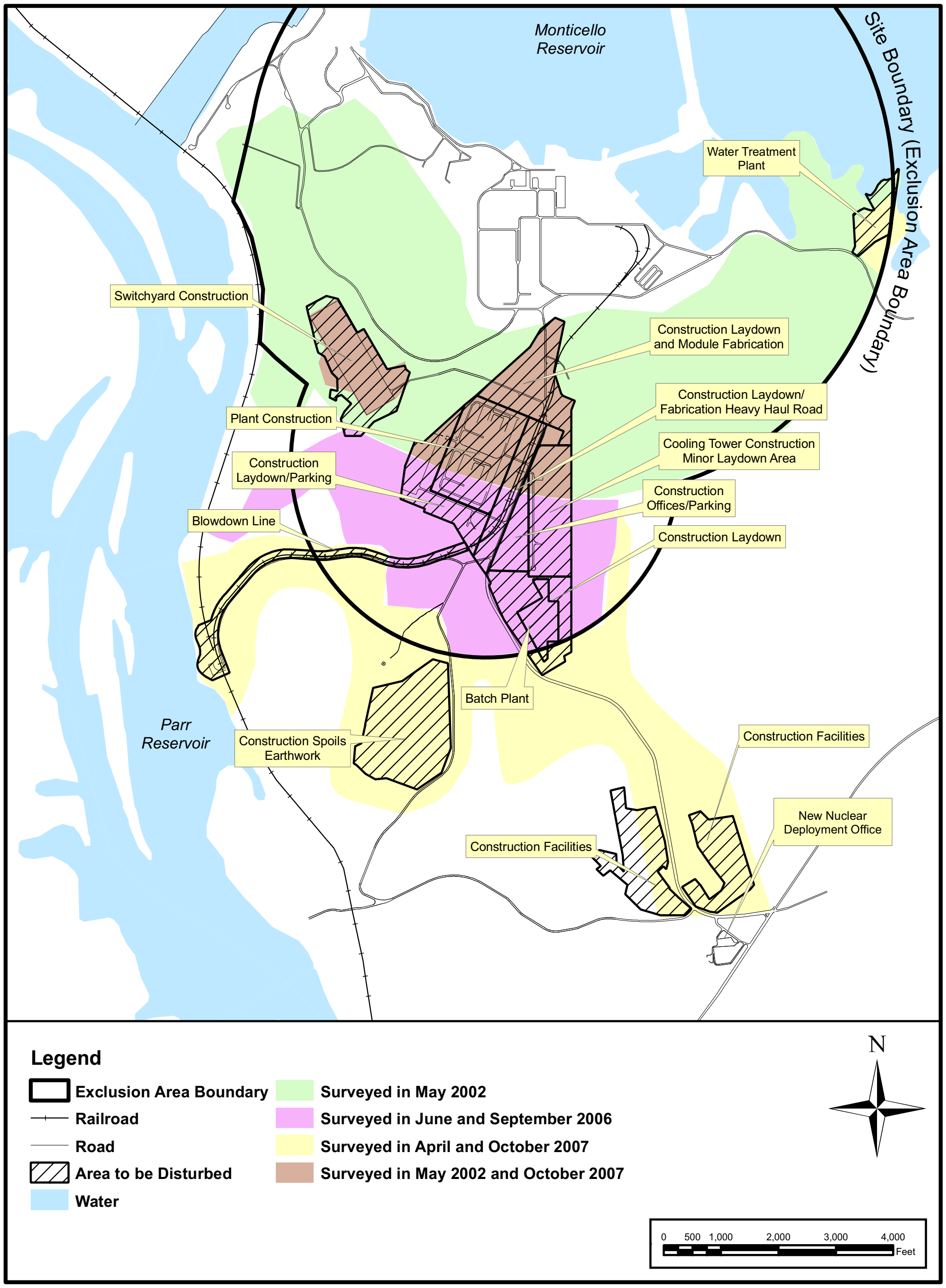

Figure 2.4-2. Areas Surveyed for Endangered and Threatened Species at VCSNS, 2002–2007

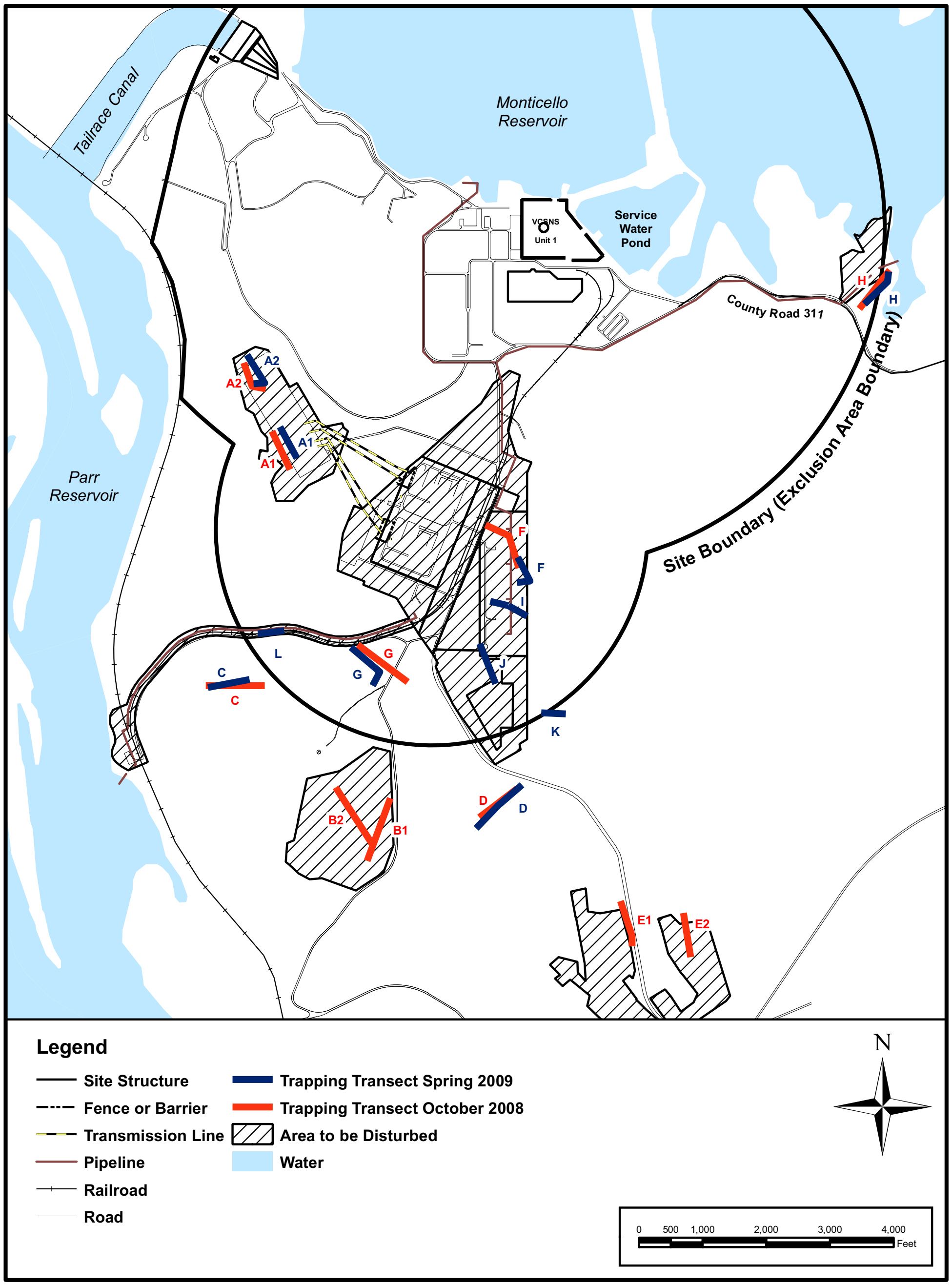

Figure 2.4-3. Small Mammal Trapping Transects on the VCSNS Site

2.5 SOCIOECONOMICS

This section presents the socioeconomic resources that have the potential to be impacted by the construction, operation, and decommissioning of new nuclear units located at VCSNS. The section is divided into four subsections: demography, community characteristics, historic properties, and environmental justice. These subsections include discussions of spatial (*e.g.*, regional, vicinity, site) and temporal (*e.g.*, 10-year increments of population growth) considerations, where appropriate.

2.5.1 DEMOGRAPHY

SCE&G determined that four types of demographic information are most pertinent to support socioeconomic analyses in Chapters 4 and 5—population data by sector, population data by political jurisdiction, population density, and transient and migrant populations. The population data is for total populations, *i.e.*, not stratified into age, race, or income. Information specific to low-income and minority populations is provided in Subsection 2.5.4.

2.5.1.1 Population Data by Sector

SCE&G prepared sector charts in accordance with NRC guidance (U.S. NRC 1999). Figure 2.5-1 shows a 10-mile-radius sector chart superimposed on a VCSNS site vicinity map. On this map, the chart is centered at the midpoint between the locations of the proposed new units, with concentric circles representing radii of 1, 2, 3, 4, 5, and 10 miles. The circles are divided into 22.5° sectors, with each sector centered on one of 16 compass points (*e.g.*, north, north-northeast, northeast, and east). Figure 2.5-2 is the 50-mile-radius sector chart, divided into 10-mile radii. Each radius is divided into sectors as described for the vicinity radii. NRC guidance suggests including residential and transient populations within the sectors (U.S. NRC 1999).

SCE&G used SECPOP2000 to estimate the residential population in each sector. SECPOP 2000 is a computer code developed for the NRC by Sandia National Laboratories. After the user inputs site-specific information (primarily site latitude and longitude and sector radii distances), the code uses imbedded U.S. Census Bureau 2000 census data at the block level to calculate the resident population for each of the sectors (U.S. NRC 2003). Block level data were appointed if the block fell into more than one sector.

NUREG-1555 does not define “transient populations.” SCE&G used Regulatory Guide 4.7 for guidance on the definition and use of the data. Regulatory Guide 4.7 provides general site suitability guidance for nuclear plants and indicates that transients are people who work, reside part-time, or engage in recreational activities and are not permanent residents of the area. The term does not include people who are just passing through the area, as on a highway. The transient population should be weighted according to the fraction of time that the transients are in the area and, where the number of transients is significant, included with resident population. (U.S. NRC 1998).

One use of population data within 10 miles is in evaluating impacts from severe accidents that result in radioactive releases to the environment. Because short-term exposure is important to determining accident impacts, SCE&G determined that knowing where and how many transients might be found within 10 miles is important regardless of time weighting. U.S. Census Bureau data do not include transients, and SCE&G is unaware of any official source of information about transient locations and numbers. For this reason, SCE&G performed a survey of the transient population for each sector within 10 miles of the site. The survey included review of area maps; review of internet information on schools, hotels and motels, hospitals, nursing homes, recreational facilities, state agencies including schools and correctional facilities, and businesses; and ground reconnaissance. The survey concluded that it is reasonable to expect there to be 76 transients within 10 miles, and SCE&G added these numbers to the SECPOP2000 results. FSAR Section 2.1.3.3.1 provides the data and basis for the number of transients within 10 miles. Table 2.5-1 presents this information, for year 2000, as resident and transient populations within 10 miles and resident populations between 10 and 50 miles.

The significance of transient populations to accident analysis within 10 miles does not exist between 10 and 50 miles from the site. This is because, beyond 10 miles, uptake is the more significant pathway and there is time for interdiction measures such as removing potentially contaminated foodstuffs from the food chain. After considering the transient populations within 50 miles of VCSNS (see Transient and Migrant Populations), SCE&G concluded that the numbers, when time-weighted, would not be significant. For these reasons, SCE&G did not include transients in the 10- to 50-mile sector data.

In order to estimate sector population by 10-year increments through the projected plant life, SCE&G developed growth rate projections based on state population projections that run to 2030 (SCBCB 2005a, NCSDC 2005). Because the state projections are by county and each county can have a different growth rate, SCE&G first had to estimate the percentage of each sector's land area that fell, either completely or partially, within each county. SCE&G used ArcGIS®[a] to determine this percentage. In addition, because the state projections are expressed as number of people, SCE&G had to calculate the growth rate that the state was using for each county in order to be able to apply the appropriate growth rates to each sector. If a sector fell within more than one county, SCE&G used the ArcGIS-developed input to multiply the correct percentage of the sector's population by the correct county's growth rate. SCE&G assumed that growth rates in individual counties would remain at a constant rate from 2030 to 2060. Table 2.5-1 presents population projections through 2060 for each sector. Details of the sector population and population projection calculations are included in a calculation package.

Table 2.5-1 also provides cumulative population data. SCE&G projects that the total population within 10 miles of the proposed units will increase from 12,209 in

a. ArcGIS is a registered trademark of Environmental Systems Research Institute, Inc.

2000 to 21,043 in 2060. Year 2060 represents a period of 40 years after the anticipated start of commercial operations that also coincidences with a U.S. Census. The population within 50 miles will increase from 1,028,075 to 2,131,394 in the same time period.

2.5.1.2 Population Data by Political Jurisdiction

The area defined by a 50-mile radius from the center of the proposed units (Figure 2.5-2) includes all or part of 21 counties in South Carolina and one county in North Carolina. Table 2.5-2 lists these counties. SCE&G has assumed that the residential distribution of the new units' operational workforce would resemble the residential distribution of VCSNS's current workforce. Approximately 95% of current Unit 1 employees reside within Fairfield, Newberry, Lexington, and Richland counties. The remaining 5% are distributed across 19 other counties. Socioeconomic effects from the proposed workforces would be most evident in those four counties so SCE&G has focused its demographic characterization on those counties. These four counties are known as the region of influence.

As discussed in the previous section, SCE&G used state data for county population and population growth. Table 2.5-3 presents historical and projected population and annual percent growth rate data for the four counties of interest plus the state as a whole. The state projects that the Fairfield County year 2000 population of 23,454 will increase to 27,900, an average annual growth rate of 0.58%, by year 2030. This growth rate is less than that for the other counties (Lexington at 1.43%, Newberry at 0.63%, and Richland at 0.80%) and the state (0.98%), suggesting that Fairfield County will remain more rural than areas further away from the site.

Table 2.5-4 lists the age distributions in Fairfield, Lexington, Newberry, and Richland Counties in 2000 and compares them to the age distribution in the state of South Carolina. As shown, the county age distributions do not vary substantially from the state averages.

The nearest population center (*i.e.*, more than 25,000 residents) is Columbia, South Carolina, to the southeast of the VCSNS site. The distance between the site and the Columbia city limits is approximately 15 miles, with the distance to the center of the city being approximately 25 miles. Columbia's 2000 population was 116,278 (USCB 2006). The Columbia Metropolitan Statistical Area includes Fairfield, Lexington, and Richland Counties as well as Calhoun, Kershaw, and Saluda Counties (USCB 2003a), and has a 2000 population of 647,158 (USCB 2003b).

Table 2.5-5 identifies incorporated places in the 50-mile radius and their 2000 population. Jenkinsville, an unincorporated community, is located approximately 2 miles southeast of the site. The postal district that includes Jenkinsville had a population of 724 in 2000 (USCB 2000a).

2.5.1.3 Population Density

This subsection looks at population density two ways. The first is by the population within 20 miles of the site and the second uses an NRC method for characterizing the site as being located in a low-, medium-, or high-population area.

Regulatory Guide 4.7 indicates that, preferably, a reactor would be located so that at the time of initial site approval and within about five years thereafter, the population density averaged over any radial distance out to 20 miles does not exceed 500 people per square mile (U.S. NRC 1988). VCSNS population data is organized by census decade. SCE&G used population data for the year 2010 as the approximate time of initial site approval (*i.e.*, NRC issuance of the combined operating license) and the year 2020 to represent the start of commercial operation. As Table 2.5-6 shows, VCSNS population density is less than 500 people per square mile for all radial distances and years.

NRC has developed a method for characterizing nuclear power plant sites as being located in low-, moderate-, or high-population areas, finding that the significance of some plant impacts is influenced by the site's category. NRC used this methodology in preparing its generic environmental impact statement for plant license renewal (U.S. NRC 1996). SCE&G has found this methodology useful in characterizing VCSNS population, having used it during Unit 1 license renewal (SCE&G 2002), and is using it for analysis of the proposed new units.

The generic environmental impact statement characterizes populations based on two factors—"sparseness" and "proximity." "Sparseness" describes population density and city size within 20 miles of a site as follows:

Demographic Categories Based on Sparseness

		Category
Most sparse	1.	Less than 40 people per square mile and no community with 25,000 or more people within 20 miles
	2.	40 to 60 people per square mile and no community with 25,000 or more people within 20 miles
	3.	60 to 120 people per square mile or less than 60 people per square mile with at least one community with 25,000 or more people within 20 miles
Least sparse	4.	Greater than or equal to 120 people per square mile within 20 miles

Source: U.S. NRC 1996

"Proximity" describes population density and city size within 50 miles as follows:

Demographic Categories Based on Proximity

		Category
Not in close proximity	1.	No city with 100,000 or more people and less than 50 people per square mile within 50 miles
	2.	No city with 100,000 or more people and between 50 and 190 people per square mile within 50 miles
	3.	One or more cities with 100,000 or more people and less than 190 people per square mile within 50 miles
In close proximity	4.	Greater than or equal to 190 people per square mile within 50 miles

Source: U.S. NRC 1996

The generic environmental impact statement then uses the following matrix to rank the population category as low, medium, or high.

GEIS Sparseness and Proximity Matrix

		Proximity			
Sparseness		1	2	3	4
	1	1.1	1.2	1.3	1.4
	2	2.1	2.2	2.3	2.4
	3	3.1	3.2	3.3	3.4
	4	4.1	4.2	4.3	4.4

Low-Population Area

Medium-Population Area

High-Population Area

Source: U.S. NRC 1996

SCE&G used 2000 census data and geographic information system software (ArcGIS) to characterize the population within 20 miles and within 50 miles of the VCSNS site.

Based on the 2000 Census Bureau information, 151,925 people lived within 20 miles of the VCSNS site resulting in a population density of 121 people per square mile within 20 miles and therefore falling into Sparseness Category 4 (greater than or equal to 120 people per square mile within 20 miles).

Approximately 1,028,075 people live within 50 miles of the VCSNS site (Table 2.5-1) resulting in a population density of 131 people per square mile within 50 miles. Applying the generic environmental impact statement proximity measures, the VCSNS site is classified as Category 3 (one or more cities with 100,000 or more people and less than 190 people per square mile within 50 miles). According to the generic environmental impact statement, sparseness and proximity matrix, (sparseness Category 4 and proximity Category 3) the VCSNS is in a high-population area.

2.5.1.4 Transient and Migrant Populations

As discussed above, SCE&G used Regulatory Guide 4.7 for guidance on the definition of “transient” and the use of transient data, and quantified the number of transients expected within 10 miles of the VSCNS site. For transients located outside of the 10-mile radius, SCE&G has prepared the discussion below.

Fort Jackson is located approximately 30 miles from the VCSNS site, in Richland County. The base has approximately 19,000 personnel on post at any one time (Global Security 2001). No other military facilities are within 50 miles.

Hospitals in the region are discussed in Subsection 2.5.2.7. Twenty-three nursing homes or personal care homes are listed in the Columbia regional telephone directory (Talking Book Undated). Schools, including colleges and universities, are discussed in Subsection 2.5.2.8. Fifteen state correctional facilities are within 50 miles (SCDOC Undated). Numerous hotels and motels exist within 50 miles; most are located in population centers such as Columbia, Lexington, West Columbia, Irmo, Camden, Saluda, Newberry, and Rock Hill. Recreation facilities and major special events are described in Subsection 2.5.2.5.

Dreher Island State Recreation Area is the state park nearest VCSNS, located approximately 15 miles to the southwest. The park had 206,948 visitors in 2004 (SCBCB 2005b).

Information on migrants is difficult to collect and evaluate. However, the 2002 Census of Agriculture collected information on migrant workers. Farm operators were asked whether any hired or contract workers were migrant workers, defined as a farm worker whose employment required travel that prevented the worker from returning to his permanent place of residence the same day. In general, the migrant population within 50 miles is expected to be low. Migrants tend to work such short-duration, labor-intensive jobs as harvesting fruits and vegetables. Table 2.5-7 provides information on farms in the region that employ migrant labor.

2.5.2 COMMUNITY CHARACTERISTICS

Information about socioeconomic characteristics of the region around the VCSNS site is important for assessing potential social or economic impacts of plant construction or operation. As indicated in Subsection 2.5.1, counties with the greatest potential to be impacted socioeconomically are Fairfield County, where the site is located. Within the four-county region of influence, 9% of the existing VCSNS employees live in Fairfield County, 34% live in Lexington County, 18% live in Newberry County, and 33% live in Richland County. Accordingly, this subsection addresses the following community characteristics for this four-county region of influence—economy, transportation, taxes, land use, aesthetics and recreation, housing, community infrastructure and public services, and education.

2.5.2.1 Economy

VCSNS lies in Fairfield County, which is part of the Central Midlands Region of South Carolina. The Central Midlands Region encompasses Lexington, Fairfield, Richland, and Newberry counties, and the state capital—Columbia—located in Richland County. The four-county region of influence includes three (Fairfield, Richland and Lexington) of the six counties that make up the Columbia Metropolitan Statistical Area.

The principal economic centers in each county are Columbia (Richland County), Winnsboro (Fairfield County), Newberry (Newberry County), and West Columbia (Lexington County). In these counties, the services sector employs the greatest number of workers (27% of employment). Other important sectors of employment shown in Table 2.5-8 include government and government enterprises (23%), retail trade (16%), finance, insurance and real estate (9%), and manufacturing (9%). From 1990 to 2000, agricultural services (6.8%), the services (3.8%), and transportation and public utilities (3.5%) sectors had the largest growth rates. Wholesale trade, retail trade and finance, construction, insurance, and real estate each experienced approximately 2% growth while manufacturing (–0.3%), mining (–0.3%), and farming (–0.9%) experienced declines.

The four-county area is characterized by two different economies. Fairfield and Newberry counties have relatively small economies with a dominant manufacturing and agriculture base followed by the service and government sectors. Lexington and Richland counties have larger economies with a dominant service base followed by the government and retail trade sectors. They also have the most people employed (Table 2.5-8).

