3.0 DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1 Land Use

The CFFF site is located in the central part of SC in Richland County, some 13 km (8 mi) southeast of the city limits of Columbia along SC Highway 48 (see Figures 2.1-1 and 3.1-1). The site coordinates are 33º 52' 52" north latitude and 80º 55' 24" west longitude. Figure 2.1-2 shows a topographic quadrangle map of the area within a radius of 13 km (8 mi). The inner circle represents a 8-km (5-mi) radius around the plant, 90 percent of which falls in Richland County and the remaining 10 percent falls within Calhoun County, to the south (Westinghouse, 2012a).

Most of the area is swamp-type land, unsuitable for commercial purposes. Much of the land that makes up the site boundary is designated as agricultural. Within a 1.6-km (1-mile) radius of the CFFF site, agricultural use makes up 44 percent of the area (see Figure 3.1-2). The remaining 56 percent is classified as "other." The CFFF site lies within the flood basin of the Congaree River, which flows approximately 6.4 km (4 mi) southwest of the main plant. The land consists of timbered tracts and wetland areas penetrated by unimproved roads. A variety of activities is conducted within the undeveloped portion of the site. These activities include management of the forested areas for timber production and harvesting of hay fields. Recreational facilities in the undeveloped portion of the site include a fitness trail, softball field, and a picnic pavilion for employee use. Employees are permitted to fish and hunt in designated areas on the CFFF property (Westinghouse, 2012a).

The CFFF is bounded by private property owners to the east, south, and west. Manufacturing facilities are located about 0.5 km (0.3 mi) from the site boundary, at its nearest point. Farms, single-family dwellings, and light commercial activities are located chiefly along nearby highways. South Carolina Electric and Gas recently constructed a new commercial electrical substation on approximately 2.8 ha (7 ac) along the northwest border of the CFFF property on land purchased from Westinghouse (Westinghouse, 2012a).

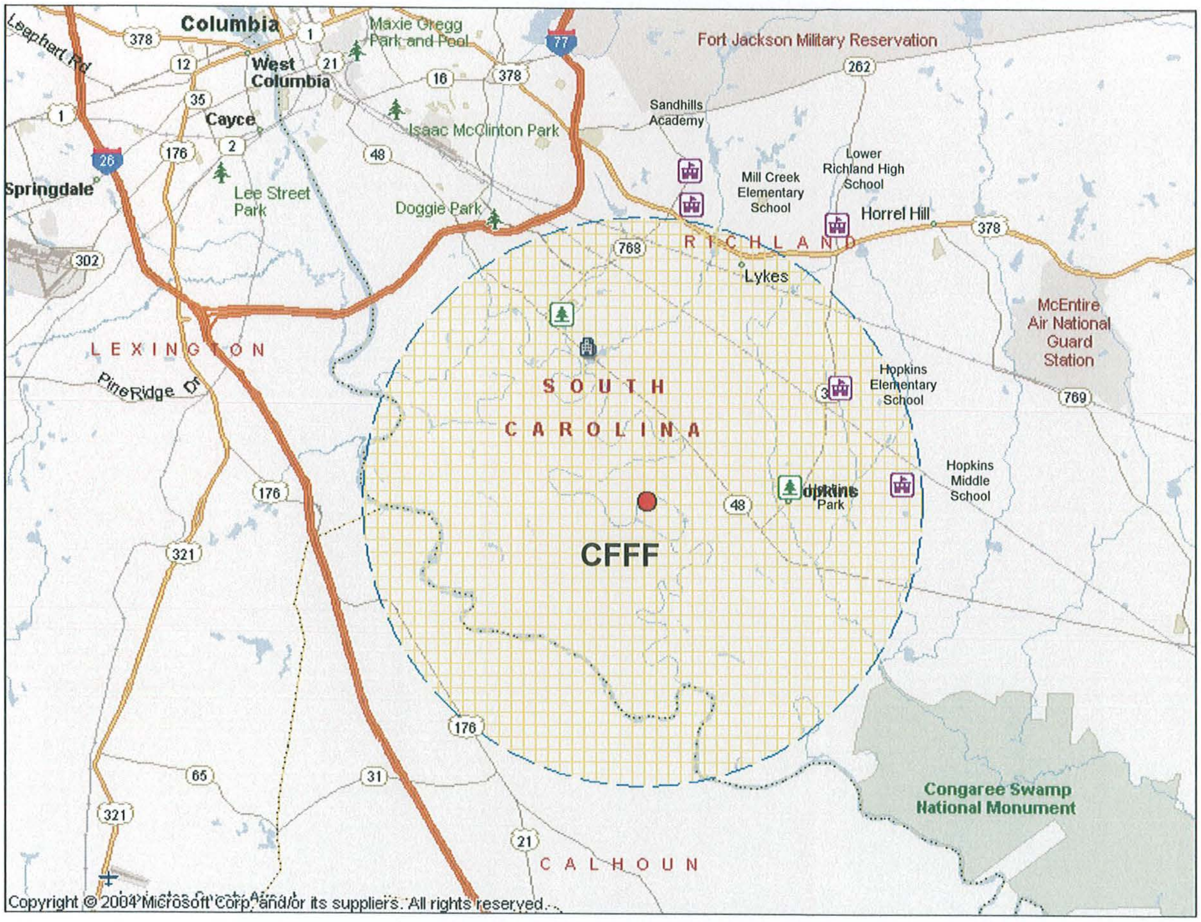
3.1.1 Manufacturing

Except for the DAK Americas (formerly Carolina Eastman) plant, which lies 7.6 km (4.75 mi) directly west of the CFFF, all firms with five or more employees were within the 180º sector north of the plant site (Westinghouse, 1983). Those facilities with potential significant atmospheric or aquatic effluent loads with which the CFFF effluents could interact include the DAK Americas plant (man-made production fibers), Nephron Pharmaceuticals (eye drop medications, respiratory medicine, vaccines and injectable drugs-site currently under construction) Wallace Concrete Products (manhole production), and Schneider Electric (industrial motor control production), and Amazon Distribution Center.

3.1.2 Agriculture

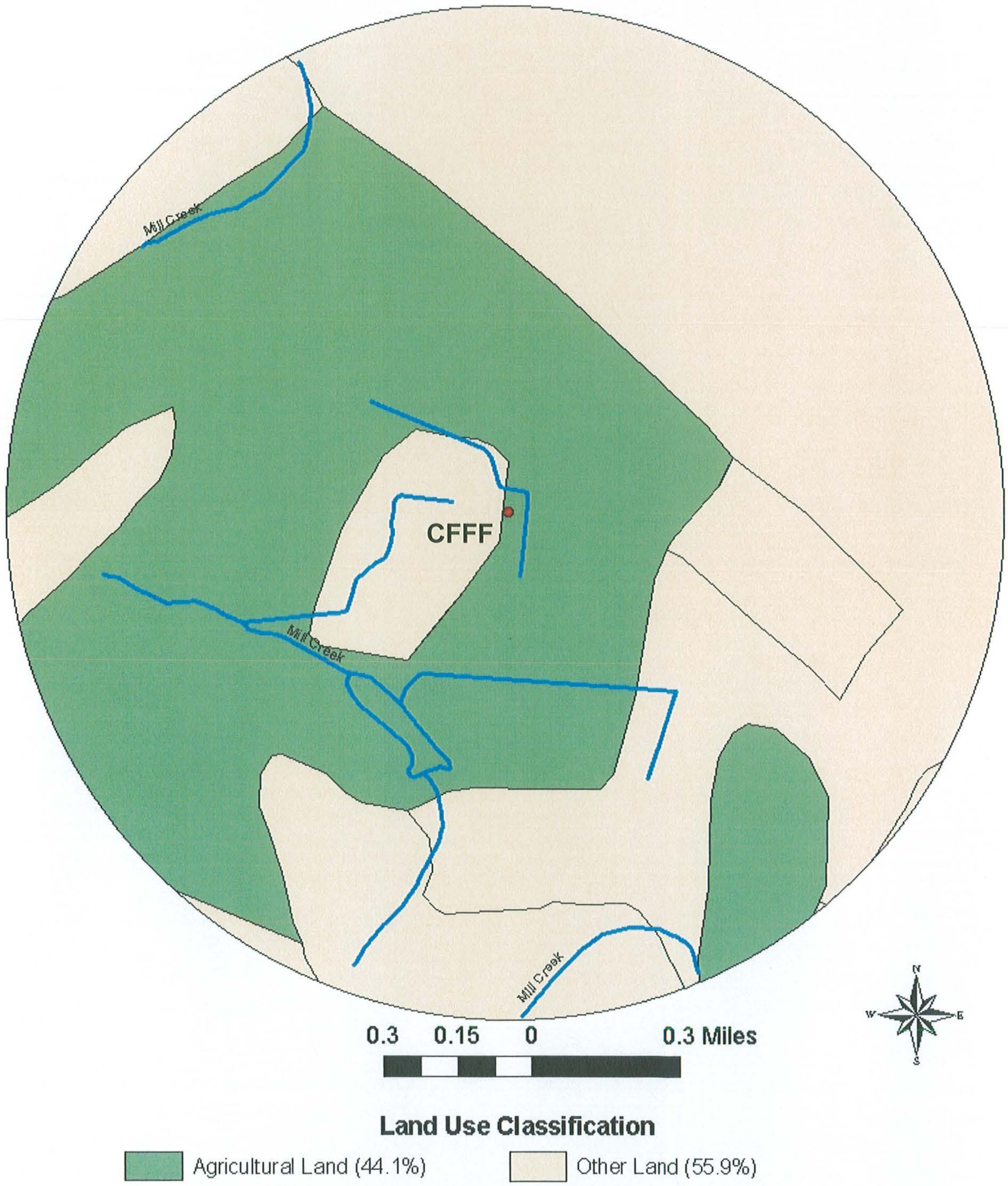
Agricultural land occupies about 20 percent of the land area within an 8-km (5 mile) radius of the CFFF, primarily in the northern and eastern portions of the study area. Crops include soybeans, corn, hay, cotton, wheat, and oats. Pecan groves are present to the east (Westinghouse, 1985).

Only one dairy farm is operating within the study areas: McGregor's Dairy, 7.7 km (4.8 mi) north-northeast of the CFFF. In 1983, this dairy had about 150 milk cows. No other important crop or livestock production appears to occur in the study area (Westinghouse, 1983).



Source: Westinghouse, 2008b

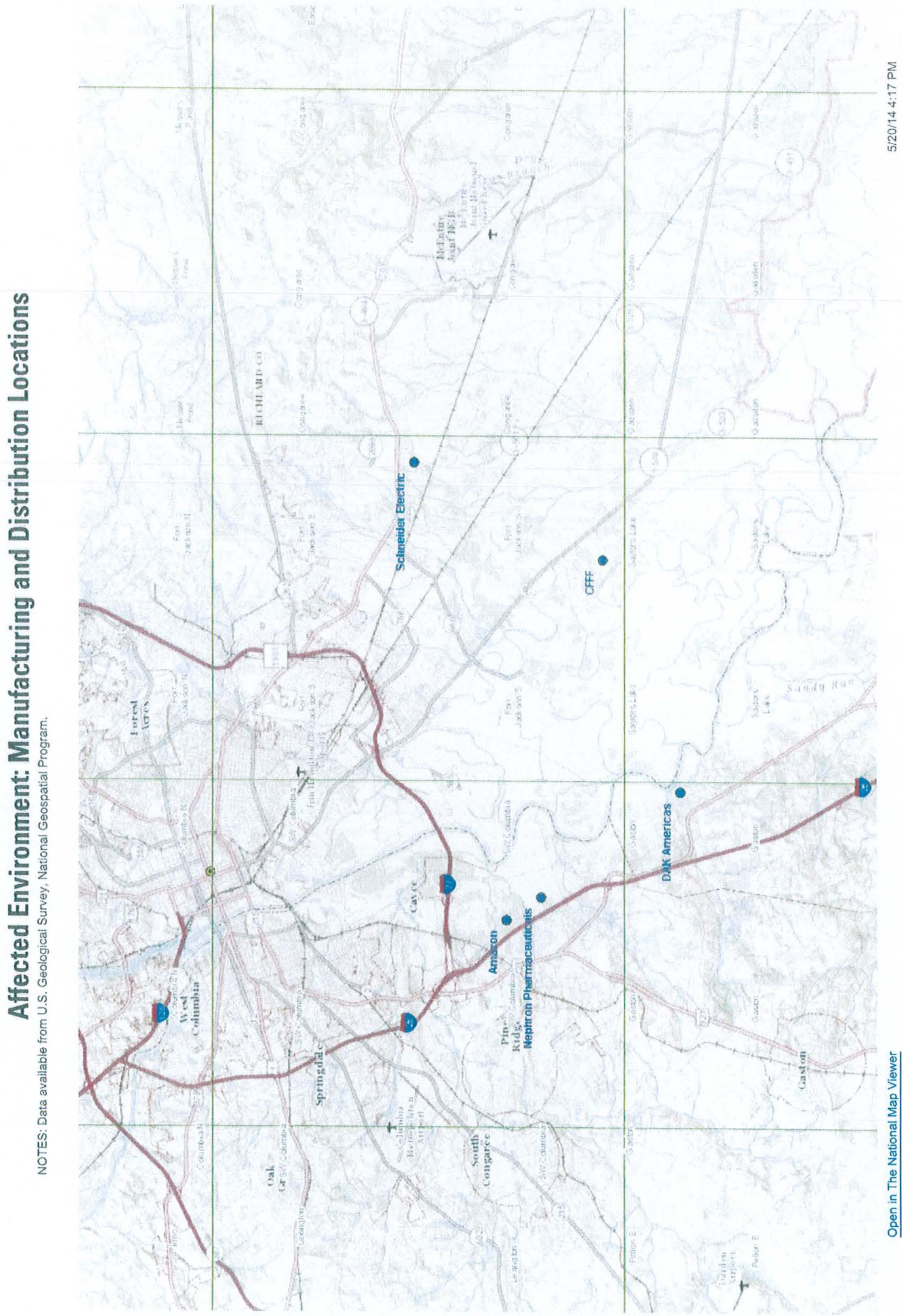
Figure 3.1-1 Land Use Features within 5 Miles of the CFFF



Source: Westinghouse, 2012a

Figure 3.1-2 Land Use Within 1.6 km (1 mi) of the CFFF

Figure 3.1-3 Affected Environment: Manufacturing and Distribution Locations



3.1.3 Undeveloped Nonagricultural Land

Forest or swamp forest cover 70 percent of the land in the study area. Extensive forests and swamps lie along the Congaree River west and south of the plant. Water tupelo-sweet gum forest dominates the better-drained sites, whereas the driest sites in the area may be dominated by loblolly pine and hardwoods (oak species, red maple, yellow poplar, etc). (Westinghouse, 1983)

The Congaree River Swamp is an 8,500-ha (21,000 ac) forested swamp lying along the Congaree River about 8.5 km (4 mi) southeast of the site. The southeast area of this swamp has been named as a national park. Its forests have been largely undisturbed for over 200 years. This area represents a rare remnant of previously extensive southern-river floodplain forests, but also contains several of the largest trees of their species. (Westinghouse, 1983)

3.1.4 Nearby Military Installations and Airports

There are two major military installations in the Columbia area: (1) Fort Jackson U.S. Army Base, located approximately 11 km (7 mi) north of the CFFF site, and (2) McEntire Air National Guard Station (ANGS), located approximately 10 km (6 mi) northeast of the CFFF site. Fort Jackson has a heliport and McEntire ANGS has an airport and heliport.

