GLE Environmental Report

Section 3.4 – Water Resources

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3.4 Water Resources

This section provides a summary of existing water resource conditions associated with the Wilmington Site, including groundwater (**Section 3.4.1**), surface water (**Section 3.4.2**), floodplains (**Section 3.4.3**), wetlands (**Section 3.4.4**), and water use (**Section 3.4.5**).

3.4.1 Groundwater

This section describes groundwater conditions associated with the Wilmington Site, including a description of regional and Site aquifers, preexisting regional and Site groundwater impacts, and existing Site groundwater remediation. In this section, the Wilmington Site region generally refers to the approximate four-county area, including New Hanover, Brunswick, Pender, and Columbus counties. The area generally refers to the Wilmington Site vicinity, including an area within approximately 3 miles (4.8 km) of the Site property boundary.

3.4.1.1 Aquifers and Confining Layers

This section presents discussions of the regional and Wilmington Site aquifers and their associated confining or semiconfining layers.

3.4.1.1.1 Regional Aquifers and Confining Layers

The Wilmington Site is within the North Carolina Coastal Plain physiographic province, which extends from the Piedmont eastward to the North Carolina coast (see **Figure 3.3-1**). The coastal aquifer system is an eastward-dipping and eastward-thickening wedge of depositional sediments and sedimentary rock underlain by a crystalline, eroded surface of igneous and metamorphic rock (Precambrian or Early Paleozoic age, as described in detail in the regional geology section of this Report [**Section 3.3.1**, *Regional Geology*]). Six regional aquifers are present in the region surrounding the Wilmington Site, including the Surficial Aquifer, the Castle Hayne Aquifer, the Peedee Aquifer, the Black Creek Aquifer, and the Upper and Lower Cape Fear aquifers. The aquifers are water-yielding formations that are more permeable than the finer-grained formations (confining units) that are typically above and/or beneath these coastal aquifers. In most areas, each aquifer is overlain by a less-permeable confining unit, with the exception of the Surficial Aquifer, which is under water-table conditions. The aquifers and confining units consist of sands, conglomerates, silts, clays, shell hash, and fossiliferous limestones deposited in nearshore and deltaic to offshore marine environments (Lautier, 1998). **Figure 3.3-16** shows cross sections through the region, illustrating the general relationship between the aquifers (lighter) and confining units (darker). The aquifers generally correspond to particular geologic formations, previously described in **Section 3.3**.**1** (*Regional Geology*); however, there is overlap in some cases (**Figure 3.4-1**). The text below provides a description of each of the regional aquifers and its associated confining unit in order of descending elevation.

3.4.1.1.1.1 Surficial Aquifer

The Surficial Aquifer refers to the uppermost aquifer in the region. This aquifer typically consists of unnamed Quaternary deposits. The unnamed deposits in New Hanover County have been correlated to the Waccamaw Formation in parts of Brunswick and Columbus counties and also correlated to the older Yorktown Formation in southwestern Bladen and easternmost Columbus counties. Neither the Waccamaw Formation nor the Yorktown Formation is found on the Site (see **Section 3.3**, *Geology and Soils*). The deposits often are considered "undifferentiated" because multiple types of deposits exist within a relatively small area without having been mapped in detail. The thickness of the Surficial Aquifer can vary from a few to 200 ft (61 m) and generally thickens eastward in the region (Lautier, 2006).

The Surficial Aquifer is unconfined (no overlying confining unit) and receives recharge from precipitation. The aquifer's hydraulic conductivity has been estimated as 130 ft/day (40 m/day), although the value is highly variable (Lautier, 2006). Due to yield limitations, water supply from the Surficial Aquifer is primarily restricted to domestic use. Salt water in the Surficial Aquifer is generally limited to the coastal barrier islands and sounds (Lautier, 2006). Chloride concentrations ranging from 5 to 60 parts per million (ppm) have been reported in the Surficial Aquifer (Lautier, 1998), with greater concentrations found closer to the coast.

3.4.1.1.1.2 Castle Hayne Aquifer

Figure 3.4-2 shows the extent of the Castle Hayne Aquifer in eastern North Carolina relative to the Wilmington Site. Although the Castle Hayne Aquifer is absent at the Wilmington Site, it is included in this evaluation because of its importance as a regional water resource. **Figure 3.4-2** includes a delineation of areas where the aquifer contains fresh water, salt water (chloride concentration exceeding 250 ppm), and a transition zone where shallow water quality typically is fresh and salt content increases with depth. In some areas of the transition zone, the aquifer provides potable-quality water; however, in other areas, even the shallowest portions of the aquifer are too salty for potable purposes.