The top ten nonfederal employers in the Central Midlands Region are listed in Table 2.5-9. Not found in the list is Fort Jackson, located on the east side of the city of Columbia. As of 2001, the fort employed some 4,000 civilian employees and 15,000 military personnel (Global Security 2001). In 2003, the economic impact of the fort was estimated to be approximately $2.08 billion dollars and approximately 33,000 direct and indirect jobs in the local economy. The estimate is based on the direct expenditures of the fort and the economic activity associated with funds injected into the local economy (Schunk 2004).

In 2005, the labor force in the four counties was 328,542, and increased at an average annual rate of 1.4% between 1995 and 2005. As indicated in Table 2.5-10, the labor force in the state of South Carolina increased at an average annual rate of 1.2% over the same time period (BLS 1995, 2005).

In 2005, 309,812 people were employed in the four counties, or 16% of state employment (BLS 2005). Employment increased at an average annual rate of 1.1% between 1995 and 2005. Employment in South Carolina increased at an average annual rate of 1.0% over the same time period (Table 2.5-10).

In 2005, 18,730 people in the four counties were unemployed. From 1995 to 2005, the four-county unemployment rate increased from 3.7% to 5.7%. In South Carolina, the number of unemployed workers increased over the same period, and the unemployment rate increased from 5.1% to 6.8% (Table 2.5-10).

Per capita personal income in 2005 ranged from a high of $31,575 in Lexington County to a low of $23,901 in Newberry County (Table 2.5-11). The South Carolina average was $28,285 (BEA 2007). From 1995 to 2005, Fairfield County's per capita personal income increased at an average annual rate of 4.2%. Lexington, Newberry, and Richland Counties' per capita personal income average annual growth rates were 3.8%, 3.6%, and 3.8%, respectively. South Carolina's rate increased 3.9% for the same period.

2.5.2.2 Transportation

VCSNS is served by a transportation network of interstate, state, and U.S. highways, as well as railroads. Figure 2.5-3 shows the road and highway transportation system in the four-county region of influence. Table 2.5-12 provides traffic information for Fairfield County roads in the immediate vicinity of the VCSNS site. One commercial airport, the Columbia Metropolitan Airport (CAE) serves the region of influence. Figure 2.5-4 presents the public airports within 50 miles of the VCSNS site.

2.5.2.2.1 Roads

Within the four counties of interest, there are three interstate highways—I-20, which runs southwest-northeast connecting Augusta, Georgia and Florence, South Carolina; I-26 which runs southeast-northwest connecting Charleston to Greenville-Spartanburg; and I-77 which runs north-south, connecting Columbia to Charlotte, North Carolina. A number of U.S. and state routes (SC) intersect these interstates and connect to the towns within the counties, providing outlying area access to the interstate system. For example, SC 202 runs east from I-26 to U.S. Highway 176, and SC 213 that provides access to VCSNS.

Most roads in South Carolina are owned and maintained by the state rather than by municipalities. The state owns 41,391 miles of roads in the state, local governments own 24,847 miles, and the federal government is responsible for 830 miles of interstate roadways. Approximately 62% of the roads in South Carolina are state-owned, and the remaining 38% are owned and maintained by municipalities. The primary access to VCSNS is via SC 213, a state-owned road (SCDOT 2007).

Workers commuting to and from VCSNS must take from one of five routes that connect to SC 213 (These routes are shown on Figure 2.5-3 and the road characteristics and traffic statistics for each route segment are provided in Table 2.5-12). Workers from the east side of greater Columbia in Richland County would likely take U.S. or state routes to I-20 and exit onto SC 215 north and then connect to SC 213. The entrance to VCSNS is approximately 1.5 miles north of the intersection of SC 213 and SC 215. Workers from the west side of greater Columbia and Lexington County would likely take U.S. or state routes to I-20 to I-26 west then exit onto U.S. Highway 176 north. From U.S. Highway 176, workers would take to SC 213 east across the Broad River to the VCSNS entrance. Workers commuting from Newberry County would likely take U.S. or state routes to I-26 east then exit on to SC 202 east to U.S. Highway 176. From SC 202, workers would take U.S. Highway 176 south to SC 213 east across the Broad River to the VCSNS entrance. Fairfield County workers would commute to the site on SC 213 from the Winnsboro area or from the north down SC 215.

Roads in Newberry County avoid the Sumter National Forest. Roads generally do not traverse Lake Murray, except for SC 6 across the Lake Murray Dam and SC 391 at the west end of the lake. Most roadways in both Lexington and Richland counties are urban. Lexington County also has rural roads, which feed into the urban roads. Fairfield County, the home of VCSNS, is a rural area and almost all the roads are farm-to-market, two lane, and state-owned/maintained roadways. Roads in Newberry County are also rural roads.

2.5.2.2.2 Railroads

Two freight rail carriers, CSX Transportation (CSXT) and Norfolk Southern, serve the four counties of interest (BTS 2002). There is no passenger rail service in Fairfield, Lexington, or Newberry Counties. Passenger rail (Amtrak) service is available in Columbia (Amtrak 2007). CSXT has several major lines from Columbia. One goes northwest to Clinton/Laurens and then north to Spartanburg; a second line goes northeast to Charlotte, North Carolina; and several other lines serve the southeast part of the state. CSXT has major rail yards in Florence and Charleston and an automobile distribution center in Columbia. From Augusta, Georgia, CSXT has three lines leading to Atlanta and Savannah, Georgia and Greenwood, South Carolina (CSX 2004a, 2004b). The Norfolk Southern Railway and its railroad operating subsidiaries serve the northern half of the state with lines from Columbia to the Greenville/Spartanburg area and to Charlotte (Norfolk Southern 2003). VCSNS has a rail spur that connects to the Norfolk Southern line on the east side of the Broad River that runs through Columbia and Spartanburg (NRC 2004a).

A high-speed rail corridor has been proposed along a northeast corridor that would link Columbia (Richland County) and Raleigh, North Carolina. A second corridor would connect Atlanta, Georgia to Greenville/Spartanburg, South

Carolina and then on to Charlotte and Greensboro, North Carolina (SCDOT 2004).

2.5.2.2.3 Waterways

The VCSNS is not on a waterway. The site is on the southern tip of the Monticello Reservoir and approximately 3 miles east of the Broad River. Neither the river, at this location nor at the Monticello Reservoir, is considered navigable by the U.S. Army Corps of Engineers. The Broad River near the site is not used for commercial transportation nor is it a part of the U.S. Inland Waterway System. The Monticello Reservoir is a 6,800-acre, man-made reservoir that includes a smaller 300-acre impoundment used for recreation on the north end of the reservoir. The reservoir provides cooling water for the Unit 1 and serves as the upper pool for the Fairfield Pumped Storage Facility. There are no deepwater seaports or freshwater ports in the region. (SCE&G 2002)

2.5.2.2.4 Airports

Twelve public airports are within 50 miles of the VCSNS site—Columbia Metropolitan Airport, Lexington County, Columbia Owens (Richland County), Newberry County, Trenton Younce Field (Edgefield County), Saluda County, Greenwood County, Laurens County, Aiken Municipal (Aiken County), Chester Catawba Regional (Chester County), Woodward Field (Kershaw County), and Fairfield County. Only the Columbia Metropolitan Airport provides commercial passenger service and it is the only one with a tower. In 2005, the airport had 10,390 air carrier operations and 52,681 air taxi operations (SCDA 2005). Table 2.5-13 and Figure 2.5-4 provide information about these airports. Restricted and/or privately owned airports are not included in the table or the figure.

2.5.2.2.5 Evacuation Routes

VCSNS is inland. Hurricane evacuation routes from the coastal areas of South Carolina use the three interstates—I-77, I-20, and I-26—that cross through the four-county area (SCDOT 2003).

2.5.2.3 Taxes

Several tax revenue categories would be affected by the construction and operation of Units 2 and 3. These include

- Income taxes on wages, salaries and corporate profits
- Sales and use taxes on construction- and operation-related purchases and on the purchases of project-related employees
- Property taxes related to the construction and operation of new nuclear units
- Property taxes on employee owned real property.

The following sections describe several types of taxes available to governments in the region.

2.5.2.3.1 Personal and Corporate Income Taxes

South Carolina has one of the lowest per capita tax rates in the country, according to the U.S. Census Bureau (Carolina Living 2006). South Carolina has a graduated individual income tax ranging from 2.5% to a maximum rate of 7.0% on income exceeding $12,650. South Carolina's income tax structure follows federal income tax laws, allowing many of the same deductions, credits, and exemptions with only a few modifications. Employees in South Carolina pay income taxes to South Carolina if their residences are in South Carolina, they are nonresidents working in South Carolina and filing a federal return that would include income from personal services rendered in South Carolina, or they are nonresidents who have income that is derived from investments in rental property in South Carolina or are required to file a composite return for nonresident partners or shareholders (SCDR 2002).

South Carolina taxes the income of for-profit corporations at a rate of 5% based on a corporation's federal taxable net income, with some modifications. In addition, corporations and other entities taxed for income tax purposes as a corporation are subject to an annual license tax of 0.001 times their capital stock and paid-in-surplus plus $15.00 (SCDR 2006a).

2.5.2.3.2 Sales and Use Taxes

South Carolina assesses a state sales tax on the sale of goods and certain services (SCDR 2006b). In order to avoid losing tax revenues on sales transactions taking place outside of the state, South Carolina imposes a 5% use tax to purchases made outside the state including via the Internet, catalog, and television shopping network sales, when the goods are shipped or brought back to South Carolina. The sales tax on the purchase of motor vehicles, including recreational vehicles, boats, motorcycles, and airplanes, is capped at $300. Counties and other local governments or municipalities may elect to impose local sales taxes in addition to those taxes levied by the state (SCDR 2006b). The local sales and use tax is sometimes used to rollback real property taxes (SCAC 2002).

Local entities may also impose local option taxes. Fairfield County's 1% local option sales and use tax became effective May 1, 2006. As a result, all sales of merchandise made in or delivered to Fairfield County will be subject to a 6% sales and use tax, the 5% state sales tax and 1% local option tax. An 8% accommodation tax is added to lodging bills typically paid by visitors to the county. The local sales and use tax will be used to reduce the property tax burden in Fairfield County (SCDR 2006c).

2.5.2.3.3 Property Tax

South Carolina counties, cities, and school districts impose ad valorem (property) taxes on real and personal property. The tax liability on the property is determined when the local government applies its millage rate to the assessed value. The tax rate is stated in terms of "mills," with ten mills equal to 1% of a property's assessed value. Millage rates vary, but the state average is about 289 mills to all taxing jurisdictions. Personal property taxes are collected annually on cars, trucks, motorcycles, recreational vehicles, boats, and airplanes (Carolina Living 2006).

2.5.2.3.4 Other Taxes

South Carolina law also allows counties, with voter endorsement, to establish special tax districts and then to collect special taxes. Counties may also impose impact fees and levy business taxes. Fairfield County derives income from franchise fees on cable television; Lexington County has franchise fees in addition to community and recreational special tax districts; Newberry County collects funds via franchise fees on cable television; and Richland County has business license fees, franchise fees on cable television, developer-imposed assessment fees for sewer, special fire tax districts, and community recreation special tax districts. State law allows counties to collect certain types of user fees. Fairfield County collects user fees for recreation and solid waste collection; Lexington County collects user fees for recreation; Newberry has no user fees; and Richland County assesses a road maintenance (vehicle) fee, a fee for solid waste collection, a fee for towing, and water/sewer tap fees (SCAC 2002).

Lexington County collects a 3% local accommodations tax in the unincorporated portion of the county. Within Newberry County, the city of Newberry collects a local hospitality tax and a local sales tax that is used for courthouse renovations, water, sewer, recreation, and hospital improvements. Richland County has a local accommodation tax of 3% in the unincorporated portions of the county and within the city limits of Columbia. There is also a local hospitality tax of 2% in the unincorporated area and in Columbia, Forest Acres, Arcadia Lakes, and Blythewood. Revenue sources for the four counties vary widely as discussed above. In all four counties however, revenue from property taxes dominate the county's general fund. Table 2.5-14 summarizes property tax revenues for all taxing jurisdictions (counties, cities, school boards) for each of the four counties.

In the fiscal year ending June 30, 2005, SCE&G made annual payments of utility property taxes to Fairfield County of $12,711,250. In addition to the property taxes paid to the county itself on behalf of VCSNS, SCE&G's payment included $7,853,550 to the Fairfield County school district, $10,198 to the city of Winnsboro, and $2,093 to the town of Ridgeway.

2.5.2.4 Land Use

All four counties have experienced growth over the last several decades and their Comprehensive Land Use Plans reflect planning efforts and public involvement in the planning process. Land use planning tools, such as zoning, guide future growth and development. All plans share the goals of encouraging growth and development in areas where public facilities, such as water and sewer systems, are planned and discouraging strip development along county roads and highways.

2.5.2.4.1 Fairfield County

Fairfield County occupies about 686 square miles and is predominantly rural; however, it is being impacted by the expansion of the greater Columbia area and interstate (I-77) accessibility through the county. The Comprehensive Plan Update (Fairfield County 1997) states these changes will lead to the suburbanization of employment facilities in the county and may lead to the exurbanization of Winnsboro and Ridgeway and suburbanization of areas near Richland County. The plan was developed to promote an arrangement of land use and provide a guide to development and change to meet existing and anticipated needs and conditions and to serve as a basis for regulating land use and the development process.

The plan identifies nine issues related to development:

- Growth — To accommodate projected growth in an orderly manner, and to ameliorate its impact on existing land uses and environmental resources
- Quality Development — To foster quality development
- Economic Development — To stimulate and accelerate economic development
- Aesthetics — To present and maintain an aesthetically pleasing environment
- Transportation — To improve access to I-77 and promote highway safety on existing and proposed streets and roads
- Housing — To make decent housing and living conditions available to all residents of Fairfield County
- Infrastructure — To extend water and wastewater service and facilities to accommodate projected growth and development
- Resource Preservation and Enhancement — To conserve and protect the county’s natural and historic resources
- Recreation — To provide a comprehensive and balanced system of parks and recreation facilities

A portion of the plan was dedicated to developing generalized land use classifications. As a result of the plan, the county passed an ordinance for land development regulation in 1998.

Fairfield County adopted an ordinance that established zoning districts in the unincorporated areas of Fairfield County in May 2007. The recently adopted ordinance will provide greater land use guidance as the county develops. The ordinance imposes no constraints on the industrial district in which the VCSNS site is located. It does not allow residential development at the VCSNS site (Fairfield County 2007).

2.5.2.4.2 Lexington County

Lexington County is approximately 700 square miles. According to the Lexington County Comprehensive Plan (Lexington County 1999), the county's land use patterns are diverse, from the metropolitan urbanized areas of West Columbia and Irmo to the rural agricultural sections in the western and southern portion of the county. The existing land use was further described as predominantly rural to suburban, characterized by small pockets of commercial areas.

The plan addressed the land use patterns and future land use needs by residential, commercial, industrial, and institutional development. Agricultural land use, representing 21% of the county land use, was not specifically addressed as a category. The plan indicated farming interests would be susceptible to pressures to build homes. The primary factors that are expected to influence land use are school districts, available land, transportation, the natural beauty of the county, and a continuously growing economy. Lexington County has a mix of zoning styles that will encourage a quality of growth for years to come. As for future land use, the economic growth of the county will dictate the pace of land use.

2.5.2.4.3 Newberry County

Newberry County is approximately 650 square miles. According to the Comprehensive Plan for Newberry County, the county is characterized by a mix of rural and urban uses including agricultural, residential, commercial, industrial, public and semiprivate uses, and vacant land. The Comprehensive Plan study area was limited to the municipalities, Lake Greenwood and Lake Murray, the U.S. 76 corridor between the town of Little Mountain and the city of Newberry, and portions of SC 773, 219, 34 and 121. The unincorporated portions of the county outside the defined study area do not have land use regulations (Newberry County 1999).

The area addressed by the plan, as defined above, is a mix of rural lands, including agricultural, low-density residential, limited commercial, and limited industrial use. Residential development is generally characterized by low to medium-density, single-family development. There are very few multifamily units in the unincorporated areas of the county. Unlike a municipality where there is dense commercial development in a downtown or some other commercial district, Newberry County's commercial development is much less dense. In most cases, the commercial development is limited to stores located at the intersections of major roads. The remainder of commercial development exists in areas that serve local residents (Newberry County 1999).

Agriculture is scattered throughout the comprehensive plan study area. There are a number of vacant platted lots inside and outside the study area. Most of these are located along the lake shores, where most of the neighborhood subdivisions have occurred (Newberry County 1999).

Generally, there is ample land available for future development in the county. The locations of growth will be guided by two major constraints—natural features and infrastructure. The study area is crisscrossed with streams and rivers, so there will be areas where topography and floodplain characteristics will constrain development. Infrastructure constraints will be mitigated by the construction of additional roads and water treatment facilities as the need arises (Newberry County 1999.)

The plan recommends that to protect the existing development within the study area and to ensure orderly development in the future, the county adopt a zoning ordinance and land development regulations.

2.5.2.4.4 Richland County

Richland County occupies approximately 748 square miles. Approximately 38% of the unincorporated portion of the county is developed, while the remaining 62% of the unincorporated land in the county is undeveloped. The unincorporated portions of the county were divided into four separate planning areas and two subareas to facilitate planning (Richland County 1999).

The comprehensive plan (Richland County 1999) noted that zoning controls were not established in Richland County until 1977. The absence of zoning controls and restrictions produced an environment where existing development patterns are a mix of many types of residential, commercial, and industrial uses. The plan noted further that rural open spaces and prime farmlands are being converted to residential and other suburban uses. The plan concluded that, in order to protect significant agricultural lands, natural areas, and open space corridors, Richland County will ultimately have to develop specific zoning and growth management tools for directing future development to sustainable areas. As yet, growth control measures have not been developed or adopted.

The Richland County Comprehensive Plan does, however, contain the “Town and Country Planning Concept” which sets forth the following goals:

- Improve the middle landscape in urban and suburban villages – In existing urban and suburban areas, lessen the sprawling character by bringing the landscape into developed areas in order to define and separate neighborhoods. The strategy is to encourage mixed-use village centers that attract employment and services development.

- Promote the idea of towns and villages – In rural areas, promote the development of compact, mixed-use development that has a distinct village edge and connection to the landscape.

- Continue preservation through the use of riparian corridors – The County Riparian Corridor network should be used to develop a sub-contiguous county-wide greenway system. The strategy is to define growth areas, while preserving natural systems and rural landscapes (Richland County 1999).

2.5.2.5 Aesthetics and Recreation

The VCSNS site is located in rural Fairfield County in the Piedmont area that consists of low rolling hills with elevations ranging from 560 feet to 210 feet above MSL (USGS 1999). Undeveloped areas are characterized by upland forests, forested wetlands, pine plantations, agriculture, and grasslands. The region has a temperate climate with mild winters and long summers.

A portion of the Sumter National Forest Enoree District lies within 6 miles of the site to the northwest. There are no state-owned recreational properties within 6 miles of the site. The 4,400-acre Parr Hydroelectric Wildlife Management Area (WMA) is adjacent to the site to the west and has a state easement to permit public access. The public also has access to the SCE&G Monticello Reservoir adjacent to the site to the north.

Recreational opportunities within 50 miles of VCSNS include a variety of federal and state attractions. Table 2.5-15 lists state parks and Natural Resource Heritage Preserves within 50 miles of the VCSNS site. The entire Enoree District and the eastern portion of the Long Cane District of the Sumter National Forest, the Congaree National Park, and Ninety Six National Historic Site are within 50 miles. Festivals and sporting events throughout the region bring in tourists for several days to a week throughout the year. Lake Murray hosts an annual Independence Day celebration regatta and major fishing tournaments. The Columbia Metropolitan Area has shopping, museums, and attractions such as the Riverbanks Zoo and events associated with the University of South Carolina, the Koger Center, and Colonial Center. Williams-Brice Stadium (capacity of 80,250) hosts college football and concerts (USC 2007). The South Carolina State Fair in Columbia draws 600,000 over a two-week period (State Fair 2007). The Greenwood Flower Festival draws about 20,000 people annually (SCFOF 2007). Public access waters include Broad, Congaree, Santee, Catawba and Saluda Rivers, Saluda Lake, Lake Murray, Lake Greenwood, and Lake Wateree. Lake Murray is a major recreation area for the Central Midlands Region.

The Unit 1 containment structure is the tallest structure at the site. SC 215 and the Monticello Reservoir are the closest points from which the public can glimpse the plant. Trees and terrain provide barriers to viewing the containment structure, turbine building, and support structures from the road. The containment structure is visible at a few locations on SC 215,. The only structures fully visible from the reservoir are the containment structure, turbine building, intake structure, and pumphouse. The discharge is a submerged structure. The plant uses a small cooling tower for the turbine building closed-cycle cooling water system. Steam vapor discharge is very seldom visible from off site.

2.5.2.6 Housing

Approximately 95% of current VCSNS employees reside in four South Carolina counties—Fairfield, Lexington, Newberry, and Richland.

Within 50 miles, residential areas are found in cities, towns, and smaller communities with farms, wood lots, and undeveloped land scattered throughout. Within the region of influence, rental property is scarce in the rural areas, but is available in municipalities such as Winnsboro, Newberry, West Columbia, Irmo, and Columbia. In the vicinity of the VCSNS site, residences are generally isolated, single-family homes. New residential developments are primarily associated with the municipalities in the region of influence.

Housing characteristics in the four-county area are summarized in Table 2.5-16. At the time of the 2000 census, approximately 22,000 housing units (9%) were vacant in the four-county area that tallies approximately 248,000 total housing units. Of that total, approximately 156,000 (63%) were owner-occupied and 70,500 (28%) were renter-occupied (USCB 2000b).

The weighted median value of single-family, owner-occupied houses in the region was $98,880 which was near the median value of all owner-occupied, single-family units in the state of South Carolina, $94,900. Fairfield County had the lowest median home value at $69,900 for a single-family unit, while Lexington County was the most expensive with a median value of single family units of $106,300 (USCB 2000c).

Lexington County experienced the most rapid expansion of housing in the region. The county's total housing units, 90,978 in 2000, represented a 34.7% increase over 1990 housing. Newberry County had the smallest increase between 1990 and 2000—16.3%. The state of South Carolina's housing increased 23.1% in the decade (USCB 2000b). The housing characteristics of select municipalities within 50 miles of VCSNS are summarized in Table 2.5-17.

2.5.2.7 Community Infrastructure and Public Services

Public services and community infrastructure consist of public water supplies and wastewater treatment systems, police and fire departments, medical facilities, social services, and schools. They are typically located within municipalities or near population centers. Schools are described in Subsection 2.5.2.8. The other services are described below.