Airports within a 32-km (20-mi) radius of the CFFF site include: Columbia Metropolitan Airport; Columbia Owens Downtown Airport; Lexington County Airport (in Gaston); Corporate Airport and Eagles Nest – Fairview Airpark (both in Pelion); Alan's Airport and Do-Little Field Airport (both in St. Matthews); and McEntire ANGS. Several hospitals, businesses, and government agencies in the Columbia area own heliports, including Providence Hospital, Palmetto Richland Hospital, Lexington Medical Center, South Carolina Pipeline, South Carolina Law Enforcement Division, Fort Jackson U.S. Army Base, and McEntire ANGS (Westinghouse, 2012a).

3.1.5 Nearby Schools and Churches

Of the schools near the CFFF, there are only two schools within a 8 km (5-mile) radius. Figure 3.1-3 identifies nearby schools and their location relative to the CFFF. Table 3.1-1 provides information about schools near CFFF. Two churches, both of which are approximately 6 km (4 mi) to the southeast, also lie within the 8-km (5-mi) radius of the site.

Table 3.1-1 Schools Near the CFFF Site

School	Grades	Enrollment[1]	Location
Hopkins Elementary	PK-5	334	6.4 km (4 mi) NE
Hopkins Middle School	6-8	530	7.4 km (4.6 mi) NE
Lower Richland High School	9-12	1,188	9.5 km (5.9 mi)NE
Mill Creek Elementary School	PK-5	380	8.5 km (5.3 mi) NNE
Sandhills School (private)	1-12	75	9.5 km (5.9 mi) NNE

[1] Enrollment data taken from 2013 SC Annual School Report Card Summary. Current for 2013 and personal phone call by D. Joyner to Sandhills School.

Source: Westinghouse, 2012a

3.1.6 Parks

The Congaree National Park is located just over 8 km (5 mi) to the southeast of the CFFF (see Figure 3.1-1). Originally designated as the Congaree Swamp National Monument in 1976, the area was designated as a National Park by the U.S. National Park Service in November 2003. The park covers an area of 8,984 ha (22,200 ac). The Congaree National Park preserves the last significant (and largest intact) tract of old-growth bottomland hardwood forest in the U.S. and North America, and contains one of the tallest deciduous forests in the world, including numerous national and state champion trees. Its wetlands are widely acknowledged to be the most outstanding example of the Southern bottomland hardwood ecosystem left in the world, providing a habitat for diverse populations of flora and fauna. The park is designated as an International Biosphere, a Globally Important Bird Area, and a National Natural Landmark (Westinghouse, 2012a).

There are also two public parks located within a 8-km (5-mile) radius of the CFFF: Bluff Road Park, located approximately 7.6 km (3.5 mi) north just off Bluff road (SC 48) and Hopkins Park, located approximately 4.0 km (2.5 mi) east off Lower Richland Blvd (SC 37) (see Figure 3.1-1) (Westinghouse, 2012a).

3.1.7 Other Land Use

There are no hospitals within a 8 km (5-mile) radius of the CFFF site. The Alvin S. Glenn (Richland County) Detention Center is located 8 km (5 mi) north of the CFFF site, just off Bluff Road (SC 48) (Westinghouse, 2012a).

3.2 Transportation

Columbia and the surrounding area contain a well-developed and maintained system of interstate, regional and local highways that provide easy year-round access. Three interstate highways serve Columbia. The CFFF site can be accessed by state highway SC 48. Although CSX Transportation, Incorporated (CSX), operates two rail lines close to the CFFF site, there are no rail lines or spurs on the Westinghouse property.

A well-developed and maintained system of interstate, regional and local highways provide easy, year-round access for commuter, business, and freight traffic to the Columbia area. Three interstate highways run through the Columbia area, I-20, I-26, and I-77. Interstate 20 (which runs east to west from Florence, SC, to Augusta, GA) is approximately 22.4 km (14 mi) north of the CFFF. Interstate 26 (which runs northwest to southeast from Spartanburg to Charleston) is slightly more than 12.8 km (8 mi) west of the CFFF. Interstate 77 (which runs from I-26 south of Columbia to Charlotte, NC) is approximately 9.6 km (6 mi) to the northwest. The plant is located just off of SC 48. Other major roads in the vicinity of the CFFF site include US- 21 [11.2 km (7 mi.) west], US 76/378 [about 9 km (5 mi) north], and SC 37 (Lower Richland Blvd.), which is approximately 2.4 km (1.5 mi) to the southeast. Two rail lines in the vicinity of the CFFF site are both operated by CSX, which are about 6.4 km (4 mi) and 9.0 km (5 mi) northeast, respectively (Westinghouse, 2004, 2012a).

The primary highway supporting traffic into and out of the site is SC 48. The South Carolina Department of Transportation (SC-DOT) provides annual average daily traffic (AADT) counts by highway and highway segment (SC-DOT, 2008). The AADT count during 2007 for that portion of SC 48 between Secondary State Highways (S) 87 and S 734 (along which is the site) was 4,400 vehicles per day.

3.3 Geology and Soils

3.3.1 Regional Geology

The area surrounding the CFFF site is just south of the Fall Line zone and the northwestern edge of the Coastal Plain Province. The terrain is characterized by low to moderate hills and gently rolling lowlands. Small streams in the area are for the most part dendritic, but the larger streams such as the Congaree River are better developed in a direction perpendicular to the strike of the underlying Tuscaloosa formation. The CFFF site lies in the flood plain of the Congaree River. Within the Congaree River flood plain are small dendritic streams that feed into the Congaree River, such as Mill Creek.

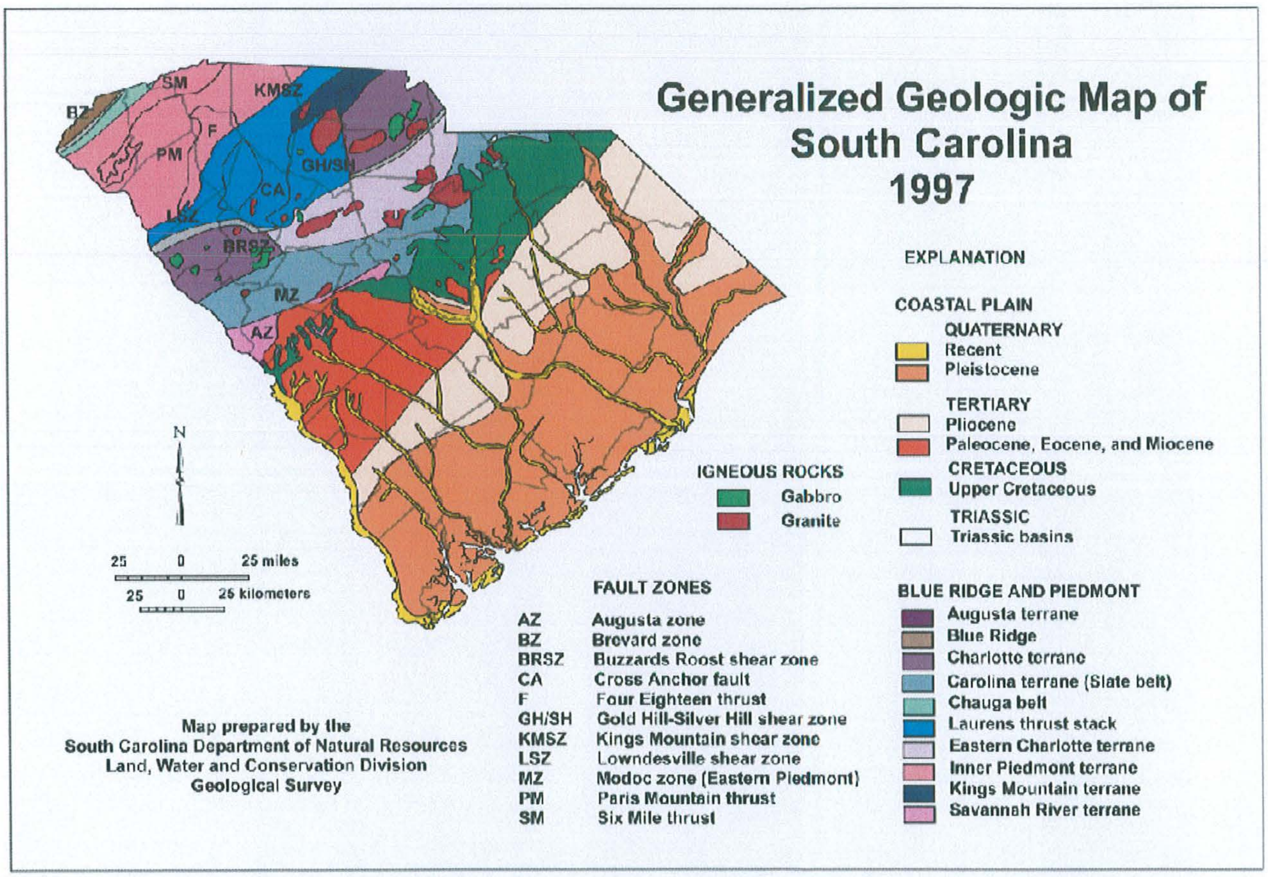
A generalized geologic map of SC is presented in Figure 3.3-1 (Westinghouse, 2012a). The Coastal Plain is composed of sediments that range in age from Late Cretaceous to recent. These sediments consist of unconsolidated sand, clay, gravel, and limestone that have been deposited on the beveled surface of the Piedmont province rocks. The formations exposed in Richland, Lexington, and Calhoun counties are described below. Coastal Plain deposits are generally the result of sediments left from the rising of sea level. The contact between rocks of the Piedmont province and the Coastal Plain dips approximately 6 m per km (30 ft per mi) towards the Atlantic coast.

The oldest formation of the Coastal Plain is the Late Cretaceous Tuscaloosa Formation. The Tuscaloosa Formation typically consists of arkosic sands and gravels interbedded with clays that were deposited in a nonmarine environment. These deposits are the result of the erosion and subsequent deposition of Piedmont rocks. The Tuscaloosa Formation is very thin near Columbia and gradually thickens to more than 244 m (800 ft) in the south coastal area.

The next oldest formation of the Coastal Plain is the Late Cretaceous Black Creek Formation, which consists of gray to black laminated clay and micaceous sands that were deposited in a marine environment. This formation marks the onset of the sea-level rise that resulted in the deposition of sediments of marine origin. The formation has an average dip of about 4 m per km (23 ft per mi) to the south-southeast and is approximately 183 m (600 ft) thick near the coast.

Overlying the Late Cretaceous units is the Black Mingo Formation at the base of the Tertiary units. The Black Mingo Formation is Paleocene to Eocene in age. It is a laminated sandy shale with layers of clay and sand that was deposited in a marine environment. Deposited on the Black Mingo Formation is the Santee Limestone Formation of Eocene age. The Santee Limestone is a white to yellow fossiliferous limestone that was deposited in a restricted marine environment.

The next oldest unit is the Barnwell Formation of Eocene age, which was also deposited in a marine environment. It consists of fine- to coarse-grained massive red sandy clay and clayey sand with minor ferruginous sandstone layers 2.54 cm to 0.9 m (1 in. to 3 ft) in thickness. Overlying the Barnwell Formation are Quaternary alluvial and fluvial deposits that fill present day stream and river channels (Westinghouse, 2012a).



(Map prepared by the South Carolina State Geological Survey, 1997)
Source: Westinghouse, 2012a

Figure 3.3-1 Generalized Geologic Map of South Carolina

3.3.2 Site Geology and Soils

The CFFF site is situated on a shelf to the northeast of the Congaree River, just off SC Highway 48. The average elevation of the Congaree River flood plain at the site is 34 m (110 ft) above MSL. The CFFF site elevation ranges from 34 to 35 m (110 - 115 ft) (above MSL) on the southwest portion of the site, around Mill Creek and Sunset Lake, to 41 to 43 m (136 - 140 ft) (above MSL) on the northeast portion of the site, around the main manufacturing building, tank farm, lagoons, and parking lots (Westinghouse, 2012a).

The CFFF site is situated on approximately 73.2 m (240 ft) of undisturbed and unconsolidated post-Triassic Coastal Plain sediments. Bedrocks of the area are primarily metamorphic gneisses and schists with some local granite intrusions. The bedrock has weathered in-place to form the overburden soils. The upper soils are the most highly weathered and are often composed of silty clays or clayey silts. With depth, these upper materials transition into less cohesive silty sands and sandy silts with varying mica content. Weathering processes, which are dependent on fractures in the rock, changing groundwater levels, rock mineralogy, and other factors, result in an extremely variable surface of the bedrock. Also, hard rock layers and boulders are often encountered within the overburden soil or the weathered rock. Soil borings in the area indicate 2.5 to 12.7 cm (1 to 5 in) of topsoil under which are very loose to dense clayey sands extending from depths of 2.4 to 5.2 m (8 to 17 ft). Under this are loose to very loose sands and soft to very hard clays. The maximum boring was terminated at a depth of 30 m (100 ft) (Westinghouse, 2012a).

The onsite sediments are described in Table 3.3-1.

Table 3.3-1. Description of the Coastal Plain Sediments at the CFFF[1]

Formation Name	Age	Thickness	Description
Okefenokee	Plio-Pleistocene	6.1 to 12.2 m [20-40 ft]	Stratified but poorly sorted mixture of clay, silt, sand, and gravel
Black Mingo	Paleocene to Eocene	22.9 m [75 ft]	Upper clay unit and lower sand unit
Tuscaloosa	Late Cretaceous	38.1 to 44.2 m [125-145 ft]	Multicolored clay interbedded with fine to coarse grade sand

[1] Source: Westinghouse, 2004.

The nature of the soils in the area is important in the assessment of CFFF buildings. The soils must support structures or holding ponds, soil permeability must not allow effluents to escape into aquifers, and the engineering designs for new facilities must overcome any limits of the soils with respect to swelling, shrinking, corrosion, and flooding potential.

The CFFF plant is situated on soils in the Craven-Leaf-Johns association. Craven series soils are moderately well drained, gently sloping Coastal Plain soils. The surface layer is loam, with a clay subsoil that is very firm and slowly permeable. Clayey sediments interfinger with sand lenses below. The Leaf association is poorly drained with a silt-loam surface and silty-clay subsoil (NRC, 1985).