The Castle Hayne Aquifer has a maximum known thickness greater than 78 ft (23 m) in eastern Pender and northeastern New Hanover counties (Lautier, 1998). The aquifer consists of white moldic limestones and bryozoan-laden limestones grading downward to calcareous, fine-grained sandstone and includes the Castle Hayne Formation and Beaufort Formation (Lautier, 1998, 2006). Phosphate is common in the upper part of the aquifer (Lautier, 1998). Based on its fossiliferous composition, the Castle Hayne Aquifer is reported to have been a bryozoan-biomicrudite deepwater deposition (Feldmann et al., 1998). Limestone is the dominate lithology in the upper section of the aquifer, with permeable sand found in the lower section (Harrelson and Fine, 2006).

The confining unit that overlies the Castle Hayne Aquifer is composed of clays, sandy clays, and silts and consists of the lower section of the undifferentiated Pleistocene deposits, the Yorktown Formation, and the upper part of the Castle Hayne Formation. The thickness of the Castle Hayne confining unit is reported to be between 10 to 25 ft (3 to 8 m), with an average thickness of 14 ft (4.3 m) (Winner and Coble, 1996; Harrelson and Fine, 2006).

Recharge to the Castle Hayne Aquifer occurs primarily from slow recharge from the Surficial Aquifer through the confining unit and from direct recharge from the Surficial Aquifer where the confining unit is absent (Harden et al., 2003). In many areas, the potentiometric surface of the Castle Hayne Aquifer is above the surface of the Cape Fear River, causing groundwater to discharge from the aquifer to the river (Lautier, 1998). The upper Castle Hayne Aquifer is reported to have moldic pores of 3 to 13% of volume (Cooper et al., 2002). Aquifer-analysis pumping tests results indicate an average transmissivity of 2,763 ft^2/day (247 m^2/day) and an average hydraulic conductivity of 38.1 ft/day (116 m/day), making this a very productive aquifer. **Table 3.4-1** provides various hydraulic characteristics of the aquifer.

Chloride levels in the majority of the Castle Hayne Aquifer are reported to be below 250 ppm; however, levels in excess of 1,000 ppm are found in the extreme eastern extent of the aquifer, as shown by the "salty" area in **Figure 3.4-2** (Lautier, 1998). Water in the Castle Hayne Aquifer is moderate to very hard, with an average of 180 ppm of solids and an iron content ranging from 0.09 to 3.3 ppm (LeGrand, 1960). Calcium and bicarbonate are the predominant ions in solution found in the aquifer (LeGrand, 1960).

3.4.1.1.1.3 Peedee Aquifer

Figure 3.4-3 shows the extent of the Peedee Aquifer in eastern North Carolina relative to the Wilmington Site. The map includes a delineation of areas where the aquifer contains fresh water, salt water, and a

transition zone where shallow water quality typically is fresh and salt content increases with depth. Although the Wilmington Site is mapped in the transition zone, water from the shallow Peedee Aquifer is fresh in the Site area. Because the Peedee Aquifer provides the process and potable water for the existing GE/GNF-A Facility, a more in-depth discussion of the aquifer water resource is provided in **Section 3.4.5**.

The Peedee Aquifer is within the Peedee Formation (Lautier, 2006) and consists of silty, fine- to very fine-grained quartz glauconitic and phosphoritic sand with trace amounts of shell and pyrite. In southeastern Brunswick and north-central New Hanover counties, the uppermost part of the aquifer consists of the Rocky Point Member, and moldic limestone grades down into calcareous sandstone (Lautier, 1998). West of the western extent of the Castle Hayne Aquifer (see **Figure 3.4-2**), the Peedee Aquifer and its confining unit, where present, are overlain by the Surficial Aquifer.

The Peedee confining unit includes the lower section of the Beaufort Formation and the upper part of the Peedee Formation (Lautier, 2006). The Peedee confining unit is reported to consist of eight subdivisions of regionally discontinuous clay, silt, and sandy clay deposits, causing intermittent hydraulic separation of the Peedee Aquifer into a set of sub-aquifers (Lautier, 1998). The confining unit ranges in thickness from zero to a maximum of 70 ft (21.3 m) in eastern Pender County, with an average thickness of 20 ft (6 m) (Lautier, 2006).