2.5.2.7.1 Public Water Supplies and Waste Water Treatment Systems

Because VCSNS is located in Fairfield County and most of the current VCSNS employees reside in Fairfield, Lexington, Newberry, and Richland Counties, the discussion of public water supply systems will be limited to those four counties.

In the Central Midlands Region, water sources can be surface water (*i.e.,* rivers, lakes, and streams) or groundwater. The Fall Line, which is the transition between the Piedmont and the Coastal Plain physiographic regions, approximately follows I-20 and splits the Central Midlands. VCSNS is in the Piedmont, north of the Fall Line. Two of the four counties (Fairfield and Newberry) of interest lie entirely in the Piedmont. Approximately one-third of Lexington and Richland Counties lies in the Piedmont. The remainder of these two counties lies in the Coastal Plain.

The Piedmont is characterized by a limited groundwater supply due to the dense, crystalline rock underlying the area. Most of the large municipal systems in the Central Midlands north of the Fall Line obtain water from the Broad or Saluda Rivers or one of their impoundments. However, some smaller municipalities have wells that can adequately meet water demands.

In the Coastal Plain, south of the Fall Line, there are two major regional aquifer systems (see Section 2.3). The lower regime is referred to as the Cretaceous aquifer system and it is estimated that it can provide 5 billion gpd throughout its known extent. The upper regime is variously referred to as the water table aquifer, the Tertiary aquifer system, the principal artesian aquifer, the limestone aquifer, or the Floridan aquifer. Yields from these systems could support water systems requiring nearly 3,000,000 gpd. Consequently, counties in the Coastal Plain obtain their water from groundwater. Despite their location in the Piedmont, some Fairfield County water suppliers also obtain their water from groundwater. Table 2.5-18 details water suppliers in the four counties, their permitted capacities, and their average daily production.

According to local planning officials, water supply in the four counties is not a concern. Local communities are adequately served by the existing water supplies and planners estimate that the counties have adequate supply at least through the current planning periods. The only concern is protection of the aquifers from chemical and radiological pollutants, erosion, and sedimentary contamination.

Wastewater treatment is provided by local jurisdictions. Each municipality decides which treatment method to use based on the municipality’s needs and the technology and funds available. The most common types of treatment facilities are primary and secondary treatments. Currently, municipalities in the four counties are able to meet wastewater treatment needs. Table 2.5-19 details public wastewater treatment systems, their permitted capacities, and their average daily production. The rural areas of each county are on septic systems.

2.5.2.7.2 Police and Fire Department and Medical Facilities

Table 2.5-20 provides police and fire suppression data for the four counties. The ratios of persons-to-police-officers vary between counties in the region: Fairfield County 321:1, Lexington County 504:1, Newberry County 457:1, and Richland County 376:1. The Fairfield County Sheriff finds the current police protection to be adequate in part because of existing multi-jurisdictional response agreements (Lewis 2007). Facility upgrades and additional personnel may be needed to accommodate future population growth.

Fire suppression in the four counties is characterized by persons-per-firefighter ratios and the Public Protection Classification ratings provided by the Insurance Services Office, Incorporated. Table 2.5-20 lists the persons-per-firefighter ratios by county. Regional planners report the following Public Protection Classification ratings by county: Fairfield County, between 5 and 10; Lexington County, between 4 and 7; Newberry County, between 3 and 9 and Richland County, between 2 and 10. In each county, rural or outlying areas are typically rated 9 or 10. Public

Protection Classification insurance rates consider a rate of 1 to be the most desirable rating and 10 to be the least desirable. Multiple ratings indicate that there are different levels of protection with each county. (Fairfield County 1997; Newberry County 1999; USC 2006; Lexington County 2007; SCONFIRE 2006).

Richland County has the highest hospital bed capacity of the four counties and of any county in the 50-mile region. Richland County's hospitals include five general hospitals with a sixth under construction and one military hospital. More than 8,000 people are employed in the medical industry in Richland County. Fairfield, Lexington, and Newberry Counties have one general hospital and Lexington County is adding a second smaller hospital (CSCA 2007). Table 2.5-21 presents hospital and medical practitioner data by county.

All four counties have health departments, which are available to residents regardless of their ability to pay. Some of the services offered by health departments include child and adolescent health programs, women's health programs, immunizations, laboratory services, teen pregnancy prevention programs, scoliosis screening, parasite screening, diabetic screening, health education and counseling, homemaker services to the elderly, prenatal services, and sexually transmitted disease prevention and education. Some public schools in the region do not have a school nurse. Many rely on the health department for nursing support.

2.5.2.7.3 Social Services

Social services in South Carolina are overseen by the Department of Social Services. The mission of the Department of Social Services is to ensure the safety and health of children and adults who cannot protect themselves, and to assist those in need of food assistance and temporary financial assistance while transitioning into employment. The Department of Social Services serves South Carolina citizens through its county offices providing 22 programs and services (SCDSS 2006).

2.5.2.8 Schools

2.5.2.8.1 Public Schools – Kindergarten through 12

The public school systems in Fairfield, Lexington, Newberry, and Richland counties are organized by county, although Lexington County District Five extends into northwestern Richland County. Lexington and Richland counties provide greater public school resources because of their county's larger populations than do Fairfield and Newberry Counties. Table 2.5-22 provides information on the number of public schools in each county, enrollment, and information about student-teacher ratios.

All publicly funded South Carolina kindergarten through grade 12 schools are required to meet South Carolina Department of Education-mandated student-teachers ratios. Ratios vary depending on the grade level, subject taught, and presence or absence of a paraprofessional. A full listing of the ratios is provided in

SC Regulation 43-205 on the South Carolina Department of Education website: http://ed.sc.gov/agency/stateboard/regs/article_17/205.doc. The school districts in all four counties either meet or exceed the state-mandated student-teacher ratios. In the past, when a district failed to meet the required ratios, the South Carolina Board of Education acquired the necessary funding to either build new schools or renovate older schools to increase facility capacity. The specific methods that each county school district chose to follow are detailed below.

The school districts in the four counties each currently has some capacity for additional students. Lexington and Richland Counties are each staying ahead of their significant annual growth in enrollment. Newberry County is staying ahead of its county's modest growth in student enrollment and Fairfield County is evaluating actions to address a trend of reduction in student enrollment.

The state of South Carolina recently passed legislation that reformulates the manner in which school districts derive their funding. In the past, school districts set their millage rates and derived approximately half of their operating revenues from ad-valorem property taxes levied and collected by the county. The other half came from the state. Starting in 2008, the school districts will receive more than half of their funds from the state thorough a state-wide increase in the sales tax with indexes for annual increases in assessments for different property types and caps on increases in millage rate. The outcome of this funding change is unknown but, at a minimum, presents challenges to the current methods of budgeting and planning for school systems and the state of South Carolina (Moody's 2006).

2.5.2.8.2 Fairfield County

Fairfield County had a public school student population of 3,365 in 2005 (SCDOE 2007). The county has seven schools and no plans to build additional school capacity. The district has undergone a baseline evaluation as part of a 2005 Long Range Facility and Population Study process. Options were developed to modernize the school district's facilities. Student-teacher ratios exceed state-mandated levels. All of the county schools have some capacity for additional students as the districts' historical enrollment has decreased from historical averages 6.3% (216 students). Further, the study's moderate projections indicate an additional decrease of 8.7% (297 students) in enrollment between 2005 and 2015 (Fairfield County 2005).

The Fairfield County District is in the process of implementing its Long Range Facility and Population Study. The next steps are to engage the community about facility options and determine mechanisms to fund the modernization of the facilities (Fairfield County 2005). The district has been able to meet its annual budget from the county residential and commercial property taxes, which include the tax revenues generated by VCSNS. The future funding for school renovations and construction is being evaluated.

2.5.2.8.3 Lexington County

Lexington County had a public school student population of 49,164 in 2005 (SCDOE 2007). The county has five districts with 63 schools and plans to build five new schools primarily in the larger districts (District One and Two) to keep pace with the triple-digit growth in enrollment of between 100 and 500 students per year projected thorough 2010. District One and Two are working off $118 million and $50 million bonds, respectively, to implement capital improvements to the districts. District Five encompasses an area approximately one-half of which is situated in each of Lexington and Richland Counties. This district is currently evaluating its facilities to develop a funding for additional facilities. With a sizeable commercial, business, retail, and residential base, the Lexington County school districts have been able to meet their renovation and new construction needs from property taxes and the local option sales taxes (Lexington County 2005a, 2005b, 2005c, and 2006).

2.5.2.8.4 Newberry County

Newberry County had a public school student population of 5,451 students in 2005 (SCDOE 2007). The county has 12 schools and is currently implementing a modernization plan for the school facilities. In addition, the district is raising capital for equipment (technology) and materials to meet curriculum requirements (Newberry County 2005).

In May 2005, the Board of Trustees approved $77.5 million dollars in capital needs as a result of an independent study completed in the district in 2004. Further, the board authorized the formation of the Newberry Investing in Children's Education, a nonprofit corporation that will assist the school district with the formulation of an installment purchase plan for capital improvements. This will allow the district to complete the capital needs within a five-year construction cycle. Although the bond referendum was passed for the capital improvements, the penny sales tax funding mechanism was not. As a result, the county has been using emergency funds for the last two years to bolster the school district's budgets. Subsequently, Newberry County property taxes have been able to support funding of the school district; however, that funding could be cut by $3.4 million in 2007 because of the lack of future revenue in the county because property reassessments have not occurred since 1999 (Newberry County 2005 and The State 2006).

2.5.2.8.5 Richland County

Richland County had a public school student population of 44,434 in 2005 (SCDOE 2007). The county has three school districts but only two are completely within the county and are discussed here. Within Districts One and Two there are 70 schools. District One recently completed a phase of building under a bond referendum passed in 2002 and District Two is implementing a $175 million facility plan passed in 2004. District One has shown a slight decline in student enrollment while District Two has been the fastest growing district in the state over the last decade, reflecting the rapidly growing population in the northeast part of the county. District Two opened two elementary schools in 2006 and plans to build the district's 16th elementary school in 2008, and 6th middle school in 2007. In addition to the new school building, major renovations are underway at an existing middle school. Renovations are planned or are underway at five elementary schools and a middle school (Richland County 2005 and 2006).

Even with these new schools, Richland County exceeds the South Carolina-mandated student-teacher ratios for kindergarten through 5th grade. The addition of the middle school in 2007 should allow the county to meet the middle school student-teacher ratio.

2.5.2.8.6 Colleges/Universities

The Commission on Higher Education provides oversight to South Carolina institutions of higher education. Higher education is defined as post-secondary, or after high school, and generally refers to colleges and universities. These institutions are recognized as being public, private, or proprietary. Senior institutions offer baccalaureate degrees and sometimes higher degrees such as Master's Degrees or Doctorial Degrees. The state's 16 technical colleges offer two-year, Associate Degrees, and other short-term certificates and diplomas. South Carolina does not have public community colleges. The most widely recognized accreditation agency is the Southern Association of Colleges and Schools. A shown in Table 2.5-23, within 50 miles of VCSNS, there are three public senior institutions accredited by the Southern Association of Colleges and Schools—University of South Carolina at Columbia, Lander University, and Winthrop University. There are also two satellite campuses of the University of South Carolina, two technical colleges (York and Midlands Technical Colleges) and seven private senior institutions (SACS 2006, SCCHE 2006).

2.5.3 HISTORIC PROPERTIES

To support the COL application, SCE&G performed cultural resource surveys of the VCSNS site and the adjoining SCE&G property potentially affected by construction of Units 2 and 3. That work progressed in several phases as the scope of the potential ground disturbance associated with construction and operation of Units 2 and 3 was defined. The extent of these surveys is shown on Figure 2.5-5. In order to inventory eligible and listed historic properties, as well as other properties deemed historically significant by the local community, several sources of information were examined.

Properties listed on the National Register of Historic Places and structures and buildings that have been determined as eligible for the National Register were identified using the South Carolina Department of Archives' Cultural Resources Inventory System. This system also contains determinations of eligibility for archaeological sites and standing structures, if those determinations have been made. Background research on archaeological sites was conducted at the South Carolina Institute of Archaeology and Anthropology, which houses the state archaeological site files.

Other facilities consulted include the Fairfield County Museum and the Fairfield County Archives. In addition, U.S. Forest Service and South Carolina State Parks and Tourism personnel were consulted regarding a known Civilian Conservation Corps camp in the area. SCE&G staff members familiar with the property were also consulted.

SCE&G met with the State Historic Preservation Office in June 2006 regarding the VCSNS COL application. During the visit, past landscape alterations and current conditions were discussed, as well as any need for additional cultural resource surveys, and results of background site files and cartographic research. This visit provided an opportunity for the State Historic Preservation Office to express any concerns regarding cultural resources and the meeting prompted the New South Associates surveys of the planned project area. At this meeting SCE&G extended an invitation for an onsite tour of the study area. SCE&G has continued to consult with the State Historic Preservation Office regarding aspects of the project (Appendix A).

2.5.3.1 Historic Context

Spanish and French explorers arrived in South Carolina in the sixteenth century and found the area inhabited by many small groups of Native Americans. Although the first European settlements failed, in 1670 an English settlement on the coast near present-day Charleston was established. By 1729, the only evidence of European influence in Fairfield County was a trading path that ran beside the Wateree-Catawba River and connected to the Catawba Indian settlement in present-day York County (McMaster 1946). According to McMaster (1946), the area between the Broad River and Wateree-Catawba River was considered Catawba territory, although there were no settlements in the region. Cherokee Indians were located west of the Broad River, which was originally called Eswaw Huppeedaw or Line River, indicating the river as a territorial boundary. The Cherokees and Catawbas likely used the region as a hunting ground.

It is difficult to tell who the first permanent European settlers in Fairfield County were and when they arrived, although it appears the earliest settlement by Europeans was in the early 1740s. Most of these settlements took place along the Broad River and other rivers and near present-day Winnsboro (McMaster 1946, Nicholson et al. 1924).

In 1772, the boundary between North and South Carolina was established and the area of Fairfield County was included in South Carolina. At this time, Fairfield County was sparsely populated and there were likely only 200 or so settlements scattered throughout the county (McMaster 1946). Land was being granted as early as the 1740s, but it is unclear how many owners actually occupied their property. Fairfield County was officially formed in 1785 as part of the Camden District (Kovacik and Winberry 1987) and remained as such until 1868, when the constitution changed the districts to counties (Kovacik and Winberry 1987).

In upland South Carolina, the American Revolution resembled a civil war. Many Piedmont settlers sided with Britain because low-country planters, who favored the Patriot cause, had consistently refused to give them adequate representation in the colony's government (Mabrey 1981). After the British captured Charleston in 1780, the conflict shifted to the upcountry. The first major victory for the Patriots was the Battle of Musgroves' Mill on the Enoree River in August of 1780. The Patriots were further encouraged in October by the victory at Kings Mountain. Also, in October, General Lord Cornwallis moved his headquarters to Winnsboro. The Battle of Fish Dam Ford (November 9, 1780) on the Broad River in Chester County was a victory for General Thomas Sumter, and was quickly followed by the Battle of Blackstock on the Tyger River (November 25). Other skirmishes in the surrounding area culminated in the Battle of Cowpens (January 1781), where the Patriots under General Morgan decisively defeated the British. After the British disaster at Cowpens, Cornwallis spent the remainder of the year trying to find and defeat Generals Greene and Morgan. He moved into North Carolina, then into Virginia. From then until the British withdrew from Charleston at the end of 1782, guerrilla warfare raged all over northwestern South Carolina (Mabrey 1981).

The slave population was low in this portion of South Carolina, and it was only after about 1850 that they began to outnumber the white residents. The increase in slave population indicated the movement of the plantation economy into the interior of the state. This increase also corresponded with the planting of cotton, as the backcountry began producing almost half of the state's crop (Kovacik and Winberry 1987).

The midlands area saw a great deal of action during the Civil War. Although considered by many to be safe, the Union attacked the city of Columbia in 1865. On February 16, 1865, the two prongs of Sherman's army met on the west bank of the Congaree River at what is now West Columbia. Sherman ordered half of the army to proceed up the Saluda River about 13 miles to Zion Church, where they were to cross and move on to Winnsboro, destroying all railroads and bridges along the way. This maneuver was designed to cut off General Beauregard's evacuation, while the other half of the army captured Columbia (Lucas 1976). Plate 76 of the *Atlas of the Official Records of the Civil War* (Oliver 1999) shows General Sherman's crossing the Broad River at or very near Parr and heading towards Blackstock.

Because the Union forces ordered to occupy Columbia found the Congaree to be swifter and wider than they had thought, they went up the west side of the Saluda to a bridge near the Saluda Factory. Finding it destroyed, they crossed the Saluda on a pontoon bridge that they constructed. The Broad River bridge had also been destroyed so a ferry line was constructed to move the army across the river (Lucas 1976). On the morning of February 17, the mayor of Columbia surrendered the city to the occupying forces under the condition that the city and its inhabitants would not be harmed. However, during the occupation, Columbia was burned.

On February 18, 1865, the Union army ordered units to destroy the railroad tracks north of the city. Portions of a Confederate Cavalry Division fought a rear guard action at Killian's Mill, and then withdrew towards Winnsboro (SC Historical

Marker 40-127). On February 20, 1865, federal troops encamped north of Killian along what is now Farrow Road, on their way to Winnsboro. Upon reaching Winnsboro, they destroyed between 20 and 30 buildings in the town including homes, stores, and public edifices (Barrett 1956).

For a decade after the Civil War, the entire state suffered severely while adjusting to a new economic order, including the collapse of the Confederate government, military occupation, the freeing of slaves, the effect of four years of naval blockades, neglect of the land during the war, loss of one quarter of those men who served in the war, and deterioration of the modes of production and transportation (Kovacik and Winberry 1987).

After the war, South Carolina and most other southern states were reorganized by Reconstruction. The Black Codes that followed Reconstruction created a low wage system under which former black slaves worked in a modified form of slavery. In the upstate, cotton again became an important cash crop in the late nineteenth and early 20th centuries. The arrival of the boll weevil in the 1920s severely affected cotton farmers, causing them to either abandon farming altogether or diversify their crops. This disaster was followed by the Great Depression, which affected all areas of the state. By this time, most upstate agricultural lands were in poor condition. Much of the topsoil had washed away and continued erosion offset the benefits provided by fertilizers.

More than 150 years of poor management, exploitative land use, and continuous row cropping had depleted the soil and caused severe erosion throughout the South Carolina Piedmont. By the 1930s, this area was one of the most severely eroded in the United States. It is estimated that from the beginning of the “King Cotton Era” in the early 1800s, through the 1930s, many areas lost almost 10 inches of topsoil, and in some large areas more than 12 inches (Kovacik and Winberry 1987).

In 1933 a Civilian Conservation Corps camp called Camp Pearson was established at Parr. The camp’s number was S.C. P-66, which was a part of Company 441. An account of the camp was written in a newsletter by James McCutchen (undated). He noted that the camp was under the command of Captain W. L. Blanton. The superintendent of forestry there was Mr. J. T. McAlister. The article notes that one of the first tasks there was to bring in gravel to cover the camp and the roads because *“if it had not been for this rock the whole company would have had to live in red sticky mud and clay during the past winter. Had it not been for all this work it would have been impossible for a motor propelled vehicle of any kind to go to and from camp.”* The camp was primarily created as a soil erosion camp. It is unknown how long the camp was active. However, it does not appear on a 1938 county highway map.

By the mid-20th century, the region had a notable drop in both population and cotton acreage. One of the reasons for this decline was the demise of tenancy. Many tenants had migrated north or were pushed off the land under the New Deal crop-reduction program. There was also an overall decline in the cotton economy.

In partial compensation, manufacturing soon became an important source of employment (Kovacik and Winberry 1987).

2.5.3.2 Description of Historic Properties within 10 miles of the VCSNS Site

The 10-mile region surrounding the proposed site of Units 2 and 3 has prehistoric Native American and historic Euro and African-American resources. Several studies have occurred on or immediately adjacent to the VCSNS site. The first was a reconnaissance survey of a very large area in the vicinity of the [now extinct] village of Parr (Teague 1979) to determine the *"significance of archaeological sites which would be potentially affected by either the Fairfield Pumped Storage Facility or the VCSNS*" (SCE&G 1978). It included:

- Approximately 2,500 acres that were inundated by the raising of the Parr Shoals Dam; primarily the first and second terraces of the Broad River for about 12 miles upstream from Parr Shoals Dam, and the mouths of Cannons, Frees, Hellers, and Terrible Creeks.
- Approximately 6,800 acres that were inundated by Monticello Reservoir.
- Approximately 2,500 acres that would be rendered inaccessible by the construction and operation of the Fairfield Pumped Storage Facility and Unit 1.

Teague (1979) identified six sites near the VCSNS site (apparently the report was completed many years after the survey was conducted in 1972). None were assessed for their National Register eligibility, although the report did comment the sites were heavily damaged by factors such as erosion, cultivation, and logging. None are located within the proposed site for Units 2 and 3. Teague focused on the excavation of the McMeekin Rock Shelter (38FA41) and the Blair Mound (38FA48), both north of Unit 1 and both listed in the National Register of Historic Places.

Trinkley (1984) identified a site east-southeast of the proposed site as part of a survey for a proposed extension of SC 213. The site consisted of a lithic scatter and a single historic artifact and was recommended as ineligible for the National Register.

Historic maps from the mid-18th to early-20th centuries were examined for historic occupations near the VCSNS site. A number of house sites and one mill were found in the general area. A Civilian Conservation Corps camp (Camp Pearson) was located at Parr Reservoir, immediately adjacent to an old steam plant southeast of Unit 1.

The Mayo family cemetery is on SCE&G property, approximately 1.5 miles south of the proposed site. This small family plot contains headstones dating back to 1895. SCE&G's Forestry Operations group is familiar with this cemetery, which is marked on their timber inventory and land cover maps, and takes measures to protect it when conducting forest management activities.

According to Fairfield County Museum staff, there are two known, but unrecorded archaeological sites in the vicinity of the VCSNS site, which are not located on SCE&G property. The condition and, thus, eligibility of these sites for the National Register are unknown. The first is a prehistoric site located on Hampton Island. The second is a potential historic ferry crossing known as Hughey's or Scherer's Ferry. Its location is just north of Free's Creek on the Broad River.