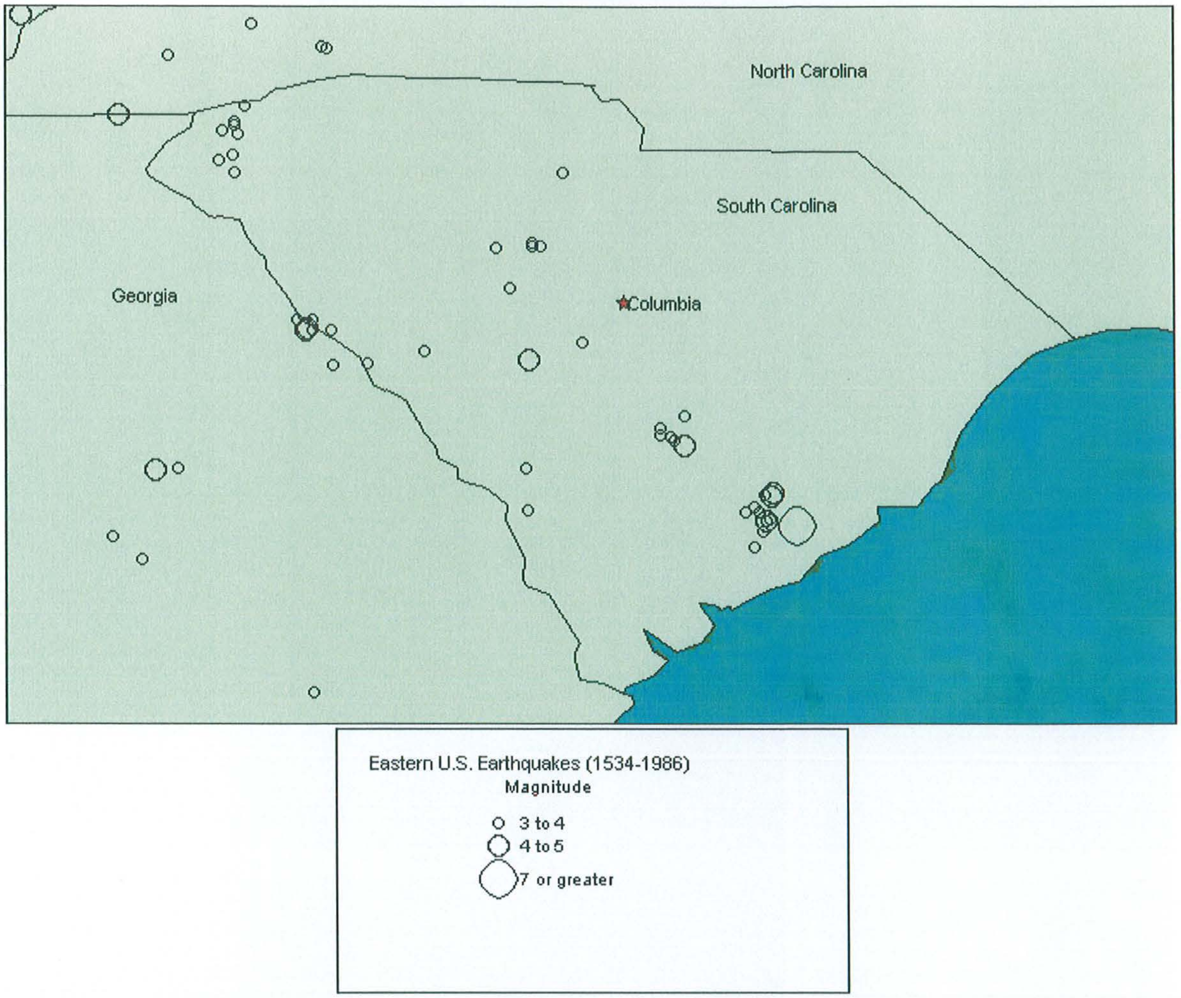
Both soil series in the association have certain limitations. They are highly corrosive to both concrete and steel, and they have high shrink-swell potential and severe wetness and flooding potential because of seasonal high water tables (NRC, 1985).

3.3.3 Regional Seismicity

The CFFF site region is not located near an active tectonic margin and is generally thought to be in a region of low seismicity within the Coastal Plain physiographic province. The 1997 Uniform Building Code (UBC) places the Columbia, SC, area within seismic zone 2A, an area for moderate earthquake activity compared to other areas of the United States. Figure 3.3-2 shows the locations of past earthquakes in the SC region having intensities of 3.0 or greater on the Richter scale. No significant earthquake has been centered nearer than about 37 km (20 mi) from the site (Westinghouse, 2012a).

The nearest major seismic source is the Charleston seismic zone, located approximately 145 km (90 mi) southeast of the CFFF site (Westinghouse, 2004). Seismicity in the area is characterized by small-magnitude background earthquakes and very infrequent moderate-to-large intra-continental earthquakes. One of the largest known intra-continental earthquakes in North American history was the 1886 Charleston earthquake, located approximately 145 km (90 mi) southeast of Columbia. This earthquake was felt in an area of about 5.2 million km^2 (2 million mi^2) that includes locations as far away as Boston, Milwaukee, New York City, Cuba, and Bermuda. A maximum intensity of X on the Modified Mercalli (MM) intensity scale has been estimated for the event (see Figure 3.3-3). (Note: The magnitude of this earthquake in Charleston is estimated as greater than 7.0 on the Richter scale.) Damage from the earthquake was reported in Columbia, where MM intensities of VII–VIII were observed. The most serious damage was reported in Charleston and nearby cities, where an estimated $23 million damage was incurred and some 60 people died. Damage in Charleston was generally correlated with local soil conditions, with structures constructed on filled-in areas experiencing the greatest damage. Cracks, sand boils, and bent railroad tracks were also observed in the epicentral region (Westinghouse, 2012a).

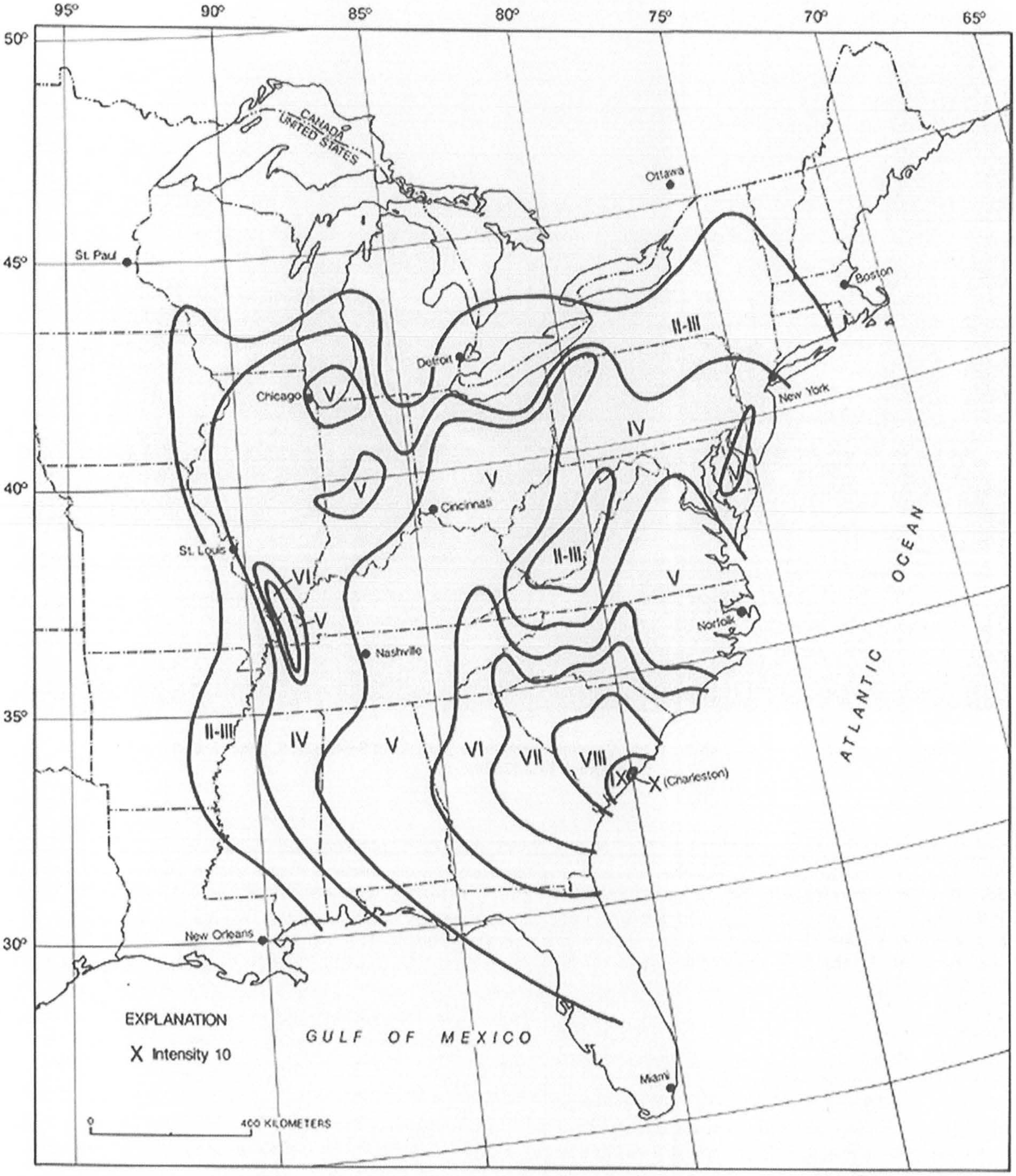
The majority of the earthquakes occurring in the coastal plain of SC are associated with the Charleston seismic zone. This earthquake activity is confined to a relatively localized area that corresponds to a discrete structural anomaly possibly related to zones of weakness in the basement rocks. Studies based on seismicity recorded by regional seismic networks indicate that zones of high seismicity correspond to the intersection of a northwest-trending zone of weakness and northeast-trending Triassic basins. There is little evidence, however, to support a sub-horizontal shear of this size. The reactivation of northwest-dipping or southeast-dipping Triassic tensional faults by present-day northwest-oriented compressional stresses has also been suggested to explain current seismic activity in the Charleston seismic zone. Although the reactivation of some northeast-trending structures in the Cenozoic has generally been recognized, the age of the lateral movement is not well known or defined. In summary, there is no conclusive evidence that would suggest that the seismogenic structure responsible for the earthquake activity in the Charleston seismic zone extends to the northwest as far as Columbia.



Source: Westinghouse, 2012a

Figure 3.3-2 Earthquakes of Magnitude 3.0 or Greater in the South Carolina Region

In addition to the Charleston earthquake of 1886, other significant historic earthquakes include the Summerville earthquake of June 12, 1912, and the Union County earthquake of January 1, 1913. The 1912 Summerville earthquake caused some damage to chimneys and had an estimated maximum MM intensity of VII. An MM intensity VI was observed at Charleston, about 32 km (20 mi) southeast of the earthquake. The earthquake was felt in an area of about 90,650 km^2 (35,000 mi^2) that included the cities of Brunswick and Macon, GA; Greenville, SC; and Wilmington, NC. The 1913 Union County earthquake occurred about 128 km (80 mi) northwest of Columbia and was felt over an area of 111,370 km^2 (43,000 mi^2). In the city of Union, cracks appeared in many brick buildings and many chimneys were damaged. The maximum MM intensity of the 1913 Union County earthquake was estimated at VI–VII (Westinghouse, 2012a).



Source: Westinghouse, 2012a

Figure 3.3-3 Isoseismal Map of the August 31, 1886 Charleston, SC, Earthquake

The nearest earthquake to the CFFF site occurred on April 20, 1964. The event had a magnitude of 3.5 and was located about 24 km (15 mi) southwest of Columbia, SC. The earthquake was felt in Fairfield, Florence, Lexington, and Richland counties. Vibrations were reported to last over 4 minutes. The maximum reported MM intensity was V in Gaston and Jenkinsville, where a trembling motion was felt by all residents. Intensity IV was reported in Cayce, Irmo, and Lexington accompanied by rumbling noises but no damage. Intensity I-III was reported at Columbia, Florence, and Pelion (Westinghouse, 2012a).

Ground motion maps prepared by the U.S. Geological Survey (USGS) indicate that the greatest earthquake hazard in South Carolina is associated with the Charleston seismic zone. The expected peak ground acceleration (PGA) calculated for South Carolina by the USGS National Seismic Hazard Mapping Project (USGS 2002). The largest PGA values (greater than 0.8 g) in South Carolina are predicted in the area just north of Charleston. For the area near Columbia, a PGA of about 0.3 g would be expected for a 2,475-yr return period. For shorter return periods, the expected ground motions are less.

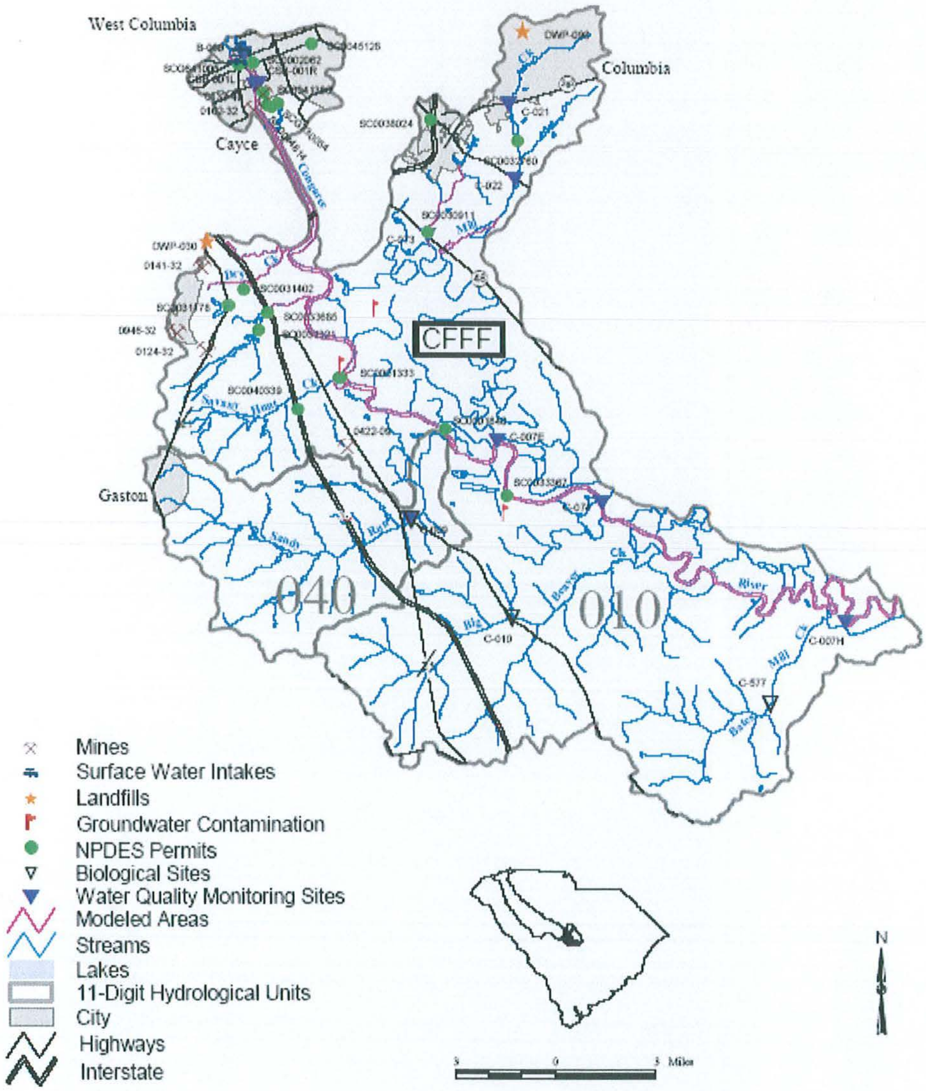
In conclusion, the CFFF site area is in a region of relatively low seismicity in the Coastal Plain physiographic province of the southeastern U.S. The nearest significant seismic source is located about 145 km (90 mi) to the southeast in the Charleston seismic zone. The site would thus be primarily affected by seismic vibrations from large distant earthquakes such as the Charleston earthquake of 1886 (Westinghouse, 2012a).