Recharge to the Peedee Aquifer in this region occurs primarily from the Surficial Aquifer, with some upward leakage of water from the underlying Black Creek Aquifer (Harden et al., 2003). Average transmissivity for the aquifer is reported to be 3,063 ft^2/day (285 m^2/day), and the average hydraulic conductivity is 38.3 ft/day (11.7 m/day), although the values are highly variable (Lautier, 1998). In the central and southeastern sections of the Coastal Plain, the aquifer thickness averages 135 ft (41 m) (NCDENR, 2002). **Table 3.4-1** provides various hydraulic characteristics of the Peedee Aquifer.

The Peedee Aquifer is used extensively as a water supply source in the Wilmington Site region. In the eastern part of this region, elevated chloride concentrations render the lower part of the Peedee Aquifer non-potable (Lautier, 1998).

3.4.1.1.1.4 Black Creek Aquifer

Figure 3.4-4 shows the extent of the Black Creek Aquifer in eastern North Carolina relative to the Wilmington Site. The map includes a delineation of areas where the aquifer contains fresh water, salt water, and a transition zone where shallow water quality typically is fresh and salt content increases with depth. In the Wilmington Site area, the Black Creek Aquifer is mapped in the zone with non-potable salt water; therefore, the Black Creek Aquifer is not a major source of water in the vicinity of the Wilmington Site.

The Black Creek Aquifer correlates with the Black Creek Formation and consists of alternating beds of "salt and pepper" sands and thinly laminated gray to black clays, indicative overall of lagoonal to marine deposits (Harrelson and Fine, 2006; Lautier, 2006). The deposits also include shell, glauconite, and organic material. In the lower Black Creek section, the presence of a kaolinitic clay and sand, silty-clay, coarse channel sands, and thinly laminated beds of sand and clay demonstrate a non-marine fluvial sequence (Harrelson and Fine, 2006).

The Black Creek confining unit is within the lower section of the upper Cretaceous Peedee Formation and the upper section of the Black Creek Formation. The unit consists of clay and silt and thin sand beds. The top of the confining unit is the base of the Peedee Aquifer, and the confining unit has an average thickness of 34 ft (10 m) and a maximum thickness of 168 ft (51 m) in eastern Brunswick County (Lautier, 2006).

The top of the Black Creek Aquifer reaches a depth of 641 ft (195 m) msl in southern New Hanover County. Where the Peedee Aquifer occurs, the Black Creek Aquifer is recharged by water moving downward from the overlying aquifer. Transmissivity in the Black Creek Aquifer in the Southern Coastal Plain has been estimated to range from 500 to 7,209 ft^2/day (46 to 670 m^2/day) (Lautier, 2006). **Table 3.4-1** provides various hydraulic characteristics of the Black Creek Aquifer.

The Black Creek Aquifer contains salt water in the southeastern part of the region, with all of New Hanover County, most of Brunswick County, and the southern half of Pender County in the Black Creek salt zones (Lautier, 2006). Both the Peedee and Black Creek aquifers are described as high bicarbonate waters, with dissolved solids consisting primarily of sodium and bicarbonate and with a greater calcium content in the shallow and up-dip sections and a greater sodium content in the deeper and down-dip parts (LeGrand, 1960). Use of the Black Creek Aquifer as a water supply source is limited to Duplin, western Onslow, and Pender counties (LeGrand, 1960).

3.4.1.1.1.5 Upper Cape Fear Aquifer

Figure 3.4-5 shows the extent of the Upper Cape Fear Aquifer in eastern North Carolina relative to the Wilmington Site. The map includes a delineation of areas where the aquifer contains fresh water, salt water, and a transition zone where shallow water quality typically is fresh and salt content increases with depth. In most of the Wilmington Site region, the Upper Cape Fear Aquifer is mapped in the zone with non-potable salt water; therefore, the aquifer not a major source of water in the Site area.