Table 2.5-24 lists the 21 archaeological sites and standing structures within 10 miles of the proposed site that are currently listed on the National Register of Historic Places. None are located on SCE&G property. Table 2.5-25 lists the 53 standing structures within a 10-mile radius determined to be eligible or contributing to the eligibility of a National Register district. None of these are located on SCE&G property. No archaeological sites within the 10-mile radius have been determined eligible, although four are listed on the National Register (see Table 2.5-24).

2.5.3.3 Description of Historic Properties within the SCE&G Property

A cemetery containing approximately 30 graves including that of General John Pearson, a Fairfield County native who served with distinction in the American Revolutionary War, is partially within the proposed site boundary (see Figure 2.5-5). A monument to General Pearson was erected at the cemetery in 1934 by the Richard Winn Chapter of the Daughters of the American Revolution. New South Associates recommended the General Pearson grave and monument as eligible for the National Register (NSA 2007c). Upon review, the South Carolina State Historic Preservation Office concurred and determined the grave and monument are eligible (see letter in Appendix A).

In March 2006, SCE&G delineated the boundaries of the cemetery to prevent any accidental damage during ground-disturbing activities. Although the cemetery was delineated, it was not assessed for its National Register eligibility at that time (NSA 2006a). SCE&G has fenced this cemetery, and SCE&G's Forestry Operations group is familiar with this cemetery, which is marked on their timber inventory and land cover maps. SCE&G takes measures to protect the cemetery when conducting forest management activities.

A Phase I archaeological survey of a proposed meteorological tower site for Units 2 and 3 encompassed approximately 17.5 acres (Webb 2006). A description of survey techniques is provided in Webb (2006). One site was recorded. It contained Middle Archaic, Mississippian, and early-19th through mid-20th century artifacts. It is believed to be the home site of General Pearson and later, Major Parr. The site had been severely disturbed and therefore, was recommended as ineligible for inclusion in the National Register of Historic Places. The South Carolina State Historic Preservation Office concurred with this recommendation and determined that the site is not eligible.

A Phase I survey of approximately 530 acres encompassing the areas that may be impacted by Units 2 and 3 was also conducted in the spring of 2006 (NSA 2007c). A description of the survey techniques is provided in NSA (2007c). Seven archaeological sites were recorded and assessed for their National Register eligibility. All of the archaeological sites were very disturbed and lacked integrity. All were recommended as not eligible for inclusion in the National Register of Historic Places. The General John Pearson cemetery was previously delineated but not assessed for eligibility (NSA 2006a). NSA (2007c) recommended General Pearson's grave and an associated Daughters of the American Revolution monument as eligible for inclusion in the National Register. The greater cemetery was recommended as potentially eligible. Upon review, the South Carolina State Historic Preservation Office concurred with the recommendation the cemetery was potentially eligible and determined the grave and monument are eligible. The cemetery has been fenced to prevent any accidental damage during construction of Units 2 and 3.

A second Phase I survey of approximately 1,300 acres encompassing other areas that may be impacted by Units 2 and 3 was conducted in early 2007 (NSA 2007a). A description of the survey techniques is provided in NSA (2007c). Nineteen newly recorded sites and one previously recorded site were assessed for their National Register eligibility. All of the sites were very disturbed and lacked integrity. All were recommended as not eligible for inclusion in the National Register of Historic Places. Although recommended as not eligible, site 38FA349, a historic tree carving, is recommended for preservation due to its association with important events in the history of Parr. The tree is marked "LHT MOV'33 CCC Camp LHT" and is associated with nearby Civilian Conservation Corps Camp Pearson established in 1933. Upon review, the South Carolina State Historic Preservation Office concurred and determined all of the sites as not eligible for the National Register of Historic Places.

A third Phase I survey of approximately 232 acres encompassing additional areas that may be impacted by Units 2 and 3 was conducted in the summer of 2008 (NSA 2008). A description of the survey techniques is provided in NSA (2007c). Eight newly recorded sites were assessed for their National Register eligibility. Six of those sites were very disturbed and lacked integrity. They were recommended as not eligible for inclusion in the National Register of Historic Places. However, two sites (38FA360 and 38FA366) contained some integrity and were recommended as potentially eligible for inclusion in the National Register of Historic Places. Phase II testing was conducted at 38FA360 and this site was recommended as eligible for inclusion in the National Register. (NSA 2009a) Site 38FA366 is in a location that can be avoided by the ground disturbing activities associated with Units 2 and 3. The State Historic Preservation Office reviewed the Phase I report and concurred that six sites were not eligible and two sites (38FA360 and 38FA366) were potentially eligible for the National Register of Historic Places. Upon review of the Phase II testing report for site 38FA360, the State Historic Preservation Office concurred that the site is eligible.

A fourth Phase I survey encompassing proposed improvements along SC 213 at Parr Road and Jenkinsville Road was conducted in June 2009. These improvements encompass 5.36 acres and include both permanent and temporary easements. No archaeological sites were identified as a result of the survey. One isolated artifact was recovered and is probably related to an unrecorded site outside of the project area on private property. (NSA 2009b) Upon review, the South Carolina State Historic Preservation Office concurred that no sites eligible for the National Register of Historic Places would be affected.

In September 2009, a fifth Phase I archaeological survey was conducted of a 7.7 acre area in the vicinity of the proposed water treatment plant for the V.C. Summer Nuclear Station. No archaeological sites or isolated finds were encountered (NSA 2009c).

2.5.3.4 Transmission Line Rights-of-Way

Although transmission line rights-of-way associated with Unit 1 have not been specifically systematically surveyed, no known significant archaeological sites or standing structures currently exist within them. The new transmission lines to support Unit 2 are expected to be constructed in these corridors or adjacent to them. Corridors for the proposed Unit 3 transmission lines are not fully known, but the termination points and potential routes are identified in Subsection 2.2.2 (Figure 2.2-4). The new transmission lines would require some new corridors, but would tend to follow existing corridors where practicable. Santee Cooper estimates that approximately 80 percent of the proposed VCSNS-Flat Creek and VCSNS-Varnville transmission lines could be routed within existing rights-of-way (Santee Cooper 2008, Santee Cooper 2009). The VCSNS-Lake Murray No. 2 line would be routed entirely in existing right-of-way (SCE&G 2008a). SCE&G has conducted siting studies for the VCSNS-Killian and VCSNS-St. George lines by applying key parts of their comprehensive, three-phase transmission line siting process to develop potential routes for the new transmission lines that will avoid or minimize effects to environmental resources, cultural resources, scenic quality, and land uses. SCE&G has initiated its comprehensive, three-phase process to select final routes. SCE&G believes it is reasonable to predict that the effects associated with the final routes for the VCSNS-Killian and VCSNS-St. George lines will be very similar to the effects that are presented in the siting report for the potential routes. (SCE&G 2008a)

Although all final routes have not been determined, the corridors would likely pass through Aiken, Chester, Colleton, Dorchester, Fairfield, Hampton, Lancaster, Lexington, Newberry, Orangeburg, Richland, and Saluda counties. In total, there are 413 properties listed on the National Register in these counties: Aiken (36), Chester (17), Colleton (9), Dorchester (12), Fairfield (42), Hampton (8), Lancaster (22), Lexington (56), Newberry (30), Orangeburg (35), Richland (136), and Saluda (10). Of these properties, nine have National Historic Landmark status: Graniteville Historic District (Aiken County), Middleton Place (Dorchester County), Lancaster County Courthouse, Lancaster County Jail, the Mills Jarret Building of the South Carolina State Hospital (Richland County), Robert Mills House aka Ainsley Hall House (Richland County), First Baptist Church (Richland County), South Carolina State House (Richland County), and Chapelle Administration Building at Allen University (Richland County). Since the transmission lines are more likely to traverse rural areas, Middleton Place would be the most likely to be visually affected (NSA 2007b).

Middleton Place was the birthplace and home, from 1742 to 1787, of Arthur Middleton, a signer of the Declaration of Independence for South Carolina, planter, politician, and soldier. The south wing, circa 1755, of the original plantation house still stands and Arthur Middleton is buried in the family cemetery near the residence. The gardens at Middleton Place are the nation's oldest extant landscaped gardens and rank among the largest and most important in the world. They contain America's oldest and largest camellias, planted about 1785. Beginning in 1916, the gardens were restored to their former beauty over a period of several decades.

2.5.3.5 Native American Sites

The Catawba Indian Nation (P.O. Box 188, Catawba, SC 29704) is the only federally recognized tribe in South Carolina. The state of South Carolina (S.C. Code Chapter 139, Section 1-31-40(A)(10)) officially recognizes the following tribes/groups as legitimate Native American Tribes and Groups (SCCMA Undated):

- The Waccamaw Indian People, P.O. Box 628, Conway, South Carolina 29528
- The Pee Dee Indian Nation of Upper South Carolina, 3814 Highway 57 N, Little Rock, South Carolina 29576
- The Pee Dee Indian Tribe of South Carolina, P.O. Box 557, McColl, South Carolina 29507
- The Santee Indian Organization, 432 Bayview St., Holly Hill, South Carolina 29059
- The Beaver Creek Indians, P.O. Box 699, Salley, South Carolina 29137
- The Eastern Cherokee, Southern Iroquois and United Tribes of South Carolina
- The Wassaamasaw Tribe of Varnertown Indians
- The Chaloklowa Chickasaw Indian People, 500 Tanner Lane, Hemingway, South Carolina 29554
- The Piedmont American Indian Association, Lower Eastern Cherokee Nation of South Carolina
- The American Indian Chamber of Commerce of South Carolina, 9377 Koester Lane, Ladson, South Carolina 29456

There are no tribal lands in the VCSNS vicinity.

2.5.4 ENVIRONMENTAL JUSTICE

2.5.4.1 Methodology

Environmental justice is defined as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies (U.S. EPA 2006a). Concern that minority and/or low-income populations might be bearing a disproportionate share of adverse health and environmental impacts led President Clinton to issue an Executive Order 12898, “Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,” in 1994 to address these issues. The order directs federal agencies to make environmental justice part of their mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority and low-income populations. The Council on Environmental Quality has provided guidance for addressing environmental justice (CEQ 1997). NRC has also issued guidance on environmental justice analysis in “Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues” (U.S. NRC 2004b). SCE&G used NRC’s guidance in determining the minority and low-income composition in the environmental impact area.

NRC previously concluded that a 50-mile radius could reasonably be expected to contain potential impact sites and that the state was appropriate as the geographic area for comparative analysis. NRC’s methodology identifies minority and low-income populations within the 50-mile region and then determines if these populations could receive disproportionately high adverse impacts from the proposed action. SCE&G has adopted this approach for identifying the minority and low-income populations and associated impacts that could be affected by the proposed action. This subsection locates populations. Potential adverse impacts are identified and discussed in Chapters 4 and 5.

SCE&G used ArcGIS 9.1 software and USCB 2000 census data to determine minority and low-income characteristics by block group within 50 miles of the proposed site. SCE&G included a block group if any part of its area was within 50 miles of the proposed site. The 50-mile radius includes 803 block groups. SCE&G defines the geographic area for the proposed site as South Carolina and North Carolina, independently, for analysis of block groups in each state.

2.5.4.2 Minority Populations

The NRC Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues defines a “minority” population as: American Indian or Alaskan Native; Asian; Native Hawaiian or other Pacific Islander; Black races; and Hispanic ethnicity (U.S. NRC 2004b). Additionally, NRC’s guidance states that “other” may be considered a separate category and requires that the multiracial and aggregate minority categories be analyzed separately. The guidance indicates that a minority population exists if either of the following two conditions exists:

- The minority population of the block group or environmental impact area exceeds 50%.
- The minority population percentage of the environmental impact area is significantly greater (typically at least 20 percentage points) than the minority population percentage in the geographic area chosen for comparative analysis.

For each of the 803 block groups within the 50-mile radius, SCE&G calculated the percent of the block group's population represented by each minority. SCE&G selected the entire states of South Carolina and North Carolina as the geographic areas for comparative analysis, and calculated the percentage of each minority category for each state. If any block group minority percentage exceeded its corresponding state percentage by more than 20% or exceeded 50%, the block group was identified as containing a minority population.

Census data for South Carolina (USCB 2000d) characterizes 29.5% of the population as Black or African American; 0.3% American Indian or Alaskan Native; 0.9% Asian; 0.04% Native Hawaiian or other Pacific Islander; 1.0% some other race; 1.0% multiracial (two or more races); 32.8% aggregate of minority races; and 2.4% Hispanic ethnicity.

Census data for North Carolina (USCB 2000d) characterizes 21.6% of the population as Black or African American; 1.2% American Indian or Alaskan Native; 1.4% Asian; 0.05% Native Hawaiian or other Pacific Islander; 2.3% some other race; 1.3% multiracial (two or more races); 27.9% aggregate of minority races; and 4.7% Hispanic ethnicity.

Table 2.5-26 and Figures 2.5-6 through 2.5-11 present the results of the analysis. Two hundred thirteen census block groups within the 50-mile radius have significant Black or African American populations (Figure 2.5-6). One block group has a significant American Indian or Alaskan Native minority population (Figure 2.5-7) and one block group has a significant Asian population (Figure 2.5-8).

Two hundred thirty-four census block groups within the 50-mile radius have significant aggregate minority population percentages (Figure 2.5-9). Two census block groups within 50 miles have significant Hispanic ethnicity populations (Figure 2.5-10). Based on the "more than 20 percent" or the "exceeded 50 percent" criteria, no Native Hawaiian or other Pacific Islander; or multiracial minorities exist in the geographic area. In addition, no populations defined as "all other single minority races" exceed these criteria.

2.5.4.3 Low-Income Populations

NRC guidance defines low-income households based on statistical poverty thresholds (U.S. NRC 2004b). A block group is considered low income if either of the following two conditions is met:

- The low-income population in the census block group or the environmental impact site exceeds 50%.
- The percentage of households below the poverty level in an environmental impact site is significantly greater (typically at least 20 percentage points) than the low-income population percentage in the geographic area chosen for comparative analysis.

SCE&G divided USCB low-income households in each census block group by the total households for that block group to obtain the percentage of low-income households per block group. Using the states of South Carolina and North Carolina as the geographical areas chosen for comparative analysis, SCE&G determined that 14.1% of South Carolina and 12.4% of North Carolina households are low income (USCB 2000e). Forty-five census block groups within 50 miles have a significant percentage of low-income households. Table 2.5-26 identifies and Figure 2.5-11 locates the low-income block groups.

2.5.4.4 Potential for Disproportionate Impacts

The proposed VCSNS Units 2 and 3 are in a block group with significant Black and Aggregate minority populations. In fact, most of the block groups (13 of 19) in Fairfield County have significant Black or African American minority populations as presented in Table 2.5-26. The majority of the low-income populations; however, are located in Richland County, within the Columbia Metropolitan area. One block group in Fairfield County contains a significant low-income household population, and it is located within the town of Winnsboro.

SCE&G contacted local government officials and the staff of social welfare agencies concerning unusual resource dependencies or practices, such as subsistence living, that could result in potentially disproportionate impacts to minority or low-income populations. Successful interviews were conducted with United Way of the Midlands, Clemson Public Service, the South Carolina Department of Health and Environmental Control (SCDHEC) Region 3 Home Health Services, South Carolina Department of Natural Resources (SCDNR), Newberry County Memorial Hospital, and Newberry County Department of Social Services. Because of the rural nature of the area, most public agencies cover more than one county. Fairfield County-specific agencies could not be located or contacted to discuss minority and low-income populations in the area, but agencies that cover several counties throughout the Midlands were contacted. SCE&G identified no unusual resource dependencies or practices such as subsistence agriculture, hunting, or fishing through which the populations could be disproportionately impacted by the construction or operation of new nuclear reactors.

These interviews support the conclusion that few, if any, subsistence living activities are known to occur near VCSNS. Most agency representatives reported that activities such as hunting, fishing, and gardening were done for recreational purposes, rather than for subsistence. A representative from SCDNR did mention that Vietnamese individuals are occasionally seen collecting *Corbicula* from Monticello Reservoir. However, according to census data (see Subsection 2.5.4), only one block group with a significant Asian population exists in the 50-mile radius (in Richland County). Since *Corbicula* harvest for possible human consumption has been observed in Lake Monticello, analysis of *Corbicula* has been incorporated into the SCE&G Supplemental Radiological Environmental Monitoring Program. Samples have been collected and analyzed for gamma emitting isotopes and no measurable gamma emitting nuclides have been detected above background (SCE&G 2008b).

Agency representatives stated that most low-income individuals relied on government and/or community aid programs rather than fishing, hunting, or gardening. Fishing does take place recreationally in Monticello Reservoir, Parr Reservoir, and the Broad River. The SCDHEC monitors water bodies and publishes fish advisories for water bodies. No advisories exist for Monticello Reservoir, Parr Reservoir, or the Broad River (SCDHEC 2009).

With respect to migrant workers, agency representatives stated that there was not a large migrant worker population in the area. No agency representative felt that the small migrant worker population in the area engaged in subsistence fishing, hunting, or gardening.

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Table 2.5-1 (Sheet 1 of 4)
Current Populations and Projections to 2060

		Radii/Distances (miles)											
Sectors		0-1	1-2	2-3	3-4	4-5	5-10	0-10[(a)]	10-20	20-30	30-40	40-50	0-50
North	2000	0	0	0	0	7	237	244	602	4,005	5,172	17,385	27,408
	2010	0	0	0	0	7	254	261	643	4,165	5,657	21,191	31,917
	2020	0	0	0	0	8	268	276	679	4,325	6,203	25,690	37,173
	2030	0	0	0	0	8	287	295	726	4,526	6,879	31,223	43,649
	2040	0	0	0	0	9	306	315	773	4,686	7,626	37,963	51,363
	2050	0	0	0	0	10	325	335	820	4,886	8,533	46,085	60,659
	2060	0	0	0	0	10	346	356	873	5,086	9,609	56,103	72,027
North-Northeast	2000	0	0	0	7	50	336	393	446	7,416	10,583	71,500	90,338
	2010	0	0	0	7	54	360	421	436	7,726	11,147	85,629	105,359
	2020	0	0	0	8	57	380	445	472	8,032	11,741	102,277	122,967
	2030	0	0	0	8	61	407	476	513	8,416	12,481	122,730	144,616
	2040	0	0	0	9	65	433	507	553	8,731	13,177	147,505	170,473
	2050	0	0	0	10	69	460	539	598	9,115	14,034	177,331	201,617
	2060	0	0	0	10	73	491	574	651	9,504	14,976	214,038	239,743
Northeast	2000	0	0	79	17	57	106	259	1,411	2,529	9,318	37,953	51,470
	2010	0	0	85	18	61	113	277	1,510	2,673	9,775	40,927	55,162
	2020	0	0	89	19	64	120	292	1,594	2,803	10,272	44,777	59,738
	2030	0	0	96	21	69	128	314	1,707	2,973	10,822	49,501	65,317
	2040	0	0	102	22	74	137	335	1,820	3,131	11,362	55,934	72,582
	2050	0	0	108	23	78	145	354	1,933	3,301	11,953	64,663	82,204
	2060	0	0	115	25	83	155	378	2,060	3,485	12,585	77,448	95,956
East-Northeast	2000	0	35	0	13	0	543	591	8,373	982	1,397	11,472	22,815
	2010	0	37	0	14	0	581	632	8,959	1,054	1,547	12,517	24,709
	2020	0	40	0	15	0	614	669	9,461	1,120	1,718	13,721	26,689
	2030	0	42	0	16	0	657	715	10,131	1,204	1,907	15,015	28,972
	2040	0	45	0	17	0	700	762	10,801	1,290	2,125	16,512	31,490
	2050	0	48	0	18	0	744	810	11,471	1,378	2,360	18,099	34,118
	2060	0	51	0	19	0	793	863	12,225	1,477	2,634	19,934	37,133

Table 2.5-1 (Sheet 2 of 4)
Current Populations and Projections to 2060

		Radii/Distances (miles)											
Sectors		0-1	1-2	2-3	3-4	4-5	5-10	0-10[(a)]	10-20	20-30	30-40	40-50	0-50
East	2000	0	13	101	0	0	627	741	3,159	5,291	14,719	20,208	44,118
	2010	0	14	108	0	0	671	793	3,382	5,735	16,752	23,004	49,666
	2020	0	15	114	0	0	709	838	3,576	6,182	19,069	26,195	55,860
	2030	0	16	122	0	0	759	897	3,832	6,713	21,679	29,784	62,905
	2040	0	17	130	0	0	809	956	4,088	7,276	24,720	33,972	71,012
	2050	0	18	138	0	0	859	1015	4,347	7,877	28,047	38,553	79,839
	2060	0	19	147	0	0	915	1081	4,637	8,552	31,951	43,930	90,151
East-Southeast	2000	80	3	8	91	15	219	416	4,102	60,471	10,288	6,268	81,545
	2010	86	3	9	97	16	234	445	4,453	66,161	11,440	6,847	89,346
	2020	90	3	9	103	17	248	470	4,859	73,060	12,798	7,516	98,703
	2030	97	4	10	110	18	266	505	5,283	80,059	14,247	8,207	108,301
	2040	103	4	10	117	19	283	536	5,739	87,761	15,889	8,979	118,904
	2050	110	4	11	125	21	301	572	6,259	96,672	17,736	9,843	131,082
	2060	117	4	12	133	22	321	609	6,820	106,337	19,823	10,765	144,354
Southeast	2000	0	20	39	0	107	256	422	28,191	187,392	34,059	8,212	258,276
	2010	0	21	42	0	114	276	453	30,754	206,115	37,137	8,950	283,409
	2020	0	23	44	0	121	295	483	33,869	228,958	40,898	9,851	314,059
	2030	0	24	47	0	129	318	518	37,016	252,729	44,666	10,752	345,681
	2040	0	26	50	0	138	341	555	40,450	278,932	48,777	11,735	380,449
	2050	0	27	53	0	147	367	594	44,458	309,998	53,570	12,859	421,479
	2060	0	29	57	0	156	394	636	48,768	343,866	58,718	14,087	466,075
South-Southeast	2000	0	0	0	0	0	1886	1886	47,835	73,130	23,297	8,921	155,069
	2010	0	0	0	0	0	2056	2056	55,280	87,025	27,103	9,817	181,281
	2020	0	0	0	0	0	2263	2263	64,310	103,845	31,717	10,871	213,006
	2030	0	0	0	0	0	2470	2470	74,911	124,321	37,185	12,036	250,923
	2040	0	0	0	0	0	2,696	2,696	86,931	147,723	43,399	13,325	294,074
	2050	0	0	0	0	0	2,960	2,960	101,793	176,975	51,049	14,859	347,636
	2060	0	0	0	0	0	3,242	3,242	118,703	210,614	59,842	16,596	408,997
South	2000	0	4	0	73	60	1,294	1,431	12,382	19,982	10,399	7,142	51,336
	2010	0	4	0	79	65	1,479	1,627	14,687	23,779	12,331	8,081	60,505
	2020	0	5	0	85	72	1,703	1,865	17,478	28,374	14,670	9,208	71,595