3.4 Water Resources

The CFFF site lies within the Congaree River Basin, shown in Figure 3.4-1, encompasses 1,782 km^2 (688 mi^2) and 7 watersheds. The Congaree River Basin is mainly located within the Sandhills region of SC, but extends to the Upper Coastal Plain region near its confluence with the Catawba-Santee Basin. The watershed specific to the CFFF is the Congaree River watershed, which occupies 56,746 ha (140,217 ac) of the Sandhills and Upper Coastal Plain regions. The Congaree River is formed by the confluence of the Broad and Saluda rivers in the capitol city of Columbia. The CFFF site is located approximately 19 km (12 mi) southeast of this confluence. The CFFF discharge permit is NPDES No. SC0001848.

Land cover for the Congaree River watershed falls within the following categories:

- Urban land: 9.45 percent
- Agricultural land: 9.45
- Scrub/shrub land: 2.22
- Barren land: 0.09
- Forested land: 61.76
- Forested wetland (swamp): 16.45
- Water: 2.79



Source: Westinghouse, 2012a

Figure 3.4-1 Congaree River and Sandy Run Watershed Map

In addition to the Congaree River, other important surface water features in the vicinity of the CFFF include Sunset Lake, which is located 0.4 km (0.25 mi) south of the CFFF's main manufacturing building (see Figure 2.1-3). The lake originally consisted of two parts, Upper Sunset Lake and Lower Sunset Lake. The two were connected by a channel passing under a causeway. The upper lake was fed by Mill Creek, a tributary of the Congaree River, flowing through the channel into the lower lake. The upper lake is now a swamp area, and the lower lake is still present as an open water area of approximately 3.24 ha (8 ac). Mill Creek continues as an outflow from Sunset Lake, meandering through the swampland, discharging into the Congaree River 4.0 km (2.5 mi) downstream from the CFFF site. Other water bodies near the

CFFF site include Adams Pond, approximately 4.8 km (3 mi) to the northwest, Goose Pond, approximately 4.8 km (3 mi) to the south, and Myers Creek, which lies approximately 3.2 km (2 mi) to the east (Westinghouse, 2012a).

Both groundwater and surface water are derived from precipitation within the region. Rainfall totals for SC were below normal for the years 1999, 2000, and 2001. Near Columbia, the rainfall totals were 41 percent, 27 percent, and 39 percent below normal for the 3 years, respectively, resulting in poorly sustained base flows. In the area around Columbia, the average annual precipitation is approximately 1.2 m (48 in.) per year.

Rainfall intensity values (in inches per hour) provided by the SC Department of Transportation for Columbia are given in Table 3.4-1.

Table 3.4-1 Rainfall Intensity for the Columbia Area

Frequency (yr)	Rainfall Intensity (inches per hour)[1]		
	tc=5 min	tc=10 min	tc=15 min
2	5.44	4.82	4.32
5	6.42	5.66	5.05
10	7.12	6.25	5.57
25	8.16	7.14	6.34
50	9.03	7.86	6.96
100	9.88	8.57	7.57

[1] tc: time duration
Source: Westinghouse, 2012a

3.4.1 Groundwater

Groundwater levels reflect both the climatic conditions of the region and groundwater withdrawals. The groundwater level also depends upon a combination of the permeability of the strata and the hydraulic head. The inclination of different strata may cause the water tables in the surrounding area to be higher or lower than the water level in the nearby Congaree River since movements of the groundwater are, to a large extent, independent of the river. Because of friction encountered by water in its passage through pervious strata, the water table is not always horizontal. Several water tables may exist at different levels, separated by impermeable strata.

Groundwater in the Upper Coastal Plain occurs in multiple aquifer systems, mostly under artesian or confined conditions. These aquifers consist of rocks of Paleozoic age and are typically composed of one to several layers of eastward thickening, permeable sands or limestone split by discontinuous, clay-rich materials. Confining units, consisting of clay-rich sediments, exist above and below the aquifers. Aquifers found below the site are the Peedee, Black Creek, and Upper Cape Fear with the Peedee aquifer being the closest to the surface. In large portions of these aquifers, sands and limestone materials are so well connected that withdrawals cause pressure reductions many miles from the pumping center.

The upper Cape Fear aquifer is present in the western portions of the Coastal Plain at elevations of 90 m to 463 m (295 ft to1,519 ft), with an average elevation of 76.2 m (250 ft). The upper Cape Fear aquifer varies in thickness from 2.4 to 203 m (8 to 665 ft) thick and averages 46 m (50 ft) thick. The aquifer is composed of very fine to coarse sands and occasional gravels. Wells typically yield 757 to 1,514 L/min [200 to 400 gpm].

The Black Creek aquifer is present in the central and southwestern portions of the Coastal Plain. Elevations range from 97 m to 368 m (317 ft to 1207 ft) and average 41 m (135 ft). The thickness of the Black Creek aquifer ranges from 5 -296 m (18 to 972 ft) thick, averaging about 53 m (175 ft) thick. The aquifer is composed of very fine to fine "salt and pepper" sands. Wells typically yield 757 to 1514 L/min (200 to 400 gpm).

The Peedee aquifer is present in the central to southeastern portion of the Coastal Plain at an average elevation of -9 m (–30 ft). Elevations vary from 35 m to -243 m (114 ft to –796 ft). The thickness of the aquifer ranges from 2.4 m to 123 m (8 to 404 ft) thick and averages about 41 m (135 ft) thick. The Peedee aquifer is composed of fine to medium sand, and wells typically yield up to 757 L/min (200 gpm).

The average depth to the water table in the area of the CFFF site is approximately 4.6 m (15 ft). Since September 1971, the highest mean water level recorded was at 0.9 m (2.95 ft) below the land-surface datum, and the lowest level was 13.66 m (44.83 ft) below the land-surface datum.

Groundwater flows from the structural highs toward the structural lows. Both the topography and the drainage around the site are controlled by the local geologic structure. Thus, regional groundwater movement to the site area is determined by the geologic structure. The slope of the terrain in the immediate area of the site has a range of 0 to 15 percent.

3.4.2 Surface Water

Stream flow for the Congaree River is dependent on recharge within the Broad River and Saluda River basins. Regulation of stream flow at the Parr Shoals Dam on the Broad River and the Lake Murray Dam (also called the Saluda Dam) on the Saluda River confines the watersheds in these basins that are relevant to stage levels for the Congaree River near the CFFF site. The Broad River represents 70 percent of the Congaree River watershed while the Saluda River represents 30 percent.

The Broad River Basin encompasses 21 watersheds and 5,833 km^2 (2,252 mi^2) within SC. The watershed that has the most influence on stage levels for the Congaree River near the CFFF site is the Broad River watershed. The Broad River watershed is located in Richland, Newberry, and Fairfield counties and consists primarily of the Broad River and its tributaries from the Parr Shoals Dam to its confluence with the Saluda River. The watershed occupies 65,125 ha (160,922 ac) of the Piedmont region of SC.

The Saluda River Basin covers 6,524 km^2 (2,519 mi^2) and contains 21 watersheds with geographic regions that extend from the Blue Ridge Province to the Piedmont Province. The watershed that has the most influence on stage levels for the Congaree River is the Saluda River watershed. The Saluda River watershed is located in Lexington and Richland counties and consists primarily of the Saluda River and its tributaries from the Lake Murray Dam to its confluence with the Broad River. The watershed occupies 26,521 ha (65,535 ac) of the Piedmont and Sandhill regions of SC.

Surface runoff at the CFFF site flows into the Congaree River to the west and into Mill Creek to the east.

For stream gauging stations, rating tables giving the discharge for any stage are prepared from stage-discharge relation curves. The accuracy of stream flow data depends primarily on (1) the stability of the stage-discharge relation or, if the control is unstable, the frequency of discharge measurements and (2) the accuracy of observations of stage, measurements of discharge, and interpretations of records.

The gauging station at Columbia (station number 02168500) is located 2.25 km (1.4 mi) downstream of the confluence of the Saluda and Broad rivers. This gauging station has a drainage area of 20,231 km^2 (7,850 mi^2) and has systematic stream flow records from 1892 to present. Table 3.4-2 gives recent data for the Congaree River from the Columbia gauging station. (Note: SC experienced a severe, multi-year drought from June 1998 to August 2002. Thus, the average stream flows for these years are lower than normally expected.)

Table 3.4-3 lists significant floods that have affected the area of central SC.

Table 3.4-2 Stream Flow Rates for the Congaree River

Year	Average Discharge (cfs)	Average Stage (ft)
1998	5,423.52	4.01
1999	4,736.25	3.71
2000	4,520.83	3.63
2001	3,473.28	3.87
2002	4,805.91	5.82
2003	12,342.65	6.32

Source: Westinghouse, 2012a

Table 3.4-3 Significant Flood Events

Date	Area Affected	Recurrence Interval (yr)	Remarks
August 1908	Statewide	2 to >50	Most extensive flood in state; rainfall of 12 in. in 24 hr
August 1928	Statewide	2 to >50	Bridges destroyed, roads and railways impassable
August 1940	Statewide	2 to >100	About 34 deaths and $10 million in damage
September 1945	Statewide	2 to >100	One death and $6-7 million in damages
September 1959	Eastern, southern and central SC	10 to 20	Hurricane Gracie; 6 to 8 in. of rainfall; seven deaths and $20 million in damages
October 1990	Central SC	Unknown	Tropical storms Klaus and Marco; five deaths and 80 bridge failures

Source: Westinghouse, 2012a

The CFFF site lies within the flood basin of the Congaree River. High water on the Congaree River usually occurs in late winter and early spring, but flooding is possible any time of the year. Flooding occurs as the water level in the river rises above the flood stage and creeks and gullies begin to flow backward into the floodplain. Flood stage for the Congaree River at the Carolina Eastman gauging station, located in close proximity to the CFFF, is 35 m (115.0 ft) (above MSL). The CFFF site elevation ranges from 35 to 34 m (115 - 122 ft) (above MSL) on the southwest portion of the site, around Mill Creek and Sunset Lake, to 41 to 44 m (136 - 140 ft) (above MSL) on the northeast portion of the site, around the main manufacturing building. The main manufacturing building's floor sits at 43 m (142 ft) (above MSL). Impacts of flooding at the Carolina Eastman gauging station have been documented for the following water levels (see Table 3.4-4):

Table 3.4-4 Flood Potential of Various Water Levels

Water Level	Flood Potential
35.0 m (115 ft)	Low lying and flood prone areas become flooded. The Congaree National Park begins to flood.
36.7 m (119 ft)	Extensive flooding occurs in the Congaree National Park. Farmland downstream from Columbia becomes flooded.
37.4 m (123 ft)	Lowlands and swampland around the Carolina Eastman Chemical Plant become flooded.
37.8 m (124 ft)	Farmland along the Congaree River from Columbia to St. Matthews becomes flooded. Extensive flooding occurs on the Carolina Eastman facility.
38.1 m (125 ft)	Extensive flooding occurs downstream from the Carolina Eastman Chemical Plant.
38.4 m (126 ft)	Extensive swampland around St. Matthews becomes flooded.

Source: Westinghouse, 2012a

Table 3.4-5 shows the crest history that has been documented for the Congaree River at the Carolina-Eastman gauging station.

Table 3.4-5 Recorded Crest History for the Congaree River

Date	Water Level (ft above MSL)
10/12/1976	126.95
02/27/1979	126.90
03/16/1975	126.00
04/03/1973	125.40
02/06/1998	124.40

Source: Westinghouse, 2012a

Estimates of flood discharge range from 269,000 to 319,000 cfs. The base flood discharge is 269,000 cfs when applying a historical adjustment to the 1908, 1928, and 1930 floods and 280,000 cfs when only the 1908 flood is adjusted for historical information. Using the entire record, station skew and adjusting the 1908 flood for historical information results in a base flood discharge of 319,000 cfs.

One of the major issues in the determination of base flood discharge for the Congaree River is the degree of regulation afforded by Lake Murray. Peak flows from 1892 to 1929 are unregulated and those from 1930 to present have some unknown degree of regulation. Theoretically, the upper and lower bounds of the base flood discharge along the Congaree River would vary with the degree of regulation. The lower bound corresponds to the condition where Lake Murray prevents upstream floodwater from entering the Congaree River, and the upper bound indicates when Lake Murray does not attenuate any of the floodwater entering the Congaree River. However, water in Lake Murray is used for hydropower generation, and there is no dedicated flood storage. Operation of Lake Murray changed in about 1956. The median lake level ranged from 101 to 107 m (333 to 351) ft between 1931 and 1955 and from 107 to 109 m (350 to 358 ft) between 1956 and 1999. The higher reservoir levels after 1955 suggest that Lake Murray has a lower potential for attenuating flood discharges. Alternative independent analyses using gauging-station data upstream and downstream of the dam indicate that the Saluda River base-flood discharge could be reduced by as much as 50 percent by Lake Murray. Since the Saluda River represents 30 percent of the Congaree River watershed, the degree of regulation of the base-flood discharge for the Congaree River has been estimated as approximately 15 percent.

3.4.3 Water Quality

The groundwater in the vicinity of the property owned by Westinghouse is contaminated with nitrates, fluoride, and volatile organics from spills, leaks, and unknown sources. The facility was in a groundwater remediation phase from 1998-2011. Surface waters affected by the groundwater contamination are Sunset Lake and the unnamed tributaries and wetlands draining into Mill Creek. See Section 4.4 for additional details.