The Upper Cape Fear Aquifer is part of the Cape Fear Formation and is composed of beds of quartz and feldspar sands, clay and silt, and iron oxide minerals. The aquifer reaches a maximum elevation of -905 ft (-276 m) msl in southern New Hanover County. In this area, the aquifer thickens to the southeast, reaching a maximum thickness of 208 ft (63 m) in northern New Hanover County (Lautier, 2006). In western areas of the region, the aquifer can average 150 ft (45.7 m) thick, yielding 200 to 400 gallons per minute (757 to 1514 liters per minute) from very fine to coarse sands and gravels (LeGrand, 1960). The Upper Cape Fear aquifer is used as a water supply source in the western portion of the region and contains salt water in Brunswick, New Hanover, southern Columbus, southeastern Duplin, and most of Pender counties. The aquifer is reported to have low resistivity values in the freshwater areas (Lautier, 2006).

The Upper Cape Fear confining unit includes both the lower section of the Black Creek Formation and the uppermost section of the Cape Fear Formation (Lautier, 2006). The unit contains clay, silt, and thin interbedded sands in a deposit that thickens and thins in a non-uniform fashion, with an average thickness of approximately 59 ft (18 m).

3.4.1.1.1.6 Lower Cape Fear Aquifer

Figure 3.4-6 shows the extent of the Lower Cape Fear Aquifer in eastern North Carolina relative to the Wilmington Site. The map includes a delineation of areas where the aquifer contains fresh water, salt water, and a transition zone where shallow water quality typically is fresh and salt content increases with depth. Across the Wilmington Site region, the Lower Cape Fear Aquifer is mapped in the zone with non-potable salt water; therefore, the aquifer is not a major source of water in the Wilmington Site area.

Aside from the reworked basement sediments, the Lower Cape Fear Aquifer is lithologically similar to the Upper Cape Fear Aquifer and is part of the same geologic formation. The Lower Cape Fear Aquifer is the deepest aquifer in the region and recharges at the lowest rate. The average thickness of the unit is 151 ft (46 m), with a maximum of 430 ft (131 m) found in Brunswick County. The aquifer contains salt water over the majority of the region; therefore, it is minimally utilized as a water supply source. A single

aquifer test in northern New Hanover County reported a transmissivity value of 1,206 ft^2/day (112 m^2/day) (Lautier, 2006).

The Lower Cape Fear confining unit consists of red to yellow-brown clays and silts and thin interbedded sands and is part of the Cape Fear Formation. This unit pinches out in the western part of the region in western Bladen and northern Duplin counties. The Lower Cape Fear confining unit varies in thickness, from zero at its up-dip limit to a maximum of 146 ft (44.5 m) in Brunswick County, with an average thickness of 55 ft (17 m) (Lautier, 2006).

3.4.1.1.2 Wilmington Site Aquifer and Semiconfining Layer

Groundwater assessments associated with the existing Wilmington Site facilities have focused on the Surficial Aquifer and the upper portion of the underlying Peedee Aquifer (referred to at the Site as the Principal Aquifer because it is the only aquifer providing water supply for the Site). The Principal Aquifer corresponds to the upper zones of the Peedee Aquifer discussed in **Section 3.4.1.1.1**. In the Eastern Site Sector, these aquifers are typically separated by a less-permeable semiconfining layer. This semiconfining layer pinches out and is thin or absent in the vicinity of the GLE Study Area, so there is no clear differentiation between the Principal and Surficial aquifers in this area. The Surficial Aquifer, semiconfining layer, and Principal Aquifer at the Wilmington Site are described below.

3.4.1.1.2.1 Surficial Aquifer

The Surficial Aquifer includes undifferentiated, stratified deposits generally located between 20 and 50 ft (6 and 15 m) msl at the Site. These sediments typically include terraced and barrier beach deposits, fossil sand dunes, and stream channel deposits (see **3.3.3** of this Report, *Site-Specific Geology,* for a geologic characterization of these deposits). The sediment texture varies from medium- to fine-grained sands to silts and clays. This aquifer is recharged directly by rainfall, and the water table is generally located relatively near the land surface (approximately averaging 9 ft [2.7 m] bgs with a range from 0 to 20 ft [0 to 6 m] bgs).

The Surficial Aquifer discharges into streams, drainage canals/ditches, and the low-lying swampy areas of the Western Site Sector and north of the Northwestern Site Sector. In addition, the Surficial Aquifer recharges groundwater into the underlying Principal Aquifer. **Figure 3.4-7** shows the groundwater elevation contours of the Surficial Aquifer at the Site and adjacent areas. Each contour line represents a constant elevation with a contour interval of 2 ft (.6 m). Solid lines are based on nearby measured data, whereas dashed lines are inferred from the surrounding hydrogeologic boundaries (e.g., streams, drainage ditches, swampy area) and topography.