Table 2.5-1 (Sheet 3 of 4)
Current Populations and Projections to 2060

		Radii/Distances (miles)											
Sectors		0-1	1-2	2-3	3-4	4-5	5-10	0-10[(a)]	10-20	20-30	30-40	40-50	0-50
South (cont.)	2030	0	5	0	92	78	1,962	2,137	20,864	33,969	17,503	10,478	84,951
	2040	0	5	0	100	85	2,254	2,444	24,731	40,364	20,734	11,885	100,158
	2050	0	5	0	108	93	2,613	2,819	29,560	48,356	24,763	13,573	119,071
	2060	0	6	0	117	102	3,020	3,245	35,109	57,548	29,388	15,465	140,755
South-Southwest	2000	0	0	8	29	61	1,737	1,835	7,236	12,835	6,375	6,849	35,130
	2010	0	0	9	31	65	1,971	2,076	8,391	14,912	7,262	7,808	40,449
	2020	0	0	9	33	70	2,251	2,363	9,778	17,390	8,322	8,969	46,822
	2030	0	0	10	36	75	2,577	2,698	11,437	20,371	9,537	10,268	54,311
	2030	0	0	0	0	0	2,470	2,470	74,911	124,321	37,185	12,036	250,923
	2040	0	0	11	38	81	2,949	3,079	13,332	23,782	10,900	11,703	62,796
	2050	0	0	11	41	86	3,396	3,534	15,662	27,997	12,539	13,412	73,144
	2060	0	0	12	44	92	3,907	4,055	18,332	32,814	14,385	15,326	84,912
Southwest	2000	0	0	31	6	38	1,044	1,119	3,577	3,379	7,498	12,580	28,153
	2010	0	0	33	6	41	1,117	1,197	3,822	3,582	7,968	14,290	30,859
	2020	0	0	36	7	44	1,201	1,288	4,097	3,784	8,441	16,121	33,731
	2030	0	0	38	7	47	1,284	1,376	4,372	3,987	8,921	18,309	36,965
	2040	0	0	41	8	50	1,378	1,477	4,682	4,224	9,477	20,625	40,485
	2050	0	0	44	8	54	1,472	1,578	4,993	4,460	10,042	23,417	44,490
	2060	0	0	47	9	57	1,576	1,689	5,334	4,697	10,615	26,568	48,903
West-Southwest	2000	0	24	11	0	111	662	808	4,151	2,518	3,479	5,366	16,322
	2010	0	26	12	0	119	708	865	4,442	2,677	3,712	5,861	17,557
	2020	0	27	13	0	128	761	929	4,774	2,845	3,947	6,369	18,864
	2030	0	29	14	0	137	814	994	5,106	3,013	4,193	6,949	20,255
	2040	0	31	15	0	147	874	1,067	5,479	3,206	4,473	7,588	21,813
	2050	0	33	16	0	157	933	1,139	5,853	3,399	4,754	8,270	23,415
	2060	0	36	17	0	168	1,000	1,221	6,268	3,601	5,059	9,065	25,214
West	2000	0	0	6	16	41	464	527	15,595	1,658	4,512	46,446	68,738
	2010	0	0	6	17	44	496	563	16,687	1,776	4,973	50,918	74,917
	2020	0	0	7	18	47	534	606	17,934	1,911	5,446	55,391	81,288
	2030	0	0	7	20	50	571	648	19,182	2,047	6,008	60,706	88,591
	2040	0	0	8	21	54	612	695	20,585	2,199	6,615	66,486	96,580

Table 2.5-1 (Sheet 4 of 4) Current Populations and Projections to 2060

Sectors		Radii/Distances (miles)											
		0-1	1-2	2-3	3-4	4-5	5-10	0-10[(a)]	10-20	20-30	30-40	40-50	0-50
West (cont.)	2050	0	0	8	23	58	654	743	21,989	2,352	7,250	72,455	104,789
	2060	0	0	9	24	62	701	796	23,548	2,522	7,991	79,542	114,399
West-Northwest	2000	0	12	0	4	36	573	625	1,854	2,942	17,480	23,226	46,127
	2010	0	13	0	4	39	613	669	1,984	3,216	19,577	26,013	51,459
	2020	0	14	0	5	41	659	719	2,132	3,505	21,675	28,800	56,831
	2030	0	15	0	5	44	705	769	2,280	3,835	24,296	32,284	63,464
	2040	0	16	0	5	48	756	825	2,447	4,195	27,093	36,000	70,560
	2050	0	17	0	6	51	808	882	2,614	4,568	30,065	39,948	78,077
	2060	0	18	0	6	54	865	943	2,800	4,997	33,560	44,593	86,893
Northwest	2000	0	0	0	6	0	423	429	495	3,295	4,127	11,816	20,162
	2010	0	0	0	6	0	453	459	526	3,500	4,351	12,994	21,830
	2020	0	0	0	7	0	486	493	561	3,711	4,578	14,268	23,611
	2030	0	0	0	7	0	520	527	598	3,962	4,856	15,668	25,611
	2040	0	0	0	8	0	558	566	637	4,206	5,111	17,247	27,767
	2050	0	0	0	8	0	596	604	677	4,476	5,410	19,040	30,207
	2060	0	0	0	9	0	639	648	721	4,774	5,727	20,941	32,811
North-Northwest	2000	24	0	6	154	16	283	483	307	2,212	18,657	9,409	31,068
	2010	26	0	6	165	17	303	517	326	2,301	19,426	10,144	32,714
	2020	27	0	7	174	18	321	547	344	2,390	20,200	10,974	34,455
	2030	29	0	7	186	19	343	584	365	2,501	21,167	11,902	36,519
	2040	31	0	8	199	21	366	625	387	2,590	21,956	12,849	38,407
	2050	33	0	8	211	22	389	663	409	2,701	22,940	13,986	40,699
	2060	35	0	9	225	23	415	707	434	2,812	23,936	15,182	43,071
TOTAL	2000	104	111	289	416	599	10,690	12,209	139,716	390,037	181,360	304,753	1,028,075
	2010	112	118	310	444	642	11,685	13,311	156,323	436,397	200,158	344,991	1,151,180
	2020	117	127	328	474	687	12,813	14,546	175,950	492,235	221,695	390,998	1,295,424
	2030	126	135	351	508	735	14,068	15,923	198,349	554,626	246,347	445,812	1,461,057
	2040	134	144	375	544	791	15,452	17,440	223,457	624,296	273,434	510,308	1,648,935
	2050	143	152	397	581	846	17,022	19,141	253,449	708,511	305,045	586,393	1,872,539
	2060	152	163	425	621	902	18,780	21,043	287,283	802,686	340,799	679,583	2,131,394

a) Transient populations are included in population estimates and projected with the 0-10 miles only.

Table 2.5-2
Counties within 50 Miles of the Proposed Site

South Carolina	North Carolina
Aiken	Union
Calhoun	
Cherokee	
Chester	
Edgefield	
Fairfield	
Greenwood	
Kershaw	
Lancaster	
Laurens	
Lee	
Lexington	
McCormick	
Newberry	
Orangeburg	
Richland	
Saluda	
Spartanburg	
Sumter	
Union	
York	

Table 2.5-3
Annual Average Population Change

	Fairfield		Lexington		Newberry		Richland		South Carolina	
Year	Population[a]	Annual Percent Growth	Population[a]	Annual Percent Growth	Population[a]	Annual Percent Growth	Population[a]	Annual Percent Growth	Population[a]	Annual Percent Growth
1970	19,999	NA	89,012	NA	29,273	NA	233,868	NA	2,590,516	N/A
1980	20,700	0.35	140,353	4.66	31,242	0.65	269,735	1.88	3,121,820	1.88
1990	22,295	0.75	167,611	1.79	33,172	0.60	285,720	0.58	3,486,703	1.11
2000	23,454	0.51	216,014	2.57	36,108	0.85	320,677	1.16	4,012,012	1.41
2010	24,910	0.60	252,900	1.59	38,560	0.66	350,670	0.90	4,458,930	1.06
2020	26,410	0.59	291,970	1.45	41,080	0.64	378,780	0.77	4,916,870	0.98
2030	27,900	0.55	330,320	1.24	43,580	0.59	407,510	0.73	5,371,150	0.89

a) SCBCB (2005a, 2005c)

Table 2.5-4
Age Distribution of Population in 2000 for the Four Counties and State of South Carolina

	Fairfield		Lexington		Newberry		Richland		South Carolina	
Age Group	Number	Percent of Population	Number	Percent of Population	Number	Percent of Population	Number	Percent of Population	Number	Percent of Population
Under 18	6,128	26.1	56,313	26.1	8,701	24.1	77,609	24.2	1,009,641	25.2
18 to 24	2,019	8.6	17,874	8.3	3,551	9.8	44,135	13.8	407,851	10.2
25 to 44	6,520	27.8	68,334	31.6	9,977	27.6	101,459	31.6	1,185,955	29.6
45 to 64	5,693	24.3	51,504	23.8	8,556	23.7	65,999	20.6	923,232	23.0
65 and over	3,094	13.2	21,989	10.2	5,323	14.7	31,475	9.8	485,333	12.1
Totals	23,454		216,014		36,108		320,677		4,012,012	

Sources: USCB (2000f)

Table 2.5-5 (Sheet 1 of 2)
Municipalities within a 50-Mile Radius

Municipality	2000 Population[(a)]	Distance in Miles from Proposed Site[(b)]	Direction[(b)]
Batesburg-Leesville	5,517	30	SW
Blythewood	170	20	SE
Camden	6,682	40	E
Cayce	12,150	25	SE
Chapin	628	9	S
Chester	6,476	29	N
Clinton	8,091	31	NW
Columbia	116,278	15	SE
Eastover	830	46	SE
Elgin	806	31	SE
Gaston	1,304	34	SSE
Gayle Mill	1,094	28	N
Great Falls	2,194	30	NE
Greenwood	22,071	49	W
Irmo	11,039	14	SE
Johnston	2,336	41	SW
Kershaw	1,645	45	NE
Lancaster	8,177	43	NNE
Laurens	9,916	41	NW
Lexington	9,793	20	S
Little Mountain	255	9	SW
Lugoff	6,278	37	E
Newberry	10,580	15	W
Ninety Six	1,936	42	W
North	813	48	S
Oak Grove	8,183	24	SE
Peak	61	4	S
Pelion	553	37	S
Pomaria	177	6	SW
Prosperity	1,047	13	SW
Red Bank	8,811	26	S
Ridgeway	328	20	E
Rock Hill	49,765	44	NNE
Saluda	3,066	31	SW
Silverstreet	216	23	W
South Congaree	2,266	29	SE
Union, SC	8,793	33	NNW

Table 2.5-5 (Sheet 2 of 2)
Municipalities within a 50-Mile Radius

Municipality	2000 Population[(a)]	Distance in Miles from Proposed Site[(b)]	Direction[(b)]
Waterloo	203	43	W
West Columbia	13,064	24	SSE
Whitmire	1,512	22	NW
Winnsboro	3,599	14	E
Winnsboro Mills	2,263	14	NE
Woodford	196	45	SE
York	6,985	48	N

a) USCB (2000g)
b) Google Earth (2007)

Table 2.5-6
Population Density

Distance (Miles)	Population Density (per square mile)		
	Year 2010	Year 2020	Year 2060
0–1	36	37	48
0–2	18	19	25
0–3	19	20	26
0–4	20	21	27
0–5	21	22	29
0–10	42	46	67
0–20	135	152	245
0–50	147	165	271

Table 2.5-7
Farms that Employ Migrant Labor in the 50-Mile Region

County	Total Farms that Hire Labor	Farms with Migrant Labor	Percent of Farms that Hire Migrant Labor
Aiken	162	21	13.0
Calhoun	66	7	10.6
Cherokee	60	8	13.3
Chester	30	1	3.3
Edgefield	77	9	11.7
Fairfield	28	0	0.0
Greenwood	72	8	11.1
Kershaw	96	2	2.1
Lancaster	90	3	3.3
Laurens	146	1	0.7
Lee	87	11	12.6
Lexington	237	16	6.8
McCormick	21	0	0.0
Newberry	85	1	1.2
Orangeburg	266	17	6.4
Richland	113	1	0.9
Saluda	133	3	2.3
Spartanburg	141	31	22.0
Sumter	150	25	16.7
Union, SC	33	4	12.1
Union, NC	285	14	4.9
York	160	21	13.1

Source: USDA (2002 a, b)

Table 2.5-8 (Sheet 1 of 2)
Employment Sectors in the Four-County Region

	Fairfield		Lexington		Newberry		Richland		Four-County Region		Avg. Annual Growth%
	1990	2000	1990	2000	1990	2000	1990	2000	1990	2000	
Total full-time and part-time employment	9,299	9,711	77,177	112,065	14,801	16,646	225,512	264,889	326,789	403,311	2.1%
Wage and salary employment	8,222	8,277	63,080	89,554	12,684	14,486	205,940	240,579	290,654	352,896	2.0%
Proprietors employment	1,077	1,434	14,097	22,511	2,117	2,160	19,572	24,310	36,863	50,415	3.2%
Farm proprietors employment	236	205	883	945	668	612	403	392	2,190	2,154	-0.2%
Nonfarm proprietors employment	841	1,229	13,214	21,566	1,449	1,548	19,169	23,918	34,673	48,261	3.4%
Farm employment	255	225	1,256	1,222	952	822	526	451	2,989	2,720	-0.9%
Nonfarm employment	9,044	9,486	75,921	110,843	13,849	15,824	224,986	264,438	323,800	400,591	2.2%
Private employment	7,639	7,788	65,315	96,351	11,802	13,396	159,901	190,114	244,711	307,649	2.3%
Agricultural services, forestry, fishing and other	59	77	604	1,307	162	159	903	1,804	1,728	3,347	6.8%
Mining	(a)	(a)	273	199	(b)	(b)	208	266	481	465	-0.3%
Services	(a)	1,561	16,698	27,610	2,160	3,151	55,770	75,767	74,628	108,089	3.8%
Construction	445	410	7,612	9,956	833	1,131	10,673	11,343	19,563	22,840	1.6%
Transportation and public utilities	(a)	1,026	5,026	7,745	440	400	7,686	9,302	13,152	18,473	3.5%
Wholesale trade	(a)	(a)	3,277	6,786	355	647	11,100	11,002	14,732	18,435	2.3%
Retail trade	1,137	1,006	14,016	21,294	2,429	2,325	34,545	40,213	52,127	64,838	2.2%

Table 2.5-8 (Sheet 2 of 2)
Employment Sectors in the Four-County Region

	Fairfield		Lexington		Newberry		Richland		Four-County Region		Avg. Annual Growth%
	1990	2000	1990	2000	1990	2000	1990	2000	1990	2000	
Finance, insurance, and real estate	210	312	3,944	8,000	445	424	24,285	26,470	28,884	35,206	2.0%
Manufacturing	2,643	2,591	13,865	13,454	4,974	5,153	14,731	13,947	36,213	35,145	-0.3%
Government and government enterprises	1,405	1,698	10,606	14,492	2,047	2,428	65,085	74,324	79,143	92,942	1.6%

a) Not shown to avoid disclosure of confidential information, but the estimates for this item are included in the totals.
b) Less than 10 jobs, but the estimates for this item are included in the totals.
Source: BEA (2006)

Table 2.5-9
Top 10 Nonfederal Employers Located in the Central Midlands Region

Company	Product/Service
Bell South/AT&T	Utility
Blue Cross & Blue Shield of South Carolina	Insurance
Department of Corrections	State
Department of Mental Health	State
Gold Kist Inc.	Agriculture
Lexington Medical Center	Health Care
Palmetto Health Alliance	Health Care
United Parcel Service	Distribution
University of South Carolina	State
Wal-Mart	Retail

Source: CSCA (2006)

Table 2.5-10
Employment Trends 1995–2005

	Labor Force	Employed	Unemployed	Unemployment Rate
Fairfield				
1995	10,971	10,079	892	8.1
2005	11,577	10,662	915	7.9
Average Annual Percent Change	0.54	0.56	0.25	
Lexington				
1995	109,216	105,896	3,320	3.0
2005	127,570	121,336	6,234	4.9
Average Annual Percent Change	1.6	1.4	6.5	
Newberry				
1995	18,055	17,025	1,030	5.7
2005	17,934	16,681	1,253	7.0
Average Annual Percent Change	-0.07	-0.20	2.0	
Richland				
1995	148,631	143,376	5,255	3.5
2005	171,461	161,133	10,328	6.0
Average Annual Percent Change	1.4	1.2	7.0	
South Carolina				
1995	1,849,873	1,754,638	95,235	5.1
2005	2,080,519	1,938,741	141,778	6.8
Average Annual Percent Change	1.2	1.0	4.1	
ROI				
1995	286,873	276,376	10,497	3.7
2005	328,542	309,812	18,730	5.7
Average Annual Percent Change	1.4	1.1	6.0	
ROI as Percent of South Carolina				
1995	15.5	15.8	11.0	
2005	15.8	16.0	13.2	

Source: BLS (1995); BLS (2005)

Table 2.5-11
Per Capita Personal Income in the Four-County Region

County	1995	2005	Average Annual Growth Rate
Fairfield	$15,717	$23,926	4.2%
Lexington	$21,600	$31,575	3.8%
Newberry	$16,653	$23,901	3.6%
Richland	$21,524	$31,518	3.8%
South Carolina	$19,124	$28,285	3.9%

Source: BEA (2007)

Table 2.5-12
Average Annual Daily Traffic Counts for 2005

	Route and Location	Number of Lanes	SCDOT Road Classification[(a)]	Estimated AADT[(b)]	AADT Capacity[(c)] (passenger cars per day)[(d)]
1	SC 215 Richland Co. Line to SC 213	2	rural minor arterial	1,700	5,292
2	SC215 SC 213 to Chester Co. Line	2	rural minor arterial	1,250	5,292
3	SC 202 I-26 to US 176	2	rural major collector	1,000	4,214
4	US Highway 176 SC 202 to SC 213	2	rural major collector	1,500	4,214
5	SC 213 US 176 to Fairfield Co. Line	2	rural major collector	1,550	4,214
6	SC 213 Newberry Co. line to SC 215	2	rural major collector	2,400	4,214
7	SC 213 SC 215 to S-23	2	rural major collector	900	4,214
8	SC 213 S-23 to US 321	2	urban collector	2,400	4,214
9	US Highway 176 I-26 to mile marker 7.34	2	urban minor arterial	5,900	5,292
	US Highway 176 Mile marker 7.34 to Newberry Co. Line	2	rural major collector	5,900	4,214
10	US Highway 176 Richland Co. Line to SC 213	2	rural major collector	1,500	4,214

a) SCDOT (2006b), Hance (2007)
b) SCDOT (2006c)
c) SCDOT (2006d)
d) Level of Service A-the most conservative design capacity of roads classifications

Table 2.5-13
Characteristics of Unrestricted, Public Airports within 50 Miles of VCSNS

Name	Owner	Tower Presence
Aiken Municipal	Aiken County	No
Chester Catawba Regional	Chester County	No
Columbia Metropolitan	Richland/Lexington Counties	Yes
Columbia Owens	Richland County	No
Trenton Younce Field	Edgefield County	No
Fairfield County	Fairfield County	No
Greenwood County	Greenwood County	No
Laurens County	Laurens County	No
Lexington County at Pelion	Lexington County	No
Newberry County	Newberry County	No
Saluda County	Saluda County	No
Woodward Field	Kershaw County	No

Source: SCDA (2005)

Table 2.5-14
Property Taxes Revenues for the Four-County Region

Revenue Source[a]	Fairfield	Lexington	Newberry	Richland
Property Taxes	$32,381,035	$234,852,449	$28,810,741	$326,984,018

a) Property tax figures include “fees in lieu of property tax.” Taxes collected are for all taxing authorities within the county – the county itself, all municipalities, and school districts for the fiscal year ending June 30, 2005.