The information given in this section below was taken from a study of ground water and surface water quality conducted by SC-DHEC (SC-DHEC, 1998). Water quality is characterized by measuring concentration and mass transport of a wide range of dissolved and suspended constituents, including nutrients, major bios, dissolved and sediment-bound heavy metals, common pesticides, and inorganic and organic forms of carbon. Water quality problems include fecal coliform bacteria contamination, low dissolved oxygen concentrations, high suspended-solid levels, and elevated nutrient levels. Runoff from urban areas can transport trace elements and synthetic organic compounds that can seriously affect the quality of water and wildlife habitats in the receiving streams. Enrichment by nitrogen and phosphorus causes algae in lakes and rivers to increase dramatically, which reduces the concentrations of dissolved oxygen and adversely affects fish and other aquatic biota. Pesticides and nutrients can contaminate both surface and groundwater. Sedimentation impairs municipal, industrial, and recreational water use; destroys aquatic habitat; and adversely impacts desired aquatic organisms. Sediment erosion due to past and present land use increases turbidity, which in turn increases the cost of treatment for public consumption and industrial use, deposits silt in reservoirs, covers fish spawning beds, and causes aesthetic problems. Examples of nonpoint sources of pollution include agricultural runoff, urban runoff, construction, mining, and silviculture.

At the confluence of the Broad River and the Saluda River, aquatic life uses are not supported due to occurrences of copper and zinc in excess of the aquatic life acute standards, including a high concentration of zinc measured in 1995, 1966, and 1997. In addition, a very high concentration of cadmium and chromium was measured in 1995, as well as a significant decreasing trend in dissolved oxygen concentration and pH. Methylene chloride was detected in the water column in 1997. In sediments, a very high concentration of copper was measured in 1994, and very high concentrations of zinc were measured in 1993 and 1994. Benzo(a)pyrene, chrysene, fluoranthene, phenanthrene, pyrene, and benzo(a)anthracene (all polycyclic aromatic hydrocarbons) were detected in the 1994 sediment sample. Isophorone was detected in the 1995 sediment sample and metabolites of DDT were detected in the 1994 sample. Although the use of DDT was banned in 1973, it is very persistent in the environment. Significantly decreasing trends in 5-day biochemical oxygen demand, total phosphorus, and total nitrogen concentration suggest improving conditions.

Mill Creek is a blackwater system characterized by naturally low pH and dissolved oxygen concentrations. Aquatic life and recreational uses are fully supported along the downstream portion of Mill Creek and decreasing trends in 5-day biochemical oxygen demand and total phosphorus concentrations suggest improving conditions.

3.4.4 Water Use

More than 95 percent of the water needs in SC are supplied by surface waters. The SC Water Resources Commission reported a state water use of 206 mgd (million gal per day) of ground water and 5,570 mgd of surface water in 1980. The total gross water withdrawal of 5,780 mgd represented a 96 percent increase from the previous decade. About 7.6 percent of this water was consumed and not returned to available supplies. Gross water use is projected to increase by 48 percent to 8,550 mgd by the year 2020, with 484 mgd projected to correspond to groundwater and 8,060 mgd to surface water.

Major industrial water users in the Congaree watershed include the Carolina Eastman Company and the CFFF.

The major public uses correspond to water supplies, recreation, and waste disposal. Major municipal water users in the Congaree watershed include the City of Columbia Metro Plant, the

City of Cayce Main Plant, and the East Richland County Public Service District Gills Creek Plant (Westinghouse, 2012a).

3.5 Ecological Resources

This section describes the Ecological resources in the vicinity of CFFF, which include terrestrial (Section 3.5.1), aquatic (Section 3.5.2) and threatened and endangered species (Section 3.5.3). A list of flora and fauna observed on and near the CFFF observed during a 1974 site survey is found in Appendix C, Table C-1 (Westinghouse, 1975).

3.5.1 Terrestrial

The Richland County area is located within the Southeastern Mixed Forest ecoregion, dominated by oak-hickory forests with the understory communities consisting of small tree species such as *dogwood (Cornus* spp.*),* red bud (*Cercis canandensis*), cedar (*Juniperus* spp.), and American holly *(Ilex opaca).* Common shrub species found within the understory include common poison ivy (*Toxicodendron radicans*) (Westinghouse, 1975).

The undeveloped portions of the CFFF property are composed of open field dominated by grasses, forbs, and succesional hardwood forests. Climax woodland areas are located along Mill Creek and east of the property boundary.

Located approximately 8 km (5 mi) southeast of CFFF is the Congaree National Park. Initially designated as the Congaree Swamp National Monument in 1976, the U.S. National Park Service designated the 9,000-ha (22,200-ac) area as a national park in 2003. The park is widely acknowledged to be one of the best examples of Southern bottomland hardwood ecosystem remaining in the world. Its wetlands provide a habitat for a diverse population of flora and fauna. The park is designated as an International Biosphere, a Globally Important Bird Area, and a National Natural Landmark (Westinghouse, 2004). According to the National Park Service (2006), there are approximately 294 species known or likely to occur within the park, including more than 34 mammal species, 32 reptile species, 29 amphibian species, 109 invertebrate species, and approximately 90 bird species. The Congaree National Park contains approximately 90 tree species with many holding state record sizes.

3.5.2 Aquatic

There are approximately 40 species of fish that are known or likely to live within the Congaree River System. The southern portion of CFFF lies within the flood plain of Mill Creek, a tributary to the Congaree River. Fish common to the area include largemouth bass, bluegill, catfish, and shiners.

3.5.3 Threatened and Endangered Species

Three federal-listed plant species have the potential to be found within Richland County: the endangered Smooth cornflower (*Echinacea laevigata),* the endangered Roughleaved loosestrife (*Lysimachia asperulifolia*), and the endangered Canby's dropwort (*Oxypolis canbyi*). In addition, two federal-listed animal species have the potential to be found within Richland County, the threatened Bald eagle *(Haliaeetus leucocephalus*) and the endangered Red-cockaded woodpecker (*Picoides borealis*). A listing of State and Federal rare, threatened, and endangered species found in Richland County is included in Appendix C, Table C-2 (SC-DNR, 2006).

3.6 Meteorology, Climatology, and Air Quality

This section describes the regional climatology (Section 3.6.1), site meteorological conditions (Section 3.6.2) and baseline air quality conditions (Section 3.6.3). The regional climatology and the local time-varying meteorological conditions determine the atmospheric transport and diffusion processes at and near the site.

3.6.1 Climatology

The climatology of the Richland County area was characterized based on data collected by the National Weather Service (NWS) station at the Columbia Metropolitan Airport, located about 19 km (12 miles) west-northwest of the site. Richland County experiences four distinct seasons due to its mid-latitude location area and resulting solar radiation effects. The weather in the region provides a temperate climate, with high relative humidity, moderate rainfall, moderate winds, and normal diurnal temperature changes. Temperatures are moderate throughout the year, averaging in the 18° C (65° F). Winters are mild, with cold waves rarely accompanied by temperatures of -18°C (0°F) or below. Freezing temperatures (0°C [32°F]) or less occur on an average of 77 days per year, generally during the months of November through March. Rainfall is moderate throughout the year as are winds. Storms bring severe weather in the form of lightning, hail, and tornadoes.

An overall summary of the climatology data for Richland County is presented in Table 3.6-1 (SC-DNR, 2006b). Temperature, precipitation, relative humidity, wind, and the frequency of certain climatology events are reported. Details are discussed below.

Table 3.6-1 Richland County Climatology Summary

Temperature, 1930 – 2000			
Annual Average Maximum	75.6 °F	(24.2 °C)	
Annual Average Mean	64.8 °F	(18.2 °C)	
Annual Average Minimum	54.0 °F	(12.0 °C)	
Highest Maximum	109 °F	(43.0 °C)	June 29, 1998
Lowest Minimum	1°F	(-17.0 °C)	January 21, 1985
Precipitation, 1930 – 2000			
Annual Average Rainfall	45.29 in.	(115 cm)	
Greatest Daily Rainfall	7.66 in	(19.5 cm)	August 16, 1949
Wettest Year	74.49 in	(189.2 cm)	1959
Driest Year	7.11 in	(69 cm)	1933
Mean Snowfall	1.2 in	(3.0 cm)	
Largest Snowfall	15.7 in	(40 cm)	1973
Severe Weather (Jan 1950 through July 2005)			
Event	**Quantity**	**Injuries**	**Deaths**
Tornadoes	32	20	1
Wind Events[1]	58	6	1
Hail Events[2]	57	0	0
Lightning Events	10	3	0
Hurricanes	0	0	0

[1] Thunderstorm winds exceeding 50 kt (57.6 mph)
[2] Hail diameter = 1 in. or greater
Source: SC-DNR, 2006b

3.6.1.1 Winds

The Appalachian Mountains have an influence on wind in the Columbia area, which changes seasonally. Winds are predominantly from the southwest, but are also prevalent from the northeast in autumn and to a lesser extent in the winter. Wind speeds for all months generally range between 9.6 and 16 km/hr (6 and 10 mi per hr [mph]), averaging 11 km/hr (7 mph). Directions change with the season as listed below:

- Spring: Southwest
- Summer: South and Southwest
- Autumn: Northeast
- Winter: Northeast and Southwest

The NCDC database for wind events exceeding 50 kt for Richland County identifies 58 total events between January 1, 1950, and July 31, 2005 (NCDC, 2006). During that time one death and three injuries were recorded. Most of the recorded high wind events (from thunderstorms) in Richland County had wind gusts less than 60 kt; the highest recorded high wind gust was 103 kt.

3.6.1.2 Precipitation

Precipitation occurs in the Richland County area in the form of rain, snow, and sleet with occasional instances of hail. Normal monthly precipitation ranges from a low of 7.3 cm (2.88 in.) in November to a high of 14.1 cm (5.54 in) in July. Normal annual precipitation is 123 cm (48.27) in. Table 3.6-2 shows the normal precipitation for each month based on data recorded between 1971 and 2000 at the Columbia Metropolitan Airport.

Probable maximum 5-th percentile precipitation is 157 cm (61.69 in.) annually. On a monthly basis, the greatest probable maximum expected quantity of rain is 44.3 cm (17.46 in.) occurring in the month of July. Table 3.6-3 shows probable maximum precipitation for each month.

Table 3.6-2 Normal Precipitation Amounts by Month for Richland County

Normal Precipitation (cm [in.])												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
11.8	9.75	11.7	7.37	8.05	12.7	14.1	13.7	10.0	7.34	7.31	8.59	122.6
(4.66)	(3.84)	(4.59)	(2.90)	(3.17)	(4.99)	(5.54)	(5.41)	(3.94)	(2.89)	(2.88)	(3.38)	(48.3)

Source: Westinghouse, 2012a

Table 3.6-3 Maximum Precipitation Amounts by Month for Richland County

Maximum Precipitation (5-th percentile, cm [in.])											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
23.5	20.6	27.7	17.4	20.0	37.6	44.4	30.0	20.0	29.6	15.9	21.7
(9.26)	(8.10)	(10.9)	(6.85)	(7.88)	(14.8)	(17.5)	(11.8)	(7.86)	(11.7)	(6.26)	(8.54)

Source: Westinghouse, 2012a

Although rain dominates the precipitation type and amount, Richland County does experience winter precipitation in the form of snow, sleet and freezing rain during the months between November and March, and there have been rare instances of snow in April. Measurable snowfall occurs one to three times during the winter, but seldom do accumulations remain on the ground very long. The average annual snowfall for Richland County totals 3 cm (1.2 in.). The maximum 24-hr snowfall recorded for the county between the years 1948 and 2002 was 41 cm (16 in.), occurring on February 9 and 10, 1973. Over all of South Carolina, the record total snowfall for any month was 86 cm (34 in.), recorded in Pickens County. Table 3.6-4 shows state snowfall statistics on a monthly basis.

Table 3.6-4 Number of Snowfall Days for South Carolina (by Month)

Number of Days with Snowfall Exceeding Threshold													
Threshold	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
> 0.25 cm (0.1 in.)	4.4	4.8	2.4	0.4	0	0	0	0	0	0	1.8	3.3	17.1
> 2.54 cm (1.0 in)	2.1	2.0	1.0	0.2	0	0	0	0	0	0	0.7	1.4	7.4

Source: Westinghouse, 2012a

3.6.1.3 Severe Weather

Severe weather occurs in SC occasionally in the form of violent thunderstorms, common in the summer months. The summer weather is dominated by a maritime tropical air mass known as the Bermuda high that brings warm moist air inland from the ocean. As the air comes inland, it rises, forming thunderstorms that bring precipitation, high winds, hail, and lightning. Tornadoes have occurred in the area, but are relatively rare. Although hurricanes are common in the Atlantic Ocean and coastal regions of the state, it is rare for a hurricane to maintain hurricane-force winds inland.

Thunderstorms

Thunderstorms occur an average of 53 days per year, 60 percent of those occurring in the summer months of June, July, and August. Damaging hail is infrequent, and thus is not a significant damaging factor. The NCDC database for hail of at least 1 in. in diameter identifies 57 events between January 1, 1950, and July 31, 2006 (NCDC, 2006). No injuries or deaths were shown to have resulted from hail. Lightning events during thunderstorms have resulted in three injuries and no deaths during the period measured between 1994 and 2006. Damaging lightning events consisted of ten recorded occurrences between January 1, 1950, and July 31, 2006. Thunderstorms with high winds can also result in damage. Thunderstorms with high wind events consisted of 58 recorded occurrences between January 1, 1950, and July 31, 2006 resulting in one death and six injuries. Most of the recorded high wind events had wind gusts less than 60 kt; the highest recorded high wind gusts were 103 kt.

Tornadoes

Tornadoes averaged 11 per year in SC during the 40-year period from 1950 to 1989 (NOAA, 2006 and NCDC, 2006). They occur between February and September, peaking during May and August. The NCDC database for tornadoes in the Richland County area showed that a total of 32 has been recorded between January 1, 1950, and July 31, 2005, resulting in 17 injuries and one death. Tornadoes with a rating on the Fujita Tornado Damage Scale between F2 and F5 are considered "strong violent" (Lott, et al., 2000). An increase in the Fujita Tornado Damage Scale number represents an increase in tornado severity. Of the 32 recorded tornadoes, 14 had a rating of F0 (40-72 mph winds), 11 were F1 (73-112 mph), and 7 were F2 (113-157 mph).

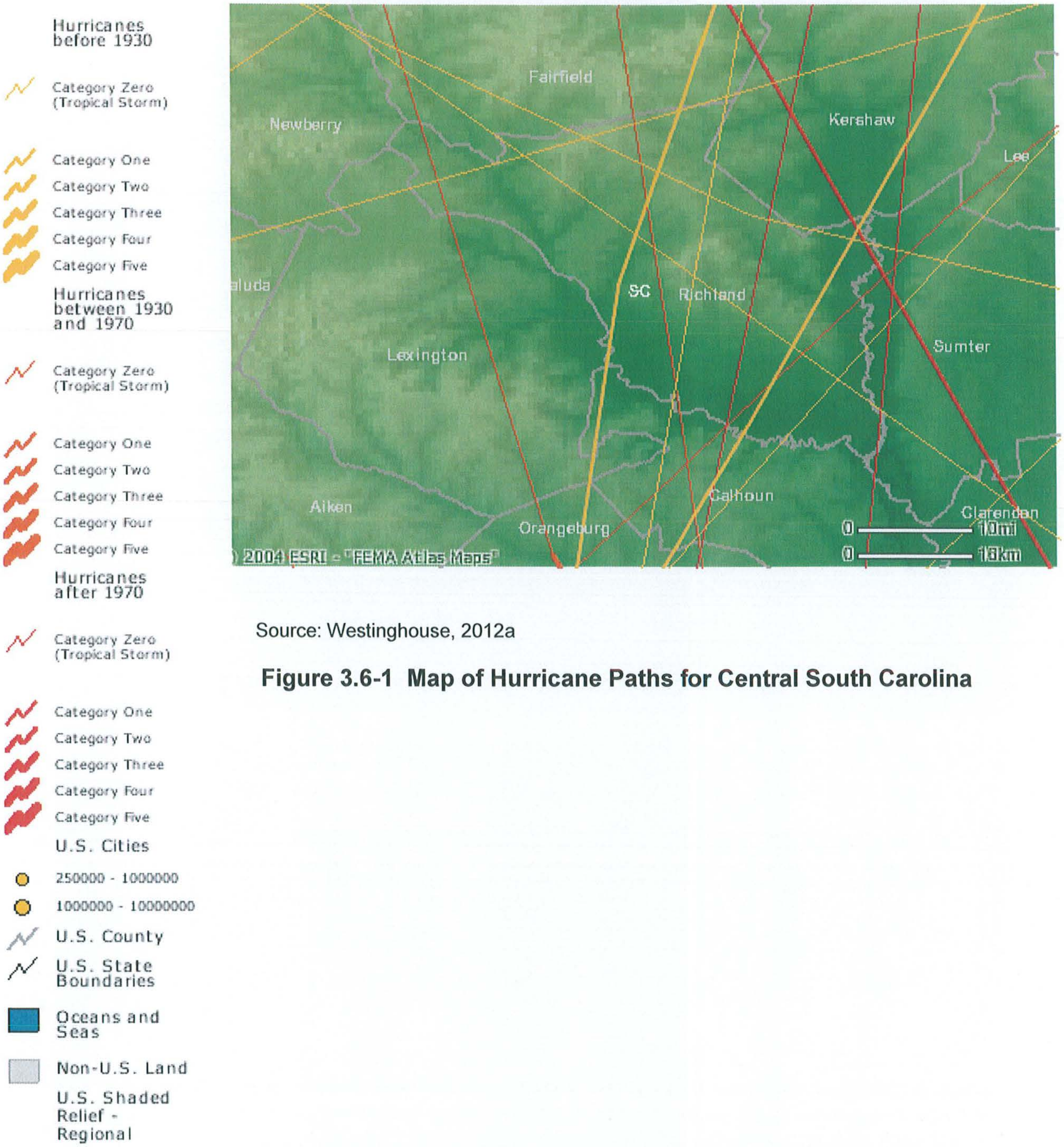
<u>Hurricanes</u>

Hurricanes impact the state of South Carolina at a rate of approximately one every 2 years. Most affect only the coastal areas. Those that do come inland decrease in intensity by the time they reach the Columbia area, becoming tropical storms. A query of the NCDC's database for hurricane landfall in South Carolina between January 1, 1995, and July 31, 2005 (database limitation) showed 30 hurricanes or tropical storms impacted the state with the coastal counties primarily effected (NCDC, 2006). Maps showing hurricane paths for central South Carolina show that two tropical storms and a category 1 hurricane have passed through Richland County since 1930 (see Figure 3.6-1) (NGS, 2006).

3.6.2 Meteorology and Atmospheric Dispersion

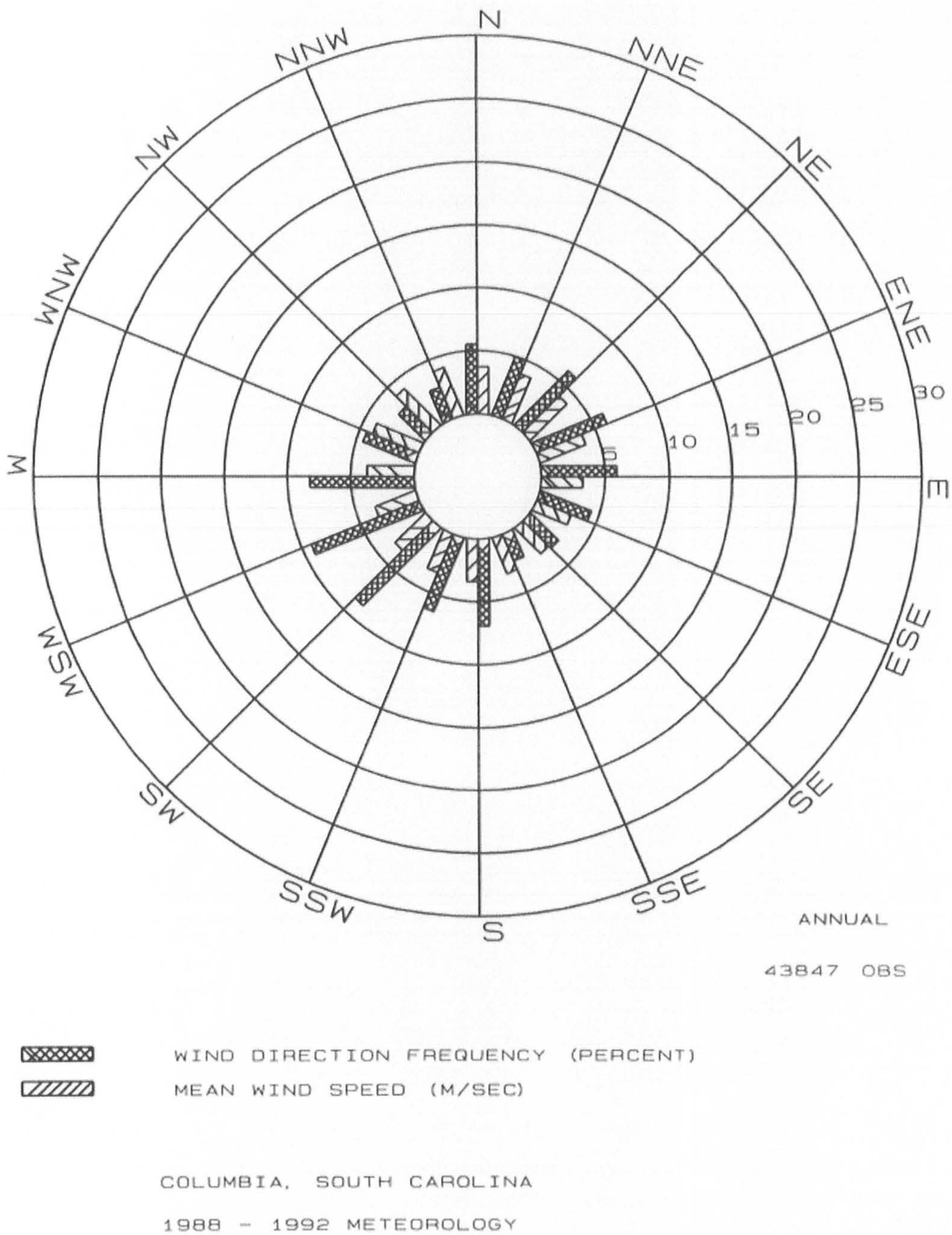
Annual and seasonal summaries of the joint frequency distribution for wind speed, wind direction and atmosphere stability were obtained from onsite meteorological data (August 1, 1972, through July 31, 1973) (Westinghouse, 1975, 1983). The data indicate that stable conditions exist 47 percent of the time, neutral conditions occur about 43 percent of the time, and unstable atmospheric conditions prevail about 10 percent of the time. The seasonal distribution of the various stability classes indicates that the greatest number of hours of unstable conditions (310 hr) and slightly stable conditions (412 hr) occurs in the spring; in winter, the most hours (1047) of neutral conditions occur; and, in summer, the most hours (984) of stable conditions occur.

A wind rose for the Columbia Metropolitan Airport for the period 1988 through 1992 is presented in Figure 3.6-2. A previous comparison of the annual wind rose for the site (August 1, 1972, to July 31, 1973), and the wind rose for the Columbia Metropolitan Airport (1948-1981) showed they were in reasonably good agreement (Westinghouse, 1975, NRC, 1985). Estimates of atmospheric dispersion factors (X/Q) on an annual basis at downwind distances up to 80 km (50 miles) in 16 compass directions at the 15-m (50-ft) level are provided in Table 3.6-5. These factors were calculated using the Gaussian plume model and diffusion coefficients for Pasquill-



Source: Westinghouse, 2012a

Figure 3.6-1 Map of Hurricane Paths for Central South Carolina



Source: NCDC, 2006

Figure 3.6-2 Annual Wind Rose for Columbia, SC Metropolitan Airport (1988 to 1992)

Table 3.6-5 Annual Average Atmospheric Dispersion Factors (X/Q) by Distance and Direction from CFFF

Direction	X/Q (s/m^3) at the Indicated Downwind Distance (km [mi])					
	0.8 (0.5)	1.6 (1.0)	3.2 (2.0)	4.8 (3.0)	6.4 (4.0)	8.0 (5.0)
N	$6.93x10^{-6}$	$2.12x10^{-6}$	$7.04x10^{-7}$	$3.80x10^{-7}$	$2.47x10^{-7}$	$1.78x10^{-7}$
NNE	$7.49x10^{-6}$	$2.28x10^{-6}$	$7.59x10^{-7}$	$4.10x10^{-7}$	$2.67x10^{-7}$	$1.93x10^{-7}$
NE	$1.13x10^{-5}$	$3.45x10^{-6}$	$1.15x10^{-6}$	$6.26x10^{-7}$	$4.09x10^{-7}$	$2.96x10^{-7}$
ENE	$8.81x10^{-6}$	$2.70x10^{-6}$	$9.01x10^{-7}$	$4.89x10^{-7}$	$3.19x10^{-7}$	$2.31x10^{-7}$
E	$1.23x10^{-5}$	$3.79x10^{-6}$	$1.27x10^{-6}$	$6.92x10^{-7}$	$4.52x10^{-7}$	$3.27x10^{-7}$
ESE	$9.62x10^{-6}$	$2.95x10^{-6}$	$9.88x10^{-7}$	$5.36x10^{-7}$	$3.50x10^{-7}$	$2.53x10^{-7}$
SE	$7.25x10^{-6}$	$2.23x10^{-6}$	$7.45x10^{-7}$	$4.04x10^{-7}$	$2.63x10^{-7}$	$1.90x10^{-7}$
SSE	$6.41x10^{-6}$	$1.97x10^{-6}$	$6.61x10^{-7}$	$3.59x10^{-7}$	$2.34x10^{-7}$	$1.69x10^{-7}$
S	$5.84x10^{-6}$	$1.79x10^{-6}$	$6.02x10^{-7}$	$3.27x10^{-7}$	$2.14x10^{-7}$	$1.55x10^{-7}$
SSW	$7.50x10^{-6}$	$2.30x10^{-6}$	$7.71x10^{-7}$	$4.18x10^{-7}$	$2.73x10^{-7}$	$1.97x10^{-7}$
SW	$1.04x10^{-5}$	$3.20x10^{-6}$	$1.07x10^{-6}$	$5.83x10^{-7}$	$3.81x10^{-7}$	$2.75x10^{-7}$
WSW	$1.10x10^{-5}$	$3.37x10^{-6}$	$1.14x10^{-6}$	$4.19x10^{-7}$	$4.06x10^{-7}$	$2.94x10^{-7}$
W	$1.26x10^{-5}$	$3.87x10^{-6}$	$1.30x10^{-6}$	$7.11x10^{-7}$	$4.66x10^{-7}$	$3.39x10^{-7}$
WNW	$1.02x10^{-5}$	$3.13x10^{-6}$	$1.05x10^{-6}$	$5.75x10^{-7}$	$3.77x10^{-7}$	$2.74x10^{-7}$
NW	$9.59x10^{-6}$	$2.95x10^{-6}$	$9.89x10^{-7}$	$5.37x10^{-7}$	$3.50x10^{-7}$	$2.53x10^{-7}$
NNW	$7.85x10^{-6}$	$2.41x10^{-6}$	$8.08x10^{-7}$	$4.37x10^{-7}$	$2.85x10^{-7}$	$2.05x10^{-7}$

Direction	X/Q (s/m^3) at the Indicated Downwind Distance (km [mi])				
	16 (10)	32 (20)	48 (30)	64 (40)	80 (50)
N	$6.71x10^{-8}$	$2.71x10^{-8}$	$1.61x10^{-3}$	$1.12x10^{-8}$	$8.45x10^{-9}$
NNE	$7.29x10^{-8}$	$2.96x10^{-8}$	$1.77x10^{-3}$	$1.23x10^{-8}$	$9.32x10^{-9}$
NE	$1.13x10^{-7}$	$4.60x10^{-8}$	$2.76x10^{-3}$	$1.92x10^{-8}$	$1.45x10^{-7}$
ENE	$8.76x10^{-8}$	$3.53x10^{-8}$	$2.09x10^{-3}$	$1.45x10^{-8}$	$1.09x10^{-7}$
E	$1.25x10^{-7}$	$5.15x10^{-8}$	$3.11x10^{-3}$	$2.17x10^{-8}$	$1.65x10^{-7}$
ESE	$9.65x10^{-8}$	$3.93x10^{-8}$	$2.36x10^{-3}$	$1.64x10^{-8}$	$1.24x10^{-7}$
SE	$7.22x10^{-8}$	$2.92x10^{-8}$	$1.75x10^{-3}$	$1.21x10^{-8}$	$9.15x10^{-9}$
SSE	$6.43x10^{-8}$	$2.62x10^{-8}$	$1.57x10^{-3}$	$1.09x10^{-8}$	$8.26x10^{-9}$
S	$5.90x10^{-8}$	$2.41x10^{-8}$	$1.45x10^{-3}$	$1.01x10^{-8}$	$7.66x10^{-9}$
SSW	$7.50x10^{-8}$	$3.06x10^{-8}$	$1.83x10^{-3}$	$1.28x10^{-8}$	$9.65x10^{-9}$
SW	$1.05x10^{-7}$	$4.29x10^{-8}$	$2.58x10^{-3}$	$1.80x10^{-8}$	$1.36x10^{-8}$
WSW	$1.13x10^{-7}$	$4.69x10^{-8}$	$2.84x10^{-3}$	$1.99x10^{-8}$	$1.51x10^{-8}$
W	$1.30x10^{-7}$	$5.40x10^{-8}$	$3.27x10^{-3}$	$2.29x10^{-8}$	$1.74x10^{-8}$
WNW	$1.06x10^{-7}$	$4.36x10^{-8}$	$2.63x10^{-3}$	$1.84x10^{-8}$	$1.39x10^{-8}$
NW	$9.63x10^{-8}$	$3.92x10^{-8}$	$2.35x10^{-3}$	$1.64x10^{-8}$	$1.24x10^{-8}$
NNW	$7.74x10^{-8}$	$3.13x10^{-8}$	$1.87x10^{-3}$	$1.30x10^{-8}$	$9.77x10^{-9}$

Source: NRC, 1985

type turbulence. Because the CFFF effluent release points are generally lower than 2.5 times the height of adjacent solid structures, the release was conservatively assumed to occur at ground level, with credit for building wake effects. Using these assumptions, the annual average *X*/Q at the nearest residence (1000 m [3300 ft] northeast) is 7.67 x 10^{-6} s/m^3 and, at the nearest site boundary (550 m [1800 ft] north-northwest), is 1.54 x 10^{-5} s/m^3.