Source: SCORS (2005)

Table 2.5-15 (Sheet 1 of 2)
Recreation Areas within 50 Miles of VCSNS

	Acreage	Nearest City	Distance to VCSNS Site in Miles[a]	Annual Visitors[b]	Overnight Facilities[b]	Overnight Facility Capacity, 2007 (# of camp sites or cabins)
U.S. National Parks and Historic Sites						
Congaree National Park	22,200[c]	Wateree	48	—	Yes	10[d]
Ninety Six National Historic Site	990[e]	Ninety Six	42	50,000	No	NA
Sumter National Forest (Enoree Ranger District)	161,216[f]	Whitmire	21	—	Yes	53, plus 4 seasonal campgrounds[g]
South Carolina Department of Parks, Recreation, and Tourism						
Andrew Jackson State Park	360[h]	Lancaster	47	64,977	Yes	26[i]
Chester State Park	523[f]	Prosperity	26	29,166	Yes	31[i]
Croft State Natural Area	7,054[f]	Spartanburg	50	79,628	Yes	55[i]
Dreher Island State Recreation Area	348[f]	Chapin	15	206,948	Yes	117[i]
Goodale State Park	763[f]	Camden	45	7,728	No	0[i]
Harbison State Forest	2,177[j]	Columbia	18	—	No	0[k]
Lake Greenwood State Recreation Area	914[f]	Ninety Six	37	139,152	Yes	145[i]
Lake Wateree State Recreation Area	238[f]	Winnsboro	27	133,008	Yes	72[i]
Landsford Canal State Park	448[f]	Lancaster	42	27,244	No	0[i]
Musgrove Mill State Historic Site	360[f]	Clinton	36	9,573	No	0[i]
Rose Hill Plantation State Historic Site	44[f]	Union	29	3,864	No	0[i]
Sesquicentennial State Park	1,419[f]	Columbia	27	105,672	Yes	89[i]

Table 2.5-15 (Sheet 2 of 2) Recreation Areas within 50 Miles of VCSNS

	Acreage	Nearest City	Distance to VCSNS Site in Miles[a]	Annual Visitors[b]	Overnight Facilities[b]	Overnight Facility Capacity, 2007 (# of camp sites or cabins)
South Carolina Department of Natural Resources Heritage Preserves and Wildlife Management Areas						
Congaree Bluffs Heritage Preserve	201[l]	Sandy Run	50	—	No	NA
Congaree Creek Heritage Preserve	627[h]	Cayce	29	—	No	NA
Forty Acre Rock Heritage Preserve	1,567[h]	Heath Springs	50	—	No	NA
Janet Harrison High Pond Heritage Preserve	30[h]	Monetta	37	—	No	NA
Nipper Creek Heritage Preserve	90[h]	Richtex	16	—	No	NA
Parr Hydroelectric Wildlife Management Area	4,400[m]	Jenkinsville	<1	—	No	NA
Rock Hill Blackjacks Heritage Preserve	291[h]	Rock Hill	45		—	NA
Savage Bay Heritage Preserve	110[h]	Camden	45		—	NA
Shealy's Pond Heritage Preserve	62[h]	Pelion	30		—	NA

a) Google Earth (2007)
b) SCBCB (2005b)
c) USGS (2006)
d) NPS (2009)
e) State Parks (undated)
f) USDA (undated)
g) USDA (2005)
h) SCDPRT (2007)
i) SCBCB (2007)
j) SCFC (undated[a])
k) SCFC (undated[b])
l) SCDNR (2006a)
m) SCDNR (2006b)

Table 2.5-16
Housing Characteristics in the Four-County Region for 2000

	Fairfield	Lexington	Newberry	Richland	Four-Counties	South Carolina
Total Housing Units[a]	10,383	90,978	16,805	129,793	247,959	1,753,670
Total Occupied Units[a]	8,774	83,240	14,026	120,101	226,141	1,533,854
Owner-Occupied[a]	6,794	64,265	10,776	73,757	155,592	1,107,617
Renter-Occupied[a]	1,980	18,975	3,250	46,344	70,549	426,237
Total Vacant Units	1,609	7,738	2,779	9,692	21,818	219,816
Percent Total Vacant Units Median Value-owner	15.5	8.5	16.5	7.5	8.8	12.5
(Single-family owner occupied)[b]	$69,900	$106,300	$78,000	$98,700	$98,880	$94,900
Percent Change 1990 to 2000 in Total Units	18.9	34.7	16.3	18.5	23.8	23.1
Mean Travel Time to work, minutes[c]	28.3	26.0	25.3	21.7	—	24.3

a) USCB (2000b)
b) USCB (2000c)
c) USCB (2000h)
— = Not applicable

Table 2.5-17
Housing Characteristics of Select Municipalities[(a)] within 50 miles of VCSNS

	Total Housing Units	Occupied Housing Units	Vacant Housing Units	Owner Vacancy Rate	Renter Vacancy Rate
Batesburg-Leesville	2,446	2,167	279	3.1	7.7
Camden	3,283	2,874	409	2.4	7.8
Cayce	5,517	5,133	384	1.2	9.5
Chester	2,774	2,465	309	2.7	6.4
Clinton	3,011	2,683	328	2.3	10.2
Columbia	46,142	42,245	3,897	2.2	7.7
Great Falls	1,041	892	149	3.4	15
Greenwood	9,373	8,496	877	2.9	7.7
Irmo	4,066	3,911	155	1.6	5.7
Johnston	1,012	923	89	3.5	4.6
Lancaster	3,778	3,396	382	2.3	12
Laurens	4,396	3,952	444	2.3	9.6
Lexington	4,025	3,644	381	2.8	17.6
Lugoff	2,467	2,364	103	0.7	6.5
Newberry	4,388	3,970	418	2.8	7.7
Ninety Six	904	820	84	2.4	6.7
Oak Grove	3,626	3,368	258	1.8	14.4
Red Bank	3,498	3,281	217	2.3	14.5
Rock Hill	20,287	18,750	1,537	3.1	7.8
Saluda	1,211	1,103	108	1.6	3.9
South Congaree	1,002	890	112	1.6	21.5
Union, SC	4,240	3,791	449	3.0	8.4
West Columbia	6,436	5,968	468	1.6	8
Winnsboro	1,597	1,454	143	1.8	5.8
Winnsboro Mills	1,005	885	120	2.5	9.1
York	2,766	2,536	230	1.6	7.2

a) Municipalities within a 50-mile radius with a 2000 population of at least 2,000 persons.
Source: USCB (2000b)

Table 2.5-18 (Sheet 1 of 2)
State-Regulated Public Water Systems in the Four-County Region[a]

System Name	System Number	Treatment Capacity (MGD)	Reported Annual Average Withdrawal (MGD)	Population Served
Groundwater				
Fairfield County				
Jenkinsville Water District	2020001	—	0.15	1,969
[9 wells and purchased from Midcounty][b] Midcounty Water District #1	2020002	—	0.083	1,487
[4 wells[2] and purchased from Winnsboro][b] Town of Ridgeway [1 well and purchased from Winnsboro][b]	2010002	—	0.056	950
Lexington County				
Gaston Rural Water District	3220002	—	0.46	6,756
[7 wells] Gilbert Summit [7 wells and purchased from Lexington Co. Joint][b]	3220001	—	0.41	4,518
Newberry County				
Town of Prosperity [3 wells]	3610005	—	0.058	1,347
Surface Water				
Fairfield County				
Town of Winnsboro [Sand Creek and 192 Acre Lake][c]	2010001	3.1[d]	1.54	8,303
Lexington County				
Town of Batesburg-Leesville	3210002	2.4[d]	1.1	7,652
[Lightwood Knot Creek, Duncan Creek][c] City of Cayce [Congaree Creek[c] and purchased from Lexington Co. Joint, Lexington, and Columbia][b	3210003	6.0[d]	3.1	15,250
City of West Columbia [Saluda River and Lake Murray[c] and purchased from Cayce][b]	3210004	20[d]	9.8	29,763
Lexington Co. Joint Municipal Water System [Lake Murray[c] and purchased from West Columbia][b]	3220003	4.3[d]	2.3[d]	12,264[d]
Town of Lexington [purchased from West Columbia and Lexington Co. Joint][b]	3210001	4.5[d]	1.8[d]	7,659[d]

Table 2.5-18 (Sheet 2 of 2) State-Regulated Public Water Systems in the Four-County Region[a]

System Name	System Number	Treatment Capacity (MGD)	Reported Annual Average Withdrawal (MGD)	Population Served
Surface Water (continued)				
Newberry County				
City of Newberry	3610001	8.1[d]	5.1[d]	10,145
[Saluda River][c] Town of Whitmire [Enoree River, Duncan Creek][c]	3610004	1.0[e]	0.64	2,755
Richland County				
Fort Jackson (US Army) [purchased from Columbia][c]	4010501	6.6[d]	2.2[d]	32,841[d]
City of Columbia [Lake Murray and Columbia Canal (Broad River)][c]	4010001	126[d]	65[d]	223,660[d]

a) Includes community water systems of 3 million gallons per month or greater
b) SCDHEC (2003a)
c) SCDHEC (2003b)
d) SCDNR (2005)
e) Sinclair (2007)
Sources: Devlin 2006, except as noted
— = Not Applicable

Table 2.5-19
State-Regulated Public Wastewater Systems in the Four-County Region[a]

System Name	Permit Number	Maximum Treatment Capacity (MGD)	Average Daily Waste Water Processed (MGD)
Fairfield County			
Winnsboro/Jackson Creek Plant	SC0020125	1.5[b]	Not Provided[b]
Lexington County			
Cayce WWTF	SC0024147	9.5[c]	5.5 to 6.0[c]
Town of Chapin	SC0040631	5.0[d] (proposed)	0.58[d]
Batesburg-Leesville Wastewater Treatment Facility	SC0024465	2.5[e]	1.3 to 1.5[e]
Lexington-Coventry Woods Wastewater Treatment Plant	SC0026735	1.95[f]	1.0[f]
Newberry County			
City of Newberry/Bush River Wastewater Treatment Plant	SC0024490	3.22[g]	2.5[g]
Town of Whitmire	SC0022390	1.0[h]	0.5 to 0.6[h]
Richland County			
Columbia Metro Wastewater Treatment Plant	SC0020940	60[i]	35[i]
East Richland County PSD/Gills Creek	SC0038865	16.0[j]	Not Provided[j]
Richland County/Broad River Wastewater Treatment Facility	SC0046621	6.0[k]	1.195[k]

a) Includes major facilities with a capacity of 1.0 million gpd or more (EPA 2006b)
b) Belton (2007)
c) Hare (2007)
d) Murphy (2007)
e) Atkins (2007)
f) Craft (2007)
g) Coddale (2007)
h) Carroll-Mayor (2007)
i) Columbia 2007
j) McClary (2007)
k) SCDHEC (2002)

Table 2.5-20
Police and Fire Protection in the Four-County Region

County	2000 Population	Police[(a)]	Ratio Persons-per-Police Officer	Firefighters (b)	Ratio Persons-per-Firefighter
Fairfield	23,454	73	321	109	215
Lexington	216,014	429	504	242	893
Newberry	36,108	79	457	198	182
Richland	320,677	852	376	541	593

a) FBI (2005)
b) Fire Department Net (Undated)

Table 2.5-21
Hospitals and Medical Personnel in the Four-County Region

County	2000 Population	Hospital Beds[(a)]	Hospital Beds per 1,000 population	Physicians (b)	Physicians per 1,000 population
Fairfield	23,454	50	2.1	19	0.81
Lexington	216,014	376	1.7	337	1.6
Newberry	36,108	103	2.9	52	1.4
Richland	320,677	1,533	4.8	1,330	4.2
Total	596,253	2,062		1,738	

a) CSCA (2007
b) SCBCB (2005d)

Table 2.5-22
Schools and Enrollment in the Four-County Region, 2005-2006

District	Elementary Schools[(a)]		Secondary Schools[a]		Student-Teacher Ratio
	Number	Enrollment	Number	Enrollment	
Fairfield School District	6	2,320	1	1,045	12.9
Lexington School District 1	15	13,550	4	5,354	13.9
Lexington School District 2	14	6,150	2	2,564	13.4
Lexington School District 3	3	1,476	1	610	14.6
Lexington School District 4	5	2,380	1	947	15.6
Lexington School District 5	15	11,242	3	4,891	13.8
Newberry School District	10	4,012	2	1,439	12.6
Richland School District 1	38	16,859	9	7,251	12.7
Richland School District 2	18	14,532	3	5,792	14.7
South Carolina Total		463,087		196,425	

a) Totals do not include alternate campuses or enrollment in those schools
Source: SCDOE (2003, 2007)

Table 2.5-23
Colleges and Universities within 50 miles

Institution	City	County	Highest Degree Offered
Public Senior Institutions			
University of South Carolina	Columbia	Richland County	Doctoral Degrees
Lander University	Greenwood	Greenwood County	Master's Degrees
Winthrop University	Rock Hill	York County	Master's Degrees
Other Public Institutions			
University of South Carolina — Lancaster	Lancaster	Lancaster County	Associates Degrees
University of South Carolina — Union	Union	Union County	Associates Degrees
Public Technical Colleges			
Midlands Technical College	Columbia	Richland County	Associates Degrees
York Technical College	Rock Hill	York County	Associates Degrees
Private Senior Institutions			
Allen University	Columbia	Richland County	Baccalaureate Degrees
Benedict College	Columbia	Richland County	Baccalaureate Degrees
Columbia International University	Columbia	Richland County	Doctoral Degrees
Columbia College	Columbia	Richland County	Master's Degrees
Lutheran Theological Seminary	Columbia	Richland County	Doctoral Degrees
Newberry College	Newberry	Newberry County	Baccalaureate Degrees
Presbyterian College	Clinton	Laurens County	Baccalaureate Degrees

Source: SACS (2006), SCCHE (2006)

Table 2.5-24 (Sheet 1 of 2)
National Register Listed Archaeological Sites and Standing Structures within 10 Miles of the Site

Name	Address	City	County	Year of Significance	Level of Significance	Area of Significance	Archaeological Site Number
Davis-Plantation	S of Monticello on SC 215	Monticello	Fairfield	1845	Local	Architecture	38FA56
Ebenezer ARP Church	4.3 mi. N of Jenkinsville on SC 213	Jenkinsville	Fairfield	1788	State	Architecture	38FA57
Folk-Holloway House	Jct. of Holloway and Folk Sts.	Pomaria	Newberry	1835	Local	Architecture	
Fonti Flora Plantation	5.4 mi. NE of Monticello on SC 99	Monticello	Fairfield	1836	Local	Architecture	
Glenn, Dr. John, House	SC 215	Jenkinsville	Fairfield	1845	State	Architecture	
Hatton House	Holloway St. between Folk St. and US 176	Pomaria	Newberry	1892	Local	Architecture	
High Point	SC 215	Jenkinsville	Fairfield	1870	State	Architecture	
Kincaid-Anderson House	NE of Jenkinsville of SC 213	Jenkinsville	Fairfield	1774	State	Religion	
Lemmon, Bob, House	Off SC 213	Winnsboro	Fairfield	1910	State	Architecture	
Little Mountain Historic District	Along portions of Pomaria, Church, Main, and Mountain Streets	Little Mountain	Newberry	1880	Local	Architecture	
Little River Baptist Church	3.8 mi. N of Jenkinsville on SC 213	Jenkinsville	Fairfield	1845	Local	Architecture	38FA58
Mayfair	Off SC 215	Jenkinsville	Fairfield	1820	Local	Architecture	
McMeekin Rock Shelter	Address Restricted	Winnsboro	Fairfield		State	Prehistoric	38FA41
Monticello Methodist Church	Off SC 215	Monticello	Fairfield	1861	State	Architecture	
Monticello Store and Post Office	Off SC 215	Monticello	Fairfield	1820	State	Commerce	
Old Stone House	Off SC 34	Winnsboro	Fairfield	1784	State	Architecture	
Pomaria	SE of Pomaria on US 176	Pomaria	Newberry	1825	Local	Architecture	

Table 2.5-24 (Sheet 2 of 2)
National Register Listed Archaeological Sites and Standing Structures within 10 Miles of the Site

Name	Address	City	County	Year of Significance	Level of Significance	Area of Significance	Archaeological Site Number
Robinson-Hiller House	113 Virginia St.	Chapin	Lexington	1917	Local	Architecture	
Rockton and Rion Railroad Historic District	S of Winnsboro from SC 34 W to SC 213	Winnsboro	Fairfield	1945	State	Industry	
St. John's Lutheran Church	SE of Pomaria	Pomaria	Newberry	1809	Local	Religion	
The Oaks	SC 213	Winnsboro	Fairfield	1850	State	Architecture	

Source: National Register of Historic Places

Table 2.5-25 (Sheet 1 of 4)
Standing Structures Determined Individually Eligible or Contributing to the Eligibility of a District within 10 Miles of the Site

Survey #	Resource Name	Approximate distance from VCSNS (miles)	Address	City	County	Eligibility	Reference
0079	Counts-Feagle House	8	308 Pomaria St.	Little Mountain	Newberry	Contributes to Eligible District	Revels 2002
0080	W.B. Shealy House	8	317 Pomaria St.	Little Mountain	Newberry	Contributes to Eligible District	Revels 2002
0081	Col. E.J. Locke House	8	274 Pomaria St.	Little Mountain	Newberry	Contributes to Eligible District	Revels 2002
0082	J.M. Sease, MD House	8	263 Pomaria St.	Little Mountain	Newberry	Contributes to Eligible District	Revels 2002
0083	J.B. Lathan House	8	229 Pomaria St.	Little Mountain	Newberry	Contributes to Eligible District	Revels 2002
0084	Preacher Wessinger House	8	175 Pomaria St.	Little Mountain	Newberry	Contributes to Eligible District	Revels 2002
0085	G.R. Shealy House	8	116 Pomaria St.	Little Mountain	Newberry	Contributes to Eligible District	Revels 2002
0086	G.M. Shealy House	8	89 Pomaria St.	Little Mountain	Newberry	Contributes to Eligible District	Revels 2002
0087	Frick House	8	69 Pomaria St.	Little Mountain	Newberry	Contributes to Eligible District	Revels 2002
0088	CN&L Railroad Section, Master's House	8	NW corner of Church and Pomaria Sts.	Little Mountain	Newberry	Contributes to Eligible District	Revels 2002
0089	Brady House	8	585 Church St.	Little Mountain	Newberry	Contributes to Eligible District	Revels 2002
0090	James H. Wise Store	8	810 Main St.	Little Mountain	Newberry	Contributes to Eligible District	Revels 2002
0092	J. M. and J. C. Sease, MD	8	824 Main St.	Little Mountain	Newberry	Contributes to Eligible District	Revels 2002

Table 2.5-25 (Sheet 2 of 4) Standing Structures Determined Individually Eligible or Contributing to the Eligibility of a District within 10 Miles of the Site

Survey #	Resource Name	Approximate distance from VCSNS (miles)	Address	City	County	Eligibility	Reference
0094	Counts and Shealy General Merchandise	8	Main St.	Little Mountain	Newberry	Contributes to Eligible District	Revels 2002
0096	Andrew Miller's Store	8	S of Main St. in alley behind Masonic Hall	Little Mountain	Newberry	Contributes to Eligible District	Revels 2002
0097	Derrick Lumber Yard	8	218 Depot St.	Little Mountain	Newberry	Contributes to Eligible District	Revels 2002
0098	Wise House	8	97 W. Church St.	Little Mountain	Newberry	Contributes to Eligible District	Revels 2002
0099	Little Mtn. Oil Mill	8	199 W. Church St.	Little Mountain	Newberry	Contributes to Eligible District	Revels 2002
0104	David Farr House	8	1172 Main St.	Little Mountain	Newberry	Contributes to Eligible District	Revels 2002
0105	Dominick-Boland House	8	1098 Main St.	Little Mountain	Newberry	Contributes to Eligible District	Revels 2002
0106	no name	8	1036 Main St.	Little Mountain	Newberry	Contributes to Eligible District	Revels 2002
0107	no name	8	1010 Main St.	Little Mountain	Newberry	Contributes to Eligible District	Revels 2002
0108	Matthews House	8	984 Main St.	Little Mountain	Newberry	Contributes to Eligible District	Revels 2002
0109	Little Mtn. School	8	692 Mill St.	Little Mountain	Newberry	Eligible	Revels 2002
0112	Miller House	8	832 Mountain St.	Little Mountain	Newberry	Contributes to Eligible District	Revels 2002
0113	Bennett Miller House	8	Mountain St.	Little Mountain	Newberry	Contributes to Eligible District	Revels 2002
0114	Malcom Sloan House	8	724 Mountain St.	Little Mountain	Newberry	Contributes to Eligible District	Revels 2002

Table 2.5-25 (Sheet 3 of 4)
Standing Structures Determined Individually Eligible or Contributing to the Eligibility of a District within 10 Miles of the Site

Survey #	Resource Name	Approximate distance from VCSNS (miles)	Address	City	County	Eligibility	Reference
0116	Mt. Zion AME School	8	Mt. Zion Cir.	Little Mountain	Newberry	Contributes to Eligible District	Revels 2002
0117	Olie Stoudenmire House	8	357 Church St.	Little Mountain	Newberry	Contributes to Eligible District	Revels 2002
0118	no name	8	329 Church St.	Little Mountain	Newberry	Contributes to Eligible District	Revels 2002
0119	no name	8	289 Church St.	Little Mountain	Newberry	Contributes to Eligible District	Revels 2002
0126	Holy Trinity Lutheran Church	8	531 Church St.	Little Mountain	Newberry	Contributes to Eligible District	Revels 2002
0129	no name	5.5	120 Angella St.	Pomaria	Newberry	Contributes to Eligible District	Revels 2002
0130	no name	5.5	N corner of int. Main, Holloway & Angella Sts.	Pomaria	Newberry	Contributes to Eligible District	Revels 2002
0131	Pomaria Post Office	5.5	N side of Angella St E of int. w/ Holloway St.	Pomaria	Newberry	Contributes to Eligible District	Revels 2002
0132	no name	5.5	152 Main St.	Pomaria	Newberry	Contributes to Eligible District	Revels 2002
0133	Kinard Bros. General Store	5.5	162 Main St.	Pomaria	Newberry	Contributes to Eligible District	Revels 2002
0134	no name	5.5	172 Main St.	Pomaria	Newberry	Contributes to Eligible District	Revels 2002
0135	no name	5.5	Main St.	Pomaria	Newberry	Contributes to Eligible District	Revels 2002
0136	Pinner's Pharmacy	5.5	Main St.	Pomaria	Newberry	Contributes to Eligible District	Revels 2002
0137	Bank of Pomaria	5.5	Main St.	Pomaria	Newberry	Contributes to Eligible District	Revels 2002

Table 2.5-25 (Sheet 4 of 4)
Standing Structures Determined Individually Eligible or Contributing to the Eligibility of a District within 10 Miles of the Site

Survey #	Resource Name	Approximate distance from VCSNS (miles)	Address	City	County	Eligibility	Reference
0139	Girl Scout Hut	5.5	140 Victoria St.	Pomaria	Newberry	Contributes to Eligible District	Revels 2002
0140	Wilson's Laundrymat	5.5	Victoria St.	Pomaria	Newberry	Contributes to Eligible District	Revels 2002
0141	no name	5.5	120 Victoria St.	Pomaria	Newberry	Contributes to Eligible District	Revels 2002
0142	Pomaria Cotton Gin and Oil Mill	5.5	108 Rest St.	Pomaria	Newberry	Contributes to Eligible District	Revels 2002
0150	Old Methodist Church	5.5	Hentz St. S side East of int. w/ Holloway St.	Pomaria	Newberry	Eligible	Revels 2002
0169	no name	5.5	671 Holloway St.	Pomaria	Newberry	Eligible	Revels 2002
0176	no name	5.5	N side of int. of Hwy 176 & Holloway St.	Pomaria	Newberry	Contributes to Eligible District	Revels 2002
1139	St. Paul's Lutheran Church	8.2	2491 SC Hwy 773	Pomaria	Newberry	Eligible	Revels 2003
1293	no name	5	7443 Broad River Road	Pomaria	Newberry	Eligible	Revels 2003
1431	Suber-Dickert House	8.3	10488 Bush River Rd.	Newberry	Newberry	Eligible	Revels 2003
4979	Pet Sites House	7.5	1311 Pet Sites Road	Chapin	Richland	Eligible	Martin et al. 2002

Table 2.5-26
Summary of Minority and Low-Income Block Groups within 50 Miles of Units 2 and 3

Block Groups with minority or low-income populations more than 20% over the state average or more than 50% of the block group population.												
State	County Name	Number of Block Groups	Black	American Indian or Alaskan Native	Asian	Native Hawaiian or Other Pacific Islander	Some Other Race	Multi-Racial	Aggregate	Hispanic	Low-Income Households
North Carolina	Union	1	0	0	0	0	0	0	0	0	0
South Carolina	Aiken	14	3	0	0	0	0	0	3	0	0
South Carolina	Calhoun	7	4	0	0	0	0	0	4	0	0
South Carolina	Cherokee	4	0	0	0	0	0	0	0	0	0
South Carolina	Chester	31	9	0	0	0	0	0	9	0	1
South Carolina	Edgefield	12	7	0	0	0	0	0	8	0	1
South Carolina	Fairfield	19	13	0	0	0	0	0	14	0	1
South Carolina	Greenwood	45	11	0	0	0	0	0	11	1	4
South Carolina	Kershaw	40	5	0	0	0	0	0	6	0	2
South Carolina	Lancaster	44	7	0	0	0	0	0	7	0	3
South Carolina	Laurens	48	8	0	0	0	0	0	8	0	4
South Carolina	Lee	2	2	0	0	0	0	0	2	0	0
South Carolina	Lexington	135	7	0	0	0	0	0	12	0	2
South Carolina	McCormick	1	1	0	0	0	0	0	1	0	0
South Carolina	Newberry	32	3	0	0	0	0	0	3	0	2
South Carolina	Orangeburg	8	3	0	0	0	0	0	3	0	0
South Carolina	Richland	235	104	0	1	0	0	0	115	0	23
South Carolina	Saluda	16	3	0	0	0	0	0	5	1	0
South Carolina	Spartanburg	12	0	0	0	0	0	0	0	0	0
South Carolina	Sumter	8	6	0	0	0	0	0	6	0	1
South Carolina	Union	29	5	0	0	0	0	0	5	0	1
South Carolina	York	60	12	1	0	0	0	0	12	0	0
	Totals:	**803**	**213**	**1**	**1**	**0**	**0**	**0**	**234**	**2**	**45**

Highlighted counties are completely contained within the 50-mile radius.

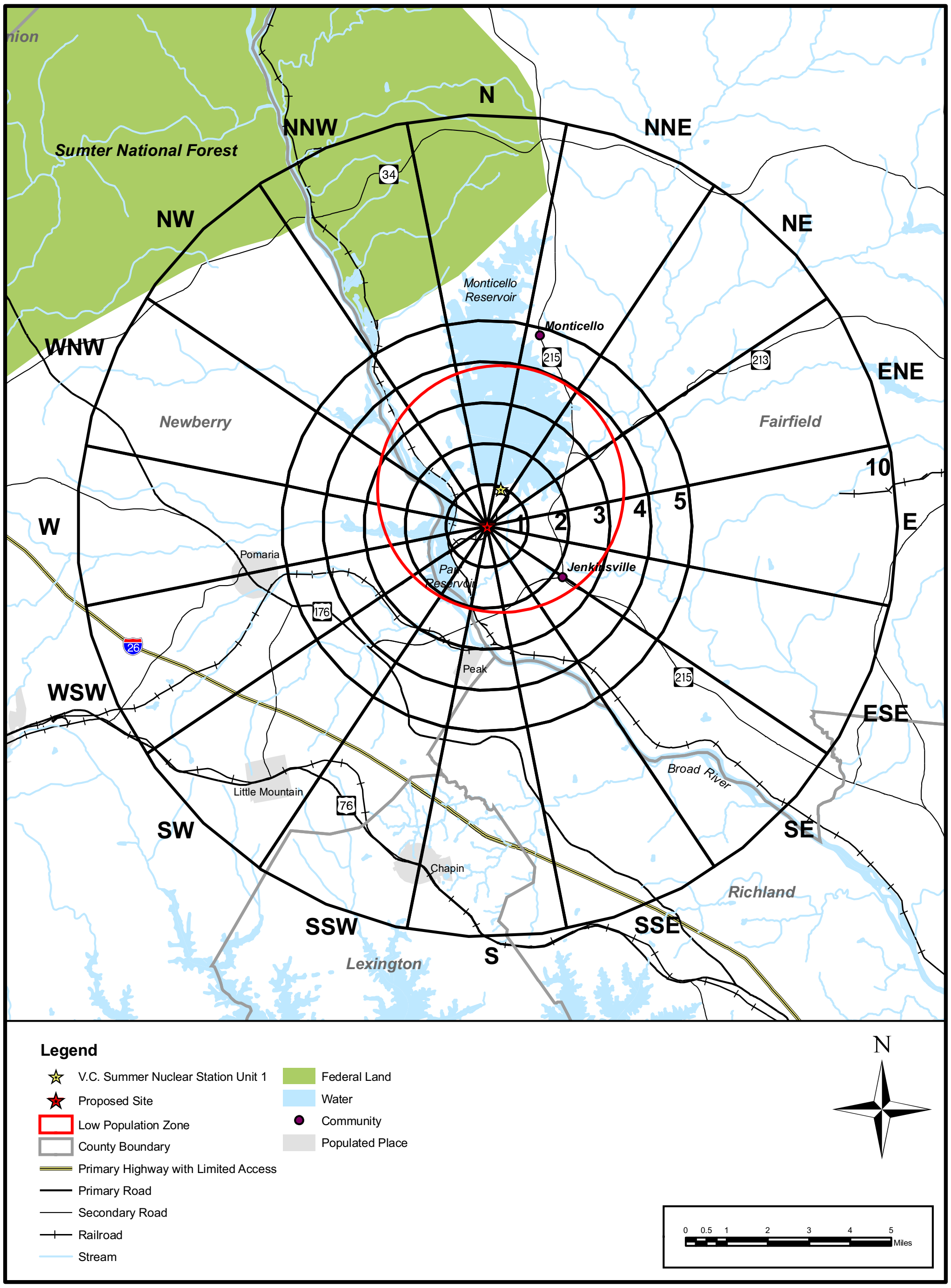

Figure 2.5-1. 10-Mile Radius Sector Chart Superimposed Over a VCSNS Site Vicinity Map

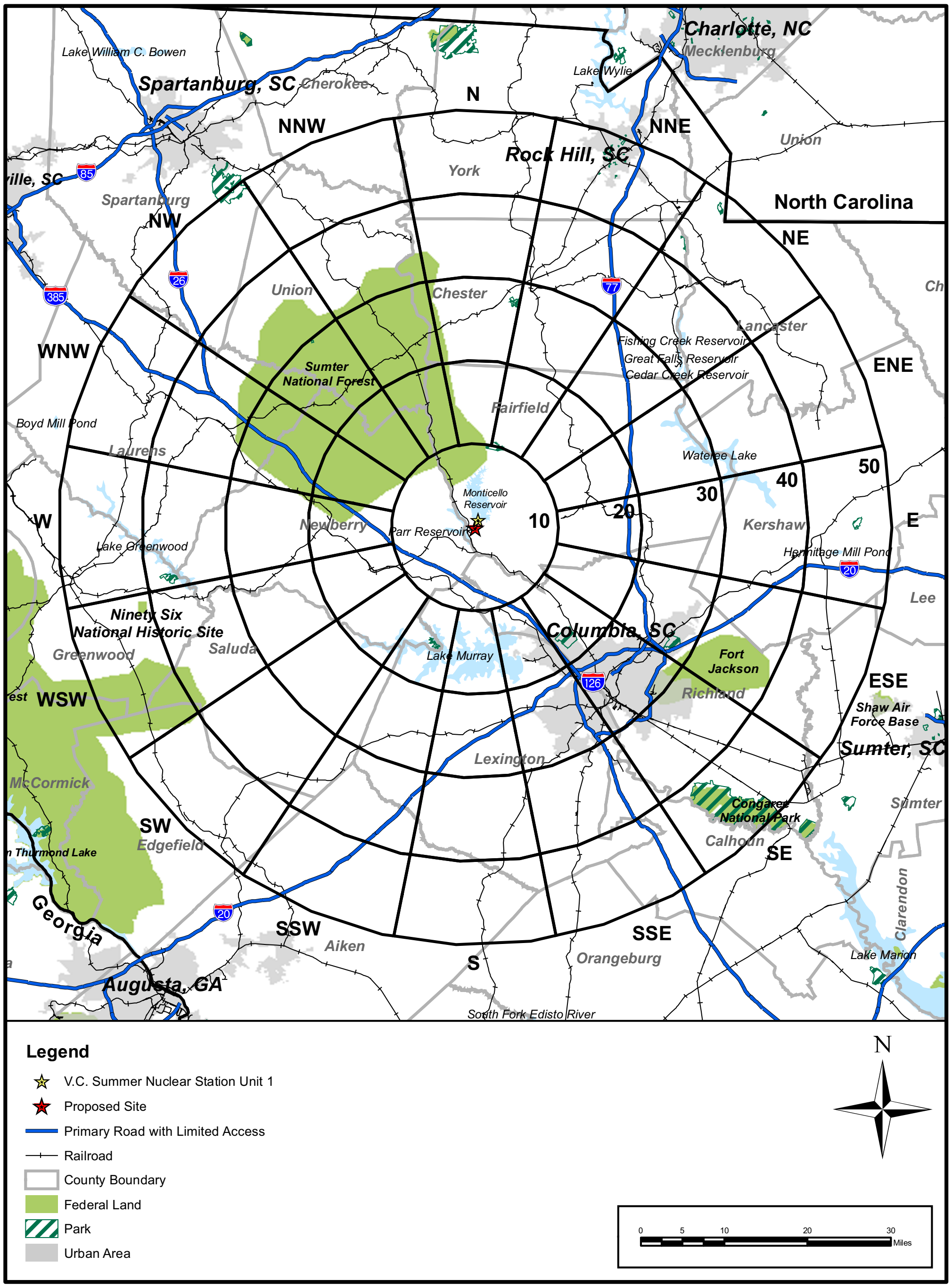

Figure 2.5-2. 50-Mile Radius Sector Chart Divided into 10-Mile Radii

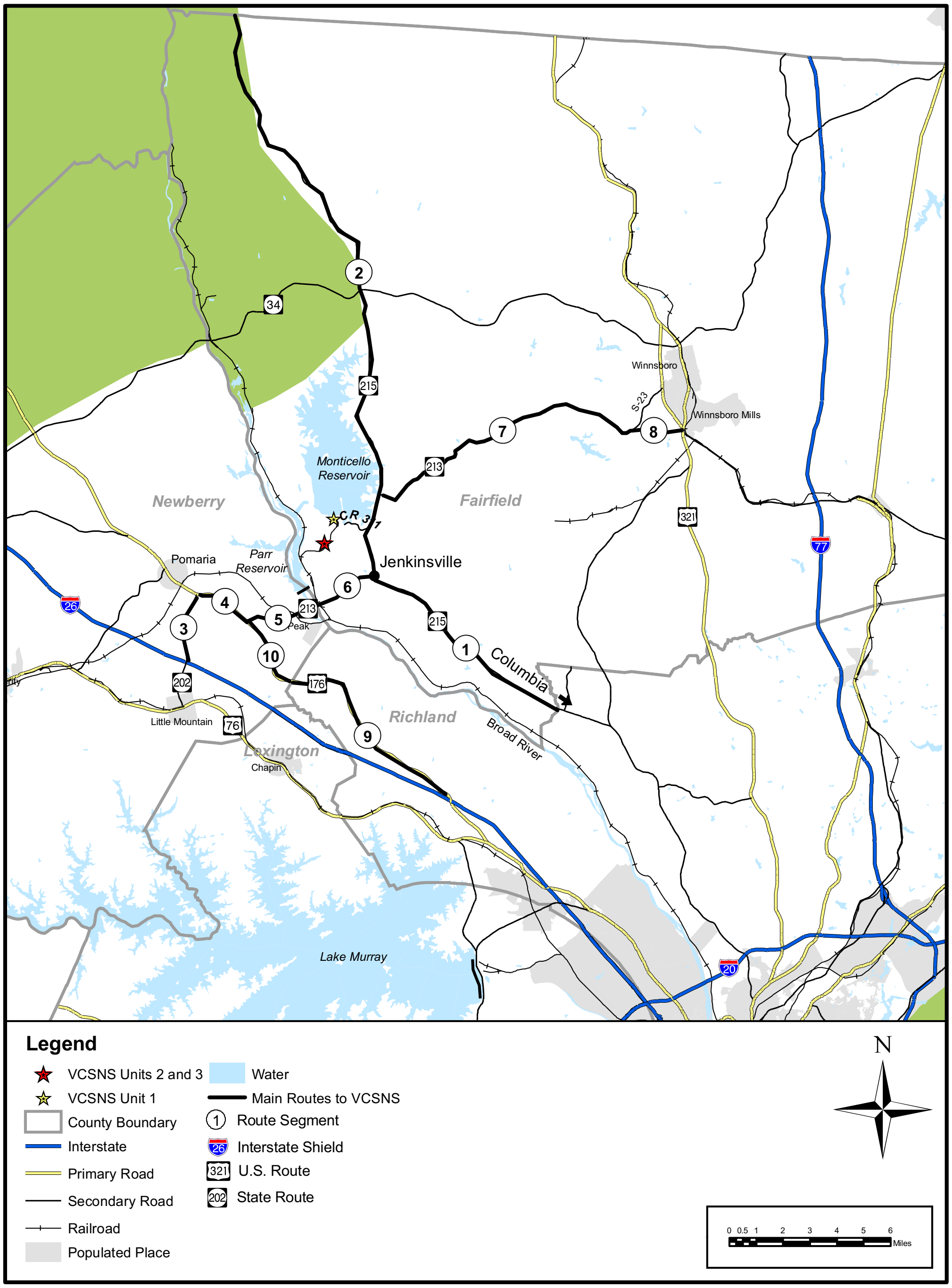

Figure 2.5-3. Road and Highway Transportation System in the Four-County Region

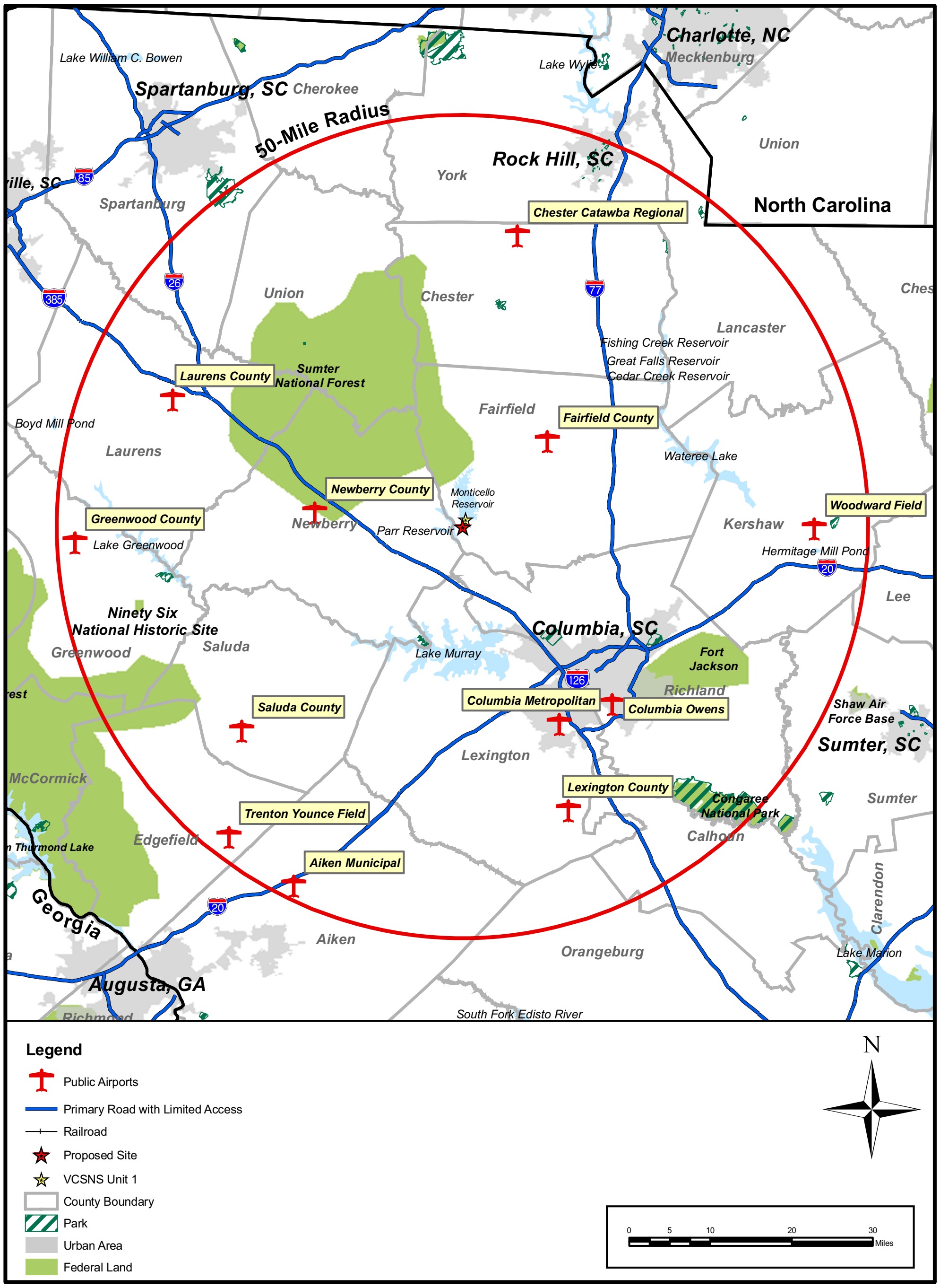

Figure 2.5-4. Public Airports and Rail System Within 50 Miles of the Proposed Site