3.6.3 Air Quality

Air quality at CFFF is regulated for nonradiological and radiological emissions. Applicable Federal air pollution control regulations include 40 CFR Part 50, National Primary and Secondary Ambient Air Quality Standards; 40 CFR Part 61, National Emission Standards for Hazardous Air Pollutants; and 10 CFR Part 20, Standards for Protection Against Radiation . Nonradiological emissions at CFFF are regulated by the SC-DHEC.

The term "ambient air quality" refers to the atmospheric concentration of a specific compound (amount of pollutants in a specified volume of air) actually experienced at a particular geographic location that may be some distance from the source of the relevant pollutant emissions. Ambient air quality data generally are reported as a mass per unit volume (such as micrograms per cubic meter of air [μg/m^3]) or as a volume fraction (e.g., parts per million [ppm] by volume).

Air pollutants are often characterized as being "primary" or "secondary" pollutants. Primary pollutants are those emitted directly into the atmosphere (such as carbon monoxide, sulfur dioxide, lead, and particulates). Secondary pollutants are those formed through chemical reactions in the atmosphere (such as ozone and nitrogen dioxide). Atmospheric chemical reactions usually involve primary pollutants, normal constituents of the atmosphere, and other secondary pollutants. Meteorological conditions such as temperature, humidity, and the intensity of ultraviolet light can also play an important role in atmospheric chemistry.

3.6.3.1 National Ambient Air Quality Standards

Under the federal Clean Air Act, the U.S. Environmental Protection Agency (EPA) established National Ambient Air Quality Standards (NAAQS), which define the acceptable levels for six pollutants: nitrogen oxides, ozone, sulfur oxides, carbon monoxide, lead, and total suspended particles. Compliance is attained when pollutant concentration levels are lower than the established NAAQS standards. The pollutant concentration levels in Richland County are lower than the established NAAQS standards for all pollutants except ozone. Portions of Lexington and Richland Counties, including the area around CFFF, have exceeded the NAAQS ozone standard (Westinghouse, 2006c).

Compliance with the NAAQS in metropolitan areas is typically related to local area meteorology, transportation, and major permitted dischargers (such as coal burning) that affect the primary pollutants. The federal Clean Air Act requires the EPA to classify areas using these three designations:

- Attainment, which means the area meets the standards;
- Nonattainment, which means the area doesn't meet the standards; and
- Unclassifiable, which means there isn't enough data to classify the area under the new or revised standard.

EPA has designated all of South Carolina in attainment for all criteria air pollutants except for the 2008 8-hour ozone standard for which York County is "non-attainment" and the remainder of the state is "unclassifiable/attainment" (EPA 2012, SC-DHEC 2012). Future changes in the NAAQS could affect the region's attainment status.

The CFFF is located in rural southeast Richland County on the southeast edge of the Columbia Metropolitan Statistical Area (MSA) (Westinghouse, 2006c). Two of three SC-DHEC monitoring sites within the MSA are classified as "Attaining" (Westinghouse, 2006c). The CFFF is located proximal to the SC-DHEC Congaree Bluff sampling site. Westinghouse does not conduct on-site monitoring for ambient air quality. Compliance with air regulations is demonstrated by issuance of the SC-DHEC air permit and emissions modeling.

3.6.3.2 National Emissions Standards for Hazardous Air Pollutants

The National Emissions Standards for Hazardous Air Pollutants (NESHAP) regulates hazardous chemicals, which are usually associated with particular industrial sources or activities (NRC, 2007a). Nonradiological emissions at CFFF are regulated by the SC-DHEC under permit number 1900-0050-R1 (effective March 5, 2008). The CFFF permit addresses NAAQS pollutants, nitric acid, and opacity. The permit does not require monitoring. Instead, operating permit limits are based on process throughputs at rated capacities as outlined by the SC-DHEC in South Carolina Air Quality Control Regulation 61-62. Emission rates are calculated based on these throughputs. Details concerning the baseline CFFF nonradiological gaseous emissions are presented in Section 3.11.

Radiological emissions are regulated by NRC under 10 CFR Part 20 and by the EPA under 40 CFR Part 61. Westinghouse monitors radiological airborne discharges from 47 stacks and calculates an offsite dose from the combined emissions. As part of the environmental monitoring program, Westinghouse also monitors for the presence of radioactive material in ambient air at four onsite locations. Exposure calculations from the CFFF radiological gaseous emissions for baseline conditions are presented in Section 3.11.

3.7 Noise

Noise from the CFFF is not detectable at the site boundary (Westinghouse, 2006c; NRC, 2007a). The distance from the facility to the site boundary (0.5 km [0.3 mi]) helps mitigate offsite noise impacts.

3.8 Historic and Cultural Resources

The CFFF site is located near the Congaree River basin. Prehistoric inhabitants and historic Indian groups exploited the Congaree River region's diverse plant and animal resources. The Congaree Indians were a small tribe that farmed and built houses along the banks of the Congaree River next to other small Indian groups. Eventually the few remaining Congaree were assimilated into the Catawba tribe.

The National Register of Historic Places lists 11 prehistoric and historic sites located within an 8-km [5-mi] radius of the CFFF site (NRC, 2007a). None of these sites is located on the CFFF property. Six prehistoric mound sites are located on bluffs along the Congaree River in the Congaree Swamp National Park, and nine historic sites are located near the town of Hopkins, South Carolina (Westinghouse 2012a):

- Barber House – 19th century dwelling in Hopkins, SC
- Big Lake Creek Cattle Mound – 18th century feature in Hopkins, SC
- Brady's Cattle Mound – 18th century feature in Hopkins, SC
- Bridge Abutments – feature in Hopkins, SC
- Cattle Mound #6 – 18th century feature in Hopkins, SC
- Cook's Lake Cattle Mound – 18th century feature in Hopkins, SC
- Cooner's Cattle Mound – 18th century feature in Hopkins, SC
- Dead River Cattle Mound – 18th century feature in Hopkins, SC
- Dead River Dike – 18th century feature in Hopkins, SC

The South Carolina Department of Archives and History considers five other sites, located within 8 km (5 mi) of the CFFF, to have historical significance (Westinghouse, 2004):

- Raiford's Mill Creek (Mill Creek)
- Cabin Branch (John Hopkins, Jr. Plantation House)—circa 1786 dwelling
- Clayton House—1887 dwelling
- Chappell Cabin Branch (Hicks Plantation House and Garden)—1781 dwelling
- Hopkins Overseers' Dwellings—19th century dwelling

During a land sale and right of way issuance to South Carolina Electric and Gas, an onsite cemetery, known as the Denley Cemetery, was rediscovered by Westinghouse employees in 2003 on Westinghouse property 304 m (1,000 ft) southwest of the CFFF. The area, approximately 80 x 160 ft was fenced off. Shrubs were removed, and existing stones were maintained. The restoration was done by Westinghouse staff. The cemetery, which operated from about 1890 to 1940, is located on property that was once part of the Denley plantation. It contains over 100 grave sites of African-Americans (Westinghouse, 2006b, 2008a).

3.9 Visual/Scenic Resources

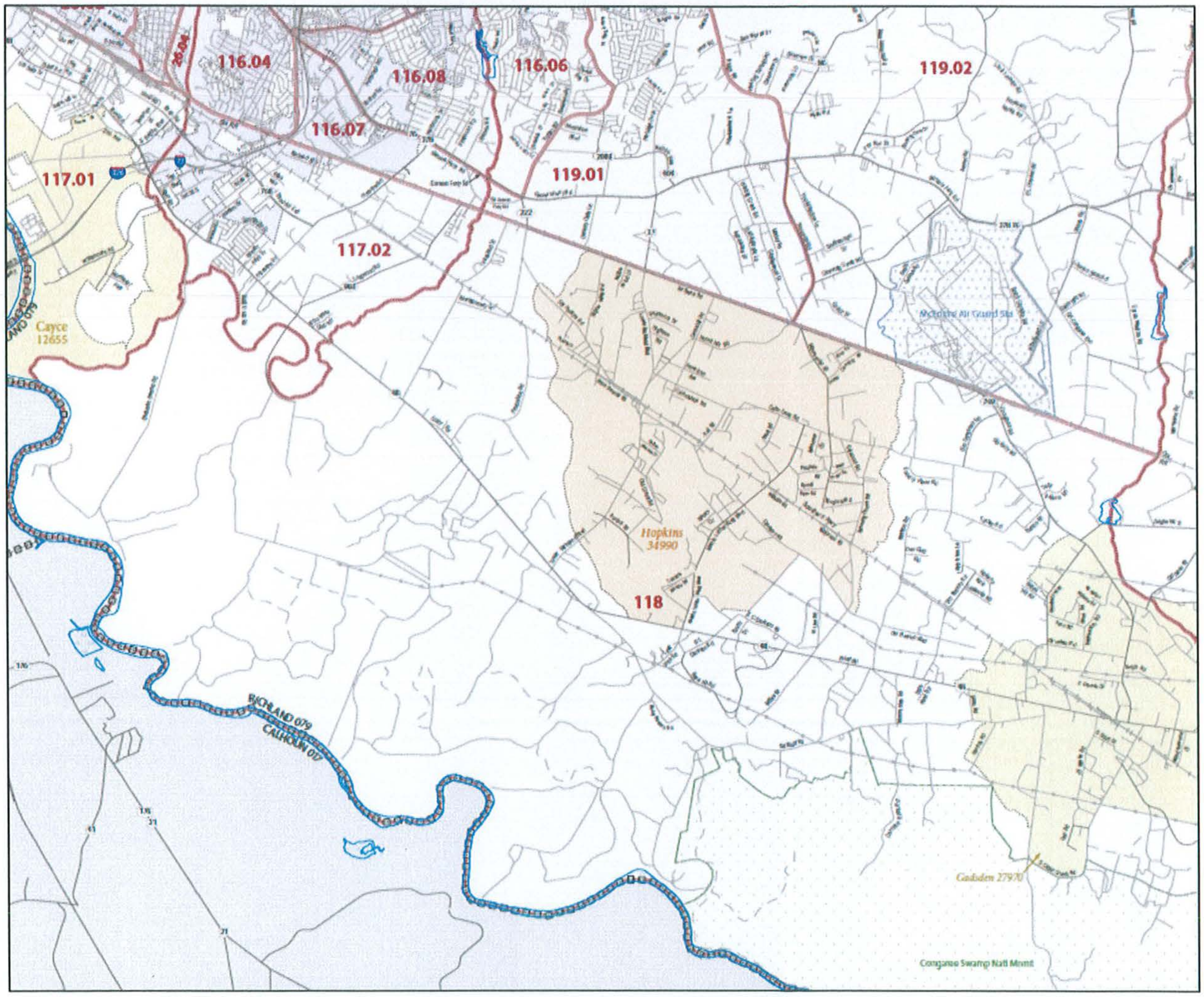
The CFFF is an industrial complex located in a semi-rural area that is surrounded in part by forested lands. There are no nearby natural or man-made features that are considered distinct visual or scenic resources, such as views of mountains, surface water features, or monuments. An aerial view of the CFFF was shown previously in Figure 2.1-4.

3.10 Socioeconomics

The CFFF is located in Richland County, within Census Tract 118 (Hopkins), and approximately 13 km (8 mi) southeast of the city limits of Columbia, which is the nearest population center (see Figure 3.10-1; USCB 2012a). Lexington County is west of Richland County; both counties are included in the Columbia, SC, Metropolitan Statistical Area. Tables 3.10-1 and 3.10-2 present general demographic and economic data, respectively, from the 2010 Census for the State of SC, Richland County, Lexington County, and Census Tract 118.

The 2010 U.S. census shows a total population of 646,895 for the Columbia metropolitan area, which includes Richland and Lexington counties. The major population is concentrated in the city of Columbia. Richland County had a population of 384,504. Lexington County to the west, which includes West Columbia, had a population of 262,391.

The data from the 2010 Census indicate that Richland County Census Tract 118, in which the CFFF is located, has a relatively higher percentage of minorities compared to Richland County in its entirety and the State; in addition, the residents of Census Tract 118 tend to have lower incomes, with a greater percent of families in poverty, compared to Richland County in its entirety and the State. The population density in census tract 118 (which has an area of 119 square miles) is low, less than 100 people per square mile.



Source: USCB, 2012a.

Figure 3.10-1 U.S. Census Bureau Census Tracks

Table 3.10-1 Census 2010 General Demographics for the State of South Carolina, Richland County, Lexington County, and Richland County Census Tract 118 (Hopkins)[1]

Population Type	State of South Carolina	Richland County	Lexington County	Census Tract 118
Total Population	4,625,364	384,504	262,391	6,424
Male	2,250,101 (48.6%)	187,330 (48.7%)	128,134 (48.8%)	3,001 (46.7%)
Female	2,375,263 (51.4%)	197,174 (51.3%)	134,257 (51.2%)	3,423 (53.3%)
Race				
White	3,060,000 (66.2%)	181,974 (47.3%)	208,023 (79.3%)	810 (12,6%)
Black or African American	1,290,684 (27.9%)	176,538 (45.9%)	37,522 (14.3%)	5,463 (85.0%)
Native American Indian and Alaska Native	19,524 (0.4%)	1,230 (0.3%)	1,134 (0.4%)	12 (0.2%)
Asian	59,051 (1.3%)	8,548 (2.2%)	3,729 (1.4%)	7 (0.1%)
Native Hawaiian and Other Pacific Islander	2,706 (0.06%)	425 (0.1%)	130 (0.05%)	2 (0.03%)
Two or more races	116,170 (2.5%)	15,789 (4.1%)	11,853 (4.5%)	140 (2.2%)
Hispanic or Latino (of any race)	235,682 (5.1%)_	18,637 (4,8%)	14,529 (5.5%)	144 (2.2%)
Number of Housing Units	2,137,683	161,725	113,957	2,610

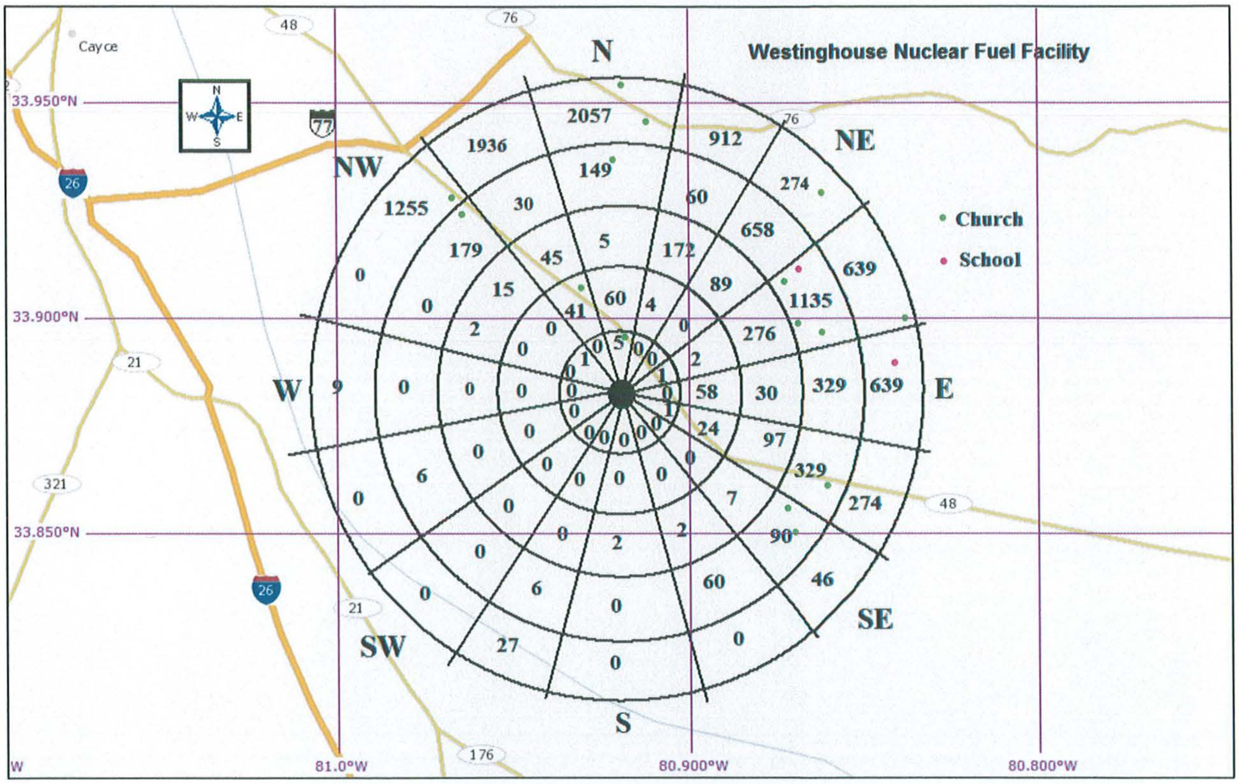
1 USCB,2012b

Table 3.10-2 Economic Data for the State of South Carolina, Richland County, Lexington County, and Richland County Census Tract 118 (Hopkins)

	State of South Carolina[1]	Richland County[1]	Lexington County[1]	Census Tract 118[2]
Civilian Labor Force	2,241,485	194,673	141,973	3,267
Civilian Labor Force Unemployment Rate	7.8%	11.3%	11.0%	11.5%
2010 Per Capita Income	$22,128	$24,037	$25,932	$17,602
2010 Families in Poverty	162,935 (13.8%)	8,586 (10.1%)	6,777 (9.7%)	337 (20.4%)

1 USCB 2012c.
2 USCB 2012d

A population wheel out to 8 km (5 mi) is presented in Figure 3.10-2 based on the 2010 census. The population within a 1.6-, 4.8-, 8.0- km (1-, 3-, and 5-mi) radius of the CFFF site is given in Table 3.10-3. Within a 8-km (5-mi) radius of the CFFF site, the population has been estimated to be 8.668. The population density in the area near the CFFF site is low, less than 39/km^2



Note: Each concentric ring represents an additional one mile radius from the CFFF. Numbers in each quadrant represent the estimated population in that area and geographical direction based on the 2010 census.

Source: Westinghouse, 2012a

Figure 3.10-2 Estimated Population Distribution within 5 Mile Radius of CFFF

Table 3.10-3 Estimated Population Near the CFFF Site

Demographic	1-Mile Radius	3-Mile Radius	5-Mile Radius
Population	8	1,327	8,668
Number of Housing Units	3	~379	~2,579
Density (people/mi^2)	1.9	~46.9	~110.3

Source:. Westinghouse, 2012a.

(100/mi^2) (Westinghouse, 2012). People living near the CFFF site primarily live northeast along the Bluff Road and Atlas Road areas, and southeast in the Hopkins area.

Since the 2000 U.S. Census, the Central Midlands region of SC has seen notable increases in its population and housing stock, as well as in its commercial and industrial sectors. A significant portion of the increases in population and housing have occurred in two areas of the region: around the Town of Lexington, and in northeast Richland County. At the same time, there are indications that population growth is occurring beyond these core areas, towards southern and western Lexington County as well as into the southern and eastern portions of both Newberry and Fairfield Counties. Commercial activity grew the most within the center of the region, with Columbia the core, extending north to Irmo, west to the Town of Lexington, and northeast to Kershaw County. Industrial growth occurred not only in Lexington County but also the north, in Newberry and Fairfield Counties. Industrial growth is expected to continue around the different interstate highways within the region (Westinghouse, 2006c).

Total Westinghouse employment at the CFFF is about 1,100 employees (Westinghouse, 2014b) working over 3 shifts. Plant employment represented 0.6 percent of 2010 Richland County total civilian employment (194,673), which was not a significant fraction of the employment of Richland County.

3.11 Public and Occupational Health

The continued handling of materials and conduct of operations at the CFFF pose potential impacts to public and occupational health. For normal operations, the potential impacts are related to the release of low levels of toxic or radioactive materials to the environment over extended periods of time. For accident conditions, the hazard may involve releasing higher concentrations of materials over relatively short periods of time.

3.11.1 Background Radiation Characteristics

For a U.S. resident, the average total effective dose equivalent from natural background radiation sources is approximately 300 mrem/yr but varies by location and elevation (NRC, 2007a and NCRP, 1987). The source of this dose includes cosmic radiation, radionuclides generated by interactions between the atmosphere and cosmic radiation, radiation sources in the earth, radionuclides in the air, and radionuclides that exist in the body. In addition, the average American receives 60 mrem/yr from man-made sources, including medical diagnostic tests and consumer products (NCRP 1987). Because of its low elevation, relatively low radon levels, and relatively low concentration of radionuclides in the earth, the natural background radiation level in the vicinity of the CFFF site is 117 mrem/yr (Westinghouse, 2004).

3.11.2 Public Health and Safety

Potential public health impacts could occur if large amounts of contaminants released from the CFFF enter the environment and are transported from the site through the air, surface water, or groundwater. The potential contaminants include uranium, ammonia, calcium fluoride, and hydrofluoric acid. An effluent monitoring program is in place at the facility to ensure that potential releases to the environment are within federal and state regulations and are maintained ALARA (Westinghouse, 2008e and 2011b).

Radioactive uranium may be transported through the environment in a variety of ways and the public may be exposed from both internal and external pathways. Potential releases to the air may cause internal exposures directly through inhalation or indirectly through ingestion of crops and animal products that come in contact with radioactive material in the air. External exposures can occur directly from the radioactive plume or from particles from the plume deposited on the ground and other surfaces. Potential liquid releases to surface water or groundwater might lead to internal exposures through drinking water or eating irrigated crops. External and/or internal exposures may also occur from recreational activities, including boating and swimming in affected surface waters.

Calculated radiological doses to the public from the CFFF operations are primarily from the air emissions. Over 99 percent of the offsite dose originates from the airborne pathway (Westinghouse, 2012). CFFF stack emissions would result in a total effective dose of less than 0.16 mrem to a hypothetical exposed individual living at the site boundary(Westinghouse 2014h). This is approximately 1.6 percent of the (10 mrem) annual dose limit from air emissions imposed by 10 CFR 20.1101. In contrast, the annual radiological total effective dose from liquid effluents is only $1.34x10^{-4}$ mrem (Westinghouse 2014h).

NRC performed a safety review of CFFF in 2007 that includes a detailed radiation safety analyses (NRC, 2007b).

3.11.3 Occupational Health and Safety

Risks to occupational health and safety include exposure to industrial hazards, hazardous materials, and radioactive materials. Industrial hazards for CFFF are typical for similar industrial facilities and include exposure to chemicals and accidents ranging from minor cuts to industrial machinery accidents (NRC, 2007b). No serious injuries or deaths have occurred at the CFFF site since operations began in 1969. For 2013, the CFFF Occupational Safety and Health Administration (OSHA) Total Recordable Incident Rate was 0.68 (Westinghouse,2014f). The incident rate accounts for both the number of OSHA recordable injuries and illnesses and the total number of man-hours worked. The incident rate is used for measuring and comparing work injuries, illnesses, and accidents within and between industries. The average incident rate for manufacturing facilities like Westinghouse is 2.0 (DOL, 2012).

The CFFF workers are exposed to nonradiological materials that pose a potential hazard through chronic exposure or improper handling. The CFFF operations use a variety of hazardous and toxic chemicals including ammonia, nitric acid, nitrates, and hydrofluoric acid. Other hazardous materials include degreasing solvents, miscellaneous lubricating and cutting oils, and spent plating solutions. The CFFF Chemical Safety Program is designed to assure that all current and proposed chemical-use hazards are evaluated, and appropriate measures are taken to assure safe operations.

Workers are monitored for radiation exposure to ensure occupational doses are maintained ALARA (Westinghouse 2013). For the 7-year period from 2005 to 2011, the average annual total effective dose to the occupational worker from the combined effluent releases ranged between 0.197 rem and 0.327 rem (Westinghouse 2009b and 2011b). The average worker dose in 2012 was 0.165 rem (Westinghouse 2013). These doses are less than 10 percent of the 5 rem annual occupational dose limit imposed by 10 CFR 20.1201. During that same time period, no individual radiation worker had an annual total effective dose above this limit.

3.12 Waste Management

This section summarizes air, liquid and solid effluents from CFFF operations (NRC, 2007a).

3.12.1 Airborne Effluents

Airborne effluents are normally treated by HEPA filters, scrubbers, or both prior to release through stacks in accordance with 40 CFR Parts 50 and 61, and 10 CFR Part 20. The CFFF is classified as a minor-source operator, and the SC-DHEC does not require Westinghouse to directly monitor for nonradiological pollutants. Instead, Westinghouse provides modeled emissions rates that the Department of Environmental Health and Control uses to determine compliance. Table 3.12-1 contains the modeled emission rates for various CFFF nonradiological gaseous pollutants. Emission rates are calculated based on process throughputs expressed in hours of operation. Typically, the SC-DHEC performs compliance calculations for minor-source operators when permits are renewed or facilities are new or undergo major changes. Table 3.12-2 contains the modeled concentrations for various CFFF nonradiological gaseous pollutants. All pollutant concentrations were below regulatory limits. The only pollutant with concentrations greater than 18 percent of the limit was sulfur dioxide. The sulfur dioxide concentration ranged between 25 and 68 percent of the limit depending on the averaging time used for the calculation. Exposure calculations from the CFFF radiological gaseous emissions are presented in Section 3.11.

3.12.2 Liquid Effluents

Liquid effluents are treated and discharged into the Congaree River in accordance with the NPDES permit and 10 CFR Part 20 requirements. On a typical day, CFFF discharges 492,000 L (130,000 gal) of liquid effluent into the Congaree River (WRC, 2004). Nonradiological parameters analyzed for NPDES compliance include pH, fluoride, ammonia, dissolved oxygen, biochemical oxygen demand, total suspended solids, phosphorus, fecal coliform, and chlorine. From 2000 to 2005, the only parameter to exceed NPDES limits was biochemical oxygen demand (Westinghouse, 2004, 2006a). During that time, the daily maximum threshold was exceeded three times and the monthly average threshold was exceeded four times. The largest of these temporary exceedances occurred on September 19, 2002, when the biochemical oxygen demand was nearly twice the daily maximum threshold (Westinghouse, 2004). Exposure calculations from the CFFF radiological liquid effluents are presented in Section 3.10. Storm water runoff is regulated by the SC-DHEC under a general NPDES permit for Storm Water Discharges Associated with Industrial Activity (Permit Number SCR000000). As required by this permit, Westinghouse developed a Storm Water Pollution Prevention Plan.

Table 3.12-1 Modeled Emission Rates for CFFF Nonradiological Gaseous Pollutants

Facility Wide Emissions	
Pollutant	Uncontrolled Emissions (TPY)
PM	7.86
PM_{10}	6.35
$PM_{2.5}$	3.90
SO_2	86.04
NO_x	27.96
CO	25.53
VOC	8.885
Nitric Acid (HNO3) [TAP]	0.77

Source: SCDHEC 2012b

Table 3.12-2 Maximum Modeled Concentrations for CFFF Nonradiological Gaseous Pollutants

Pollutant	Averaging Time	Maximum Modeled Concentration (μg/m^3)	Standard (μg/m^3)
SO_2	3 hours	724.93	1,300
	24 hours	245.55	365
	Annual	20.082	80
PM_{10}	24 hours	18.04	150
NO_2	Annual	18.06	100
CO	1 hour	202.28	40,000
	8 hours	151.85	10,000
Nitric Acid	--	0.5	125

Source: NRC, 2007a.

3.12.3 Solid and Hazardous Waste

The CFFF operations produce low-level radioactive solid waste. As described in Section 1.3.2, the material is either decontaminated for free release or reuse, incinerated onsite, or shipped offsite for disposal. From 1996 to 2003, the annual amount of low-level radioactive waste shipped offsite varied between 79 m^3 (2,790 ft^3) and 5,132 m^3 (181,235 ft^3) (Westinghouse, 2004).

Hazardous wastes such as degreasing solvents, lubricating and cutting oils, and spent plating solutions are generated at the CFFF. These wastes are regulated under 40 CFR Part 261, Identification and Listing of Hazardous Waste; 40 CFR Part 262, Standards Applicable to Generators of Hazardous Waste; and South Carolina Hazardous Waste Regulations R61-79.261. Hazardous Waste Generation Reports are provided quarterly and the waste is disposed of offsite through permitted contractors. The annual CFFF hazardous waste generation rate is approximately 18,100 kg (39,904 lb) (Westinghouse, 2006a).

Nonhazardous waste is generated from routine office and industrial activities and is disposed of locally at an offsite state-permitted landfill. The annual CFFF generation rate for this type of waste is approximately 550 MT (610 T) (Westinghouse, 2006a).

No waste is disposed onsite. Also, no mixed waste (radiological and chemical hazardous waste) is present or generated onsite.