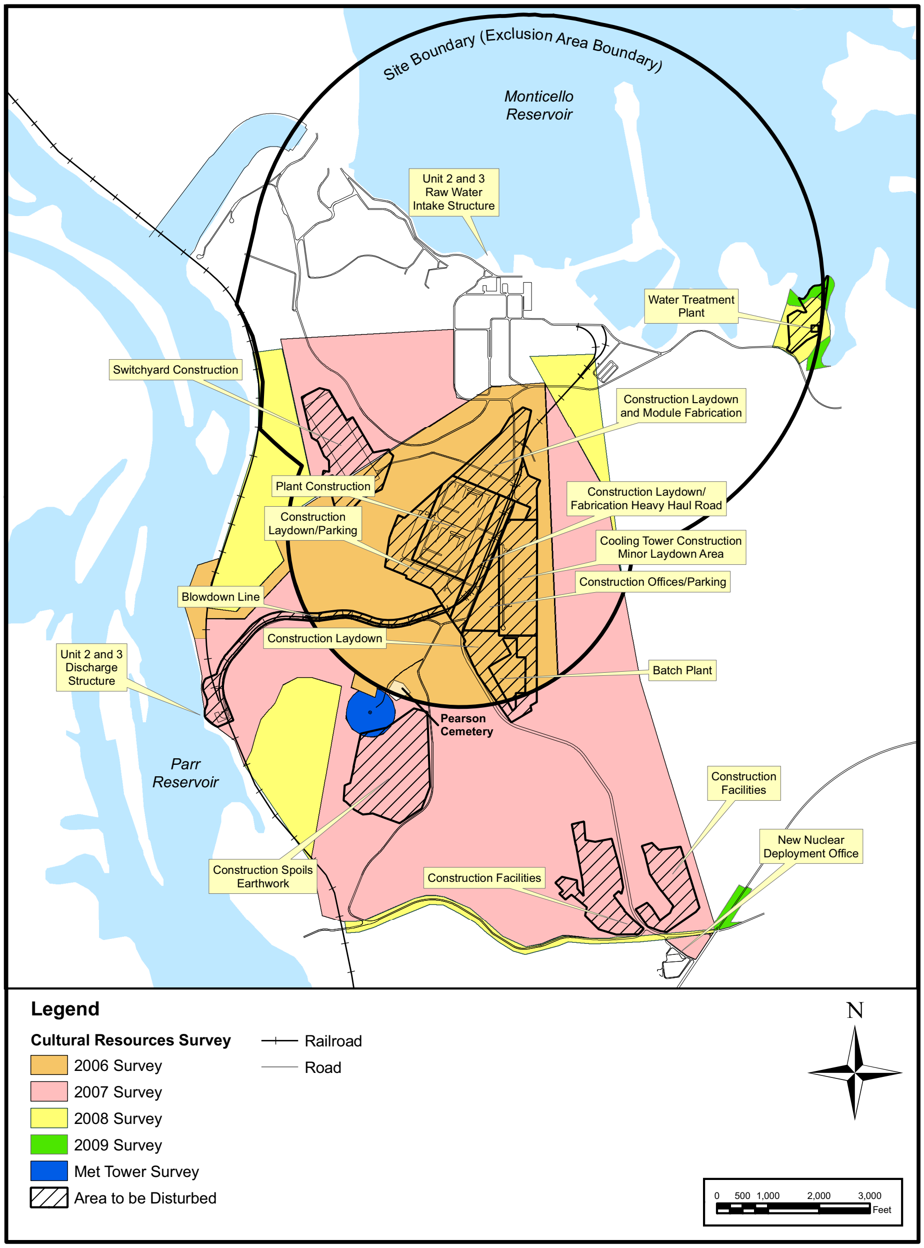

Figure 2.5-5. Areas Surveyed for Cultural Resources at VCSNS

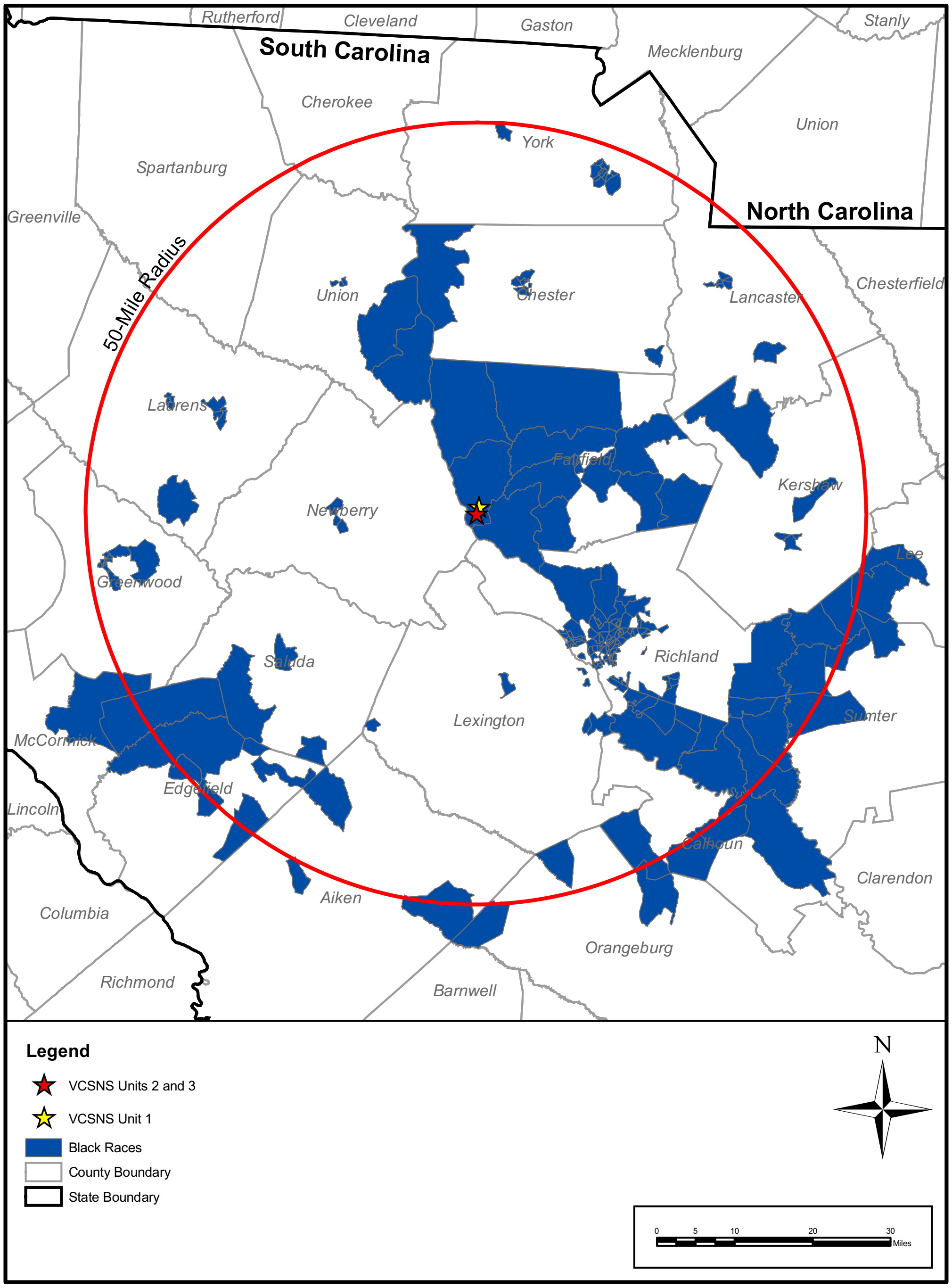

Figure 2.5-6. Black Races Block Groups Within 50 Miles

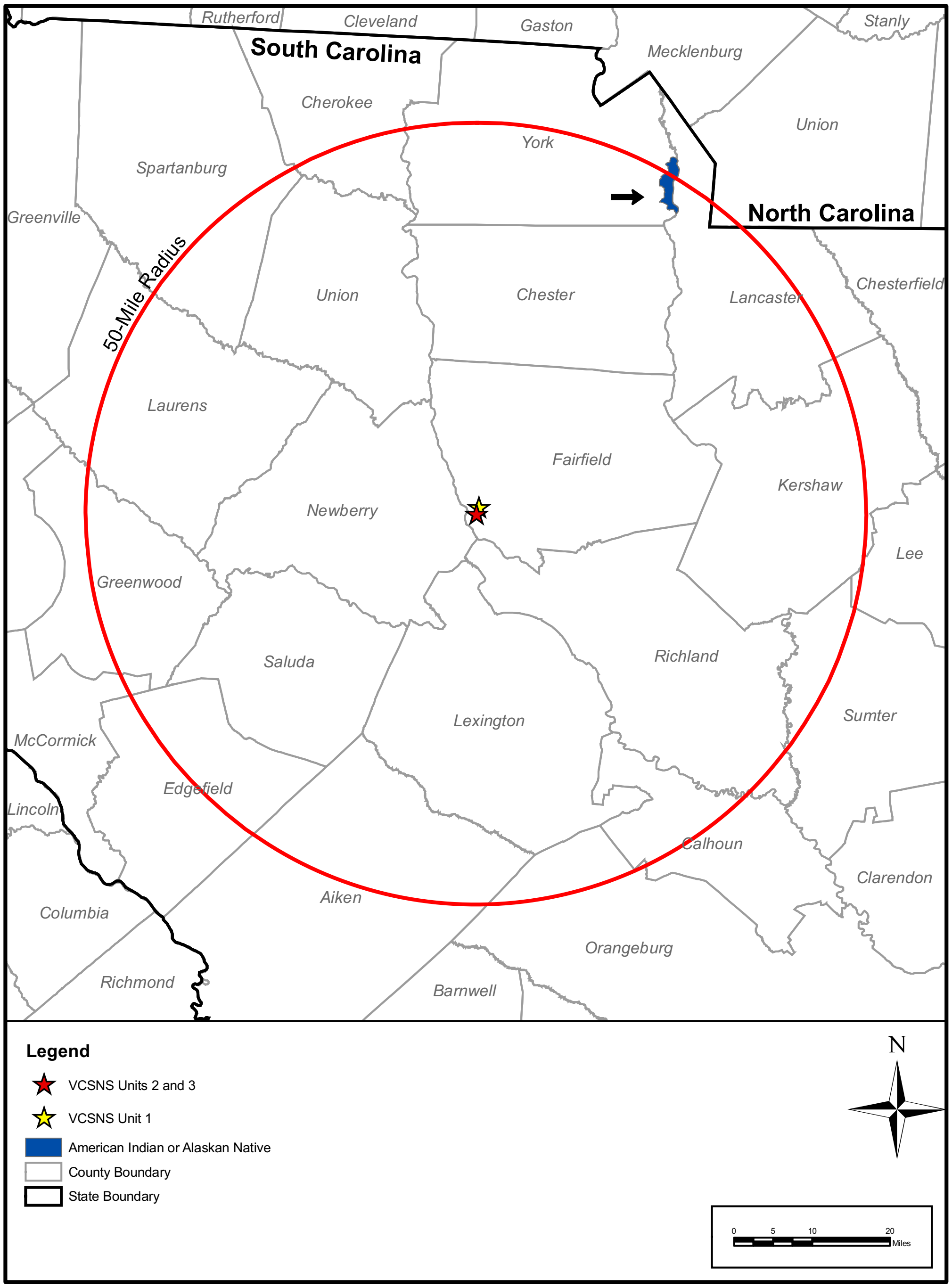

Figure 2.5-7. American Indian or Alaskan Native Block Groups Within 50 Miles

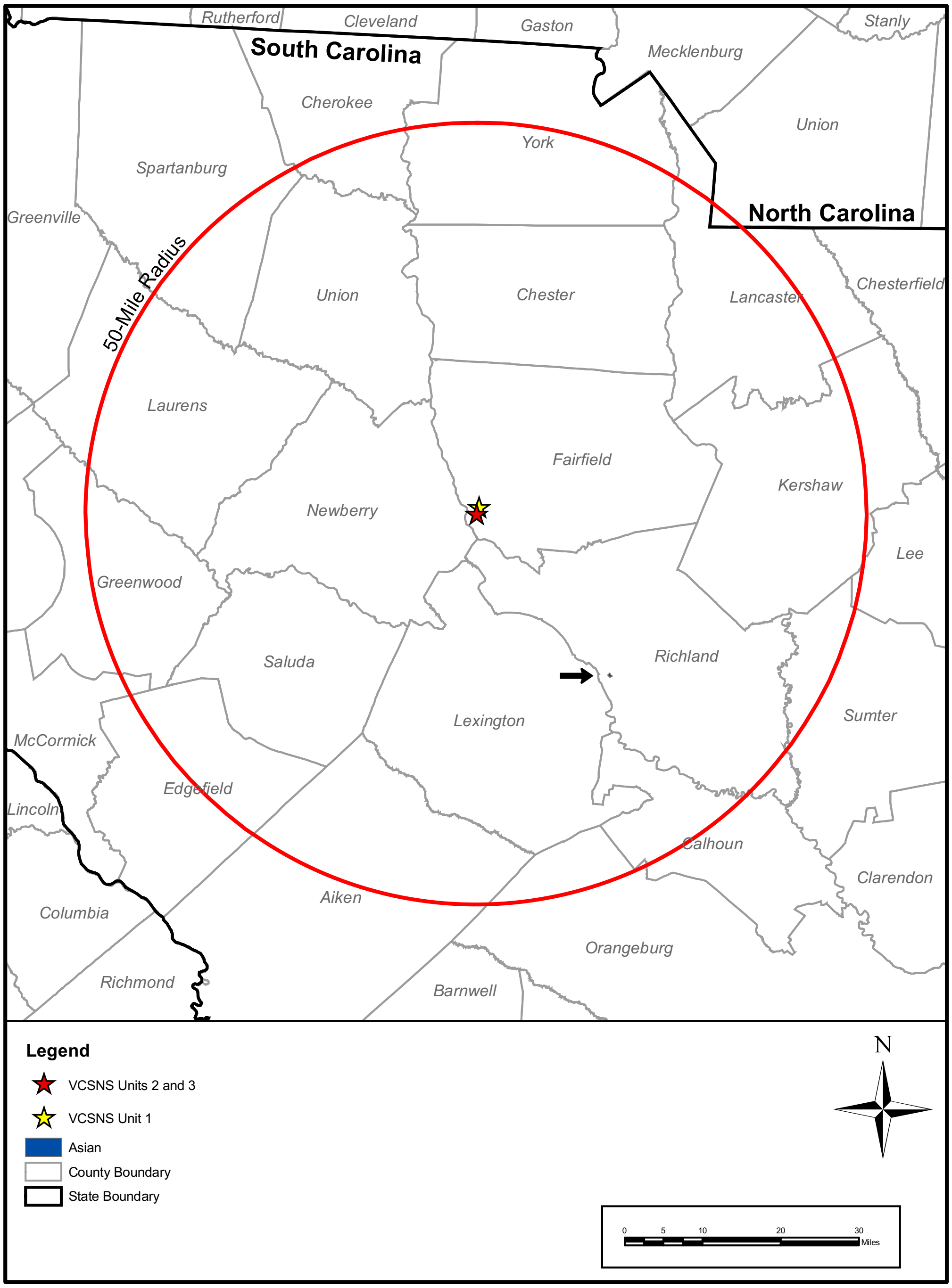

Figure 2.5-8. Asian Block Groups Within 50 Miles

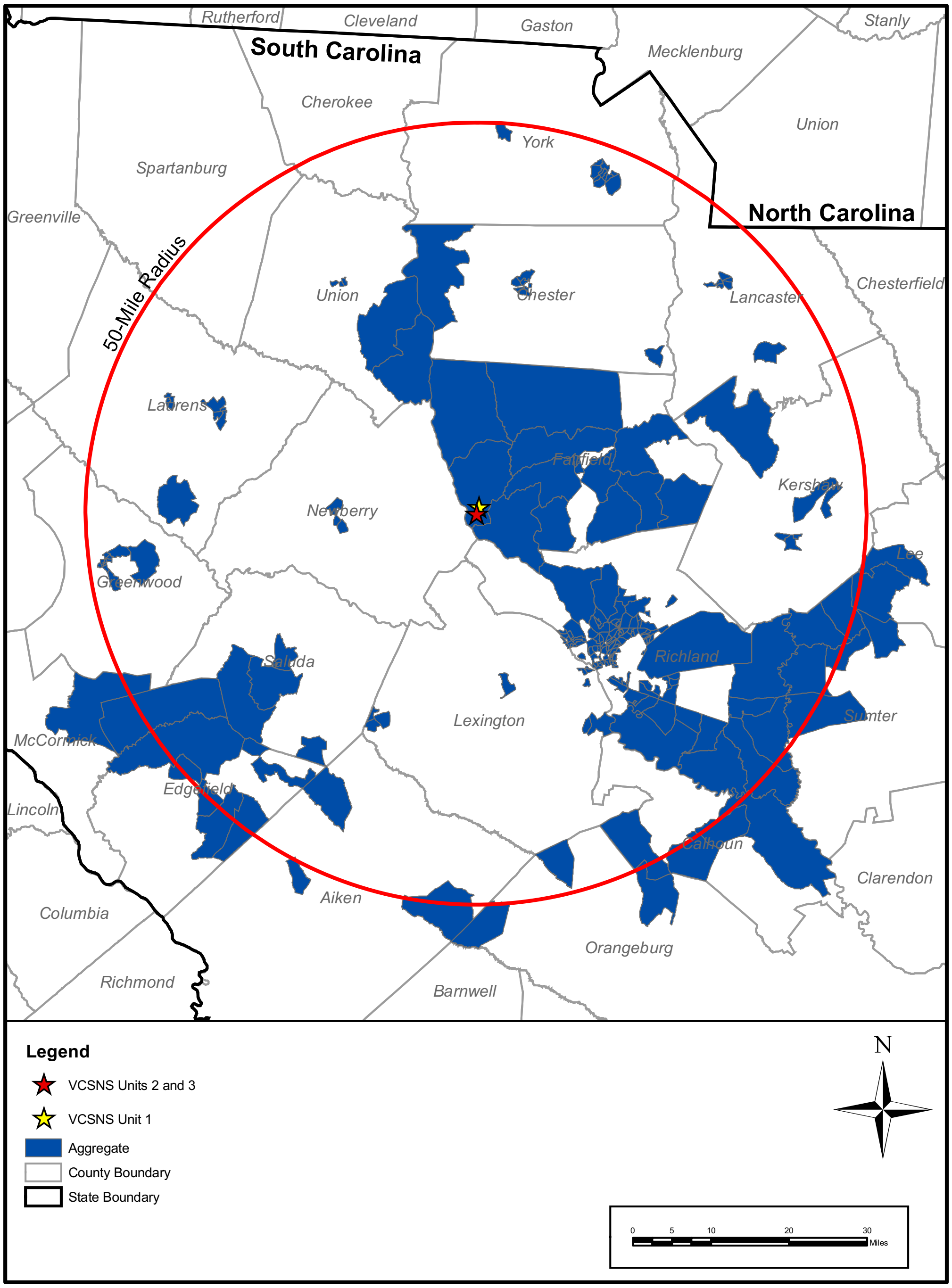

Figure 2.5-9. Aggregate Block Groups Within 50 Miles

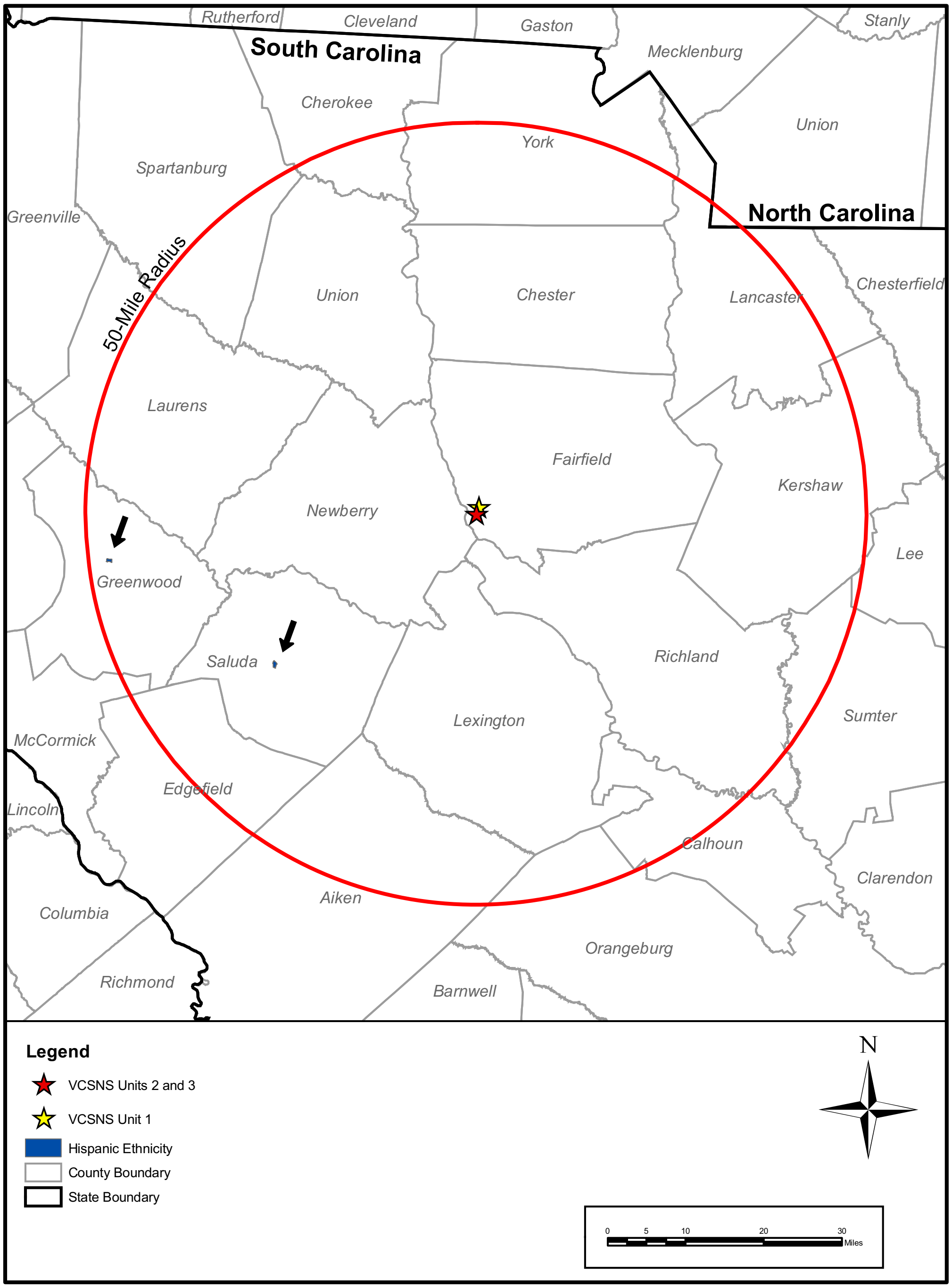

Figure 2.5-10. Hispanic Ethnicity Block Groups Within 50 Miles

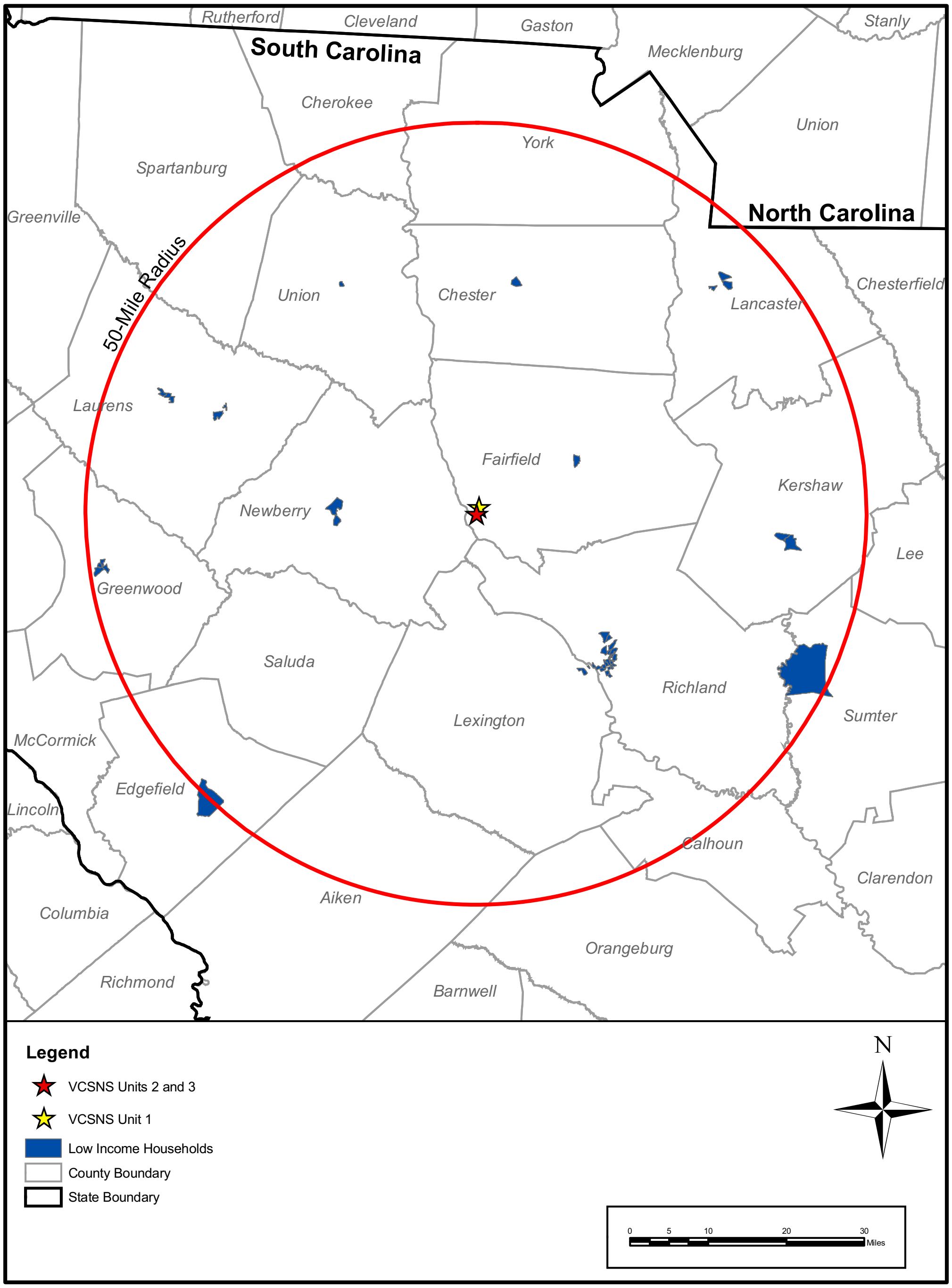

Figure 2.5-11. Low-Income Block Groups Within 50 Miles