Groundwater generally flows perpendicular to the contour lines along the gradient of decreasing groundwater elevation, as depicted by the green arrows in **Figure 3.4-7.** The groundwater elevation contours demonstrate that drainage ditches, the effluent channel, and the swampy area are significant hydrogeologic boundaries receiving Surficial Aquifer discharge. A groundwater elevation mound in the GLE Study Area occurs due to the topographic high of the Study Area (see **Figure 1.2-4**) and to the surrounding hydrogeologic boundaries, including swampy discharge areas on nearly three sides and the effluent channel to the south.

Graphs of the groundwater elevation versus time in the Surficial Aquifer were reviewed for seasonal variations in water levels. As shown in the example graphs in **Figure 3.4-8**, a general seasonal pattern occurs where water levels tend to be higher during winter, with an approximate seasonal variation of 5 to 10 ft (1.5 to 3 m). However, the pattern is not consistent, suggesting that the groundwater levels also respond to other influences, such as rainfall variability.

There is a Surficial Aquifer groundwater mound in the GLE Study Area, where the groundwater to the south of the divide ultimately flows into the effluent channel and groundwater to the north of the divide flows into the swampy area located to the north. Groundwater flow velocities in the GLE Study Area are estimated to range between 0.01 and 1.6 ft/day (.003 and .48 m/day), assuming a hydraulic conductivity range between 1 and 20 ft/day (.3 and 6 m/day), a hydraulic gradient between 0.004 and 0.02, and a porosity between 0.25 and 0.35. The hydraulic conductivity range is based on measured values at the Site (**Figure 3.4-12**) and professional judgment. The assumed gradient values are based on the groundwater elevation contours in **Figures 3.4-7 and 3.4-10**. The porosity range is typical for fine to medium sands (Freeze and Cherry, 1979). The semiconfining layer separating the Surficial and Principal aquifers is thin, absent, and/or unsaturated in the GLE Study Area. Thus, the Surficial and Principal aquifers behave as the same hydrogeologic unit and have similar flow and transport properties.

3.4.1.1.2.2 Semiconfining Layer

The relatively less-permeable Peedee clay layer, which is discussed in **Section 3.3.3.2.2**, *Peedee Clay (Site-Specific Geology)*, underlies much of the Surficial Aquifer and acts as a semiconfining layer for the Principal Aquifer. The thickness of the semiconfining layer is variable, and the unit is not present in all areas of the Wilmington Site. Where present and sufficiently below the water table, the Peedee clay layer hydraulically separates the Surficial Aquifer and Principal Aquifer (i.e., acts as a semiconfining layer). Based on Site investigations performed in the GLE Study Area in 1980 and 2007, the marine Peedee clay present in the Eastern Site Sector transitions to an alluvial clay across the North-Central Site Sector, and the position of this alluvial clay generally is at or above the water table, thereby rendering it ineffective as a semiconfining layer. Previous Site investigations performed in the Northwestern Site Sector revealed an absence of either of these clay layers (RTI, 1998). **Figure 3.3-22** depicts the approximate western extent of the semiconfining layer and its thickness across the Site (labeled as the Peedee Clay layer in the figure). The western boundary of the semiconfining layer is based on site-specific geologic data, as discussed above, as well as a hydrogeologic assessment of New Hanover County by Bain (1970). The boundary in **Figure 3.3-22** indicates the general area where the marine and/or alluvial clay layer ceases to serve as a semiconfining layer rather than a clearly defined and sharp boundary.

3.4.1.1.2.3 Principal Aquifer

The Principal Aquifer at the Site refers to the upper zones of the Peedee Aquifer, a deposit that includes greenish-gray to dark-gray silt and sand interbedded with semiconsolidated calcareous sandstone and limestone. The upper portion of the Principal Aquifer is generally more permeable and contains more sand than the lower zones that have been investigated beneath the Site. In a study of New Hanover County hydrogeology, Bain (1970) mapped the Principal Aquifer as shown in **Figure 3.4-9** (labeled as Sandstone Aquifer in this figure). This eastward-dipping layer is the uppermost water-bearing unit within the Peedee Aquifer. The approximate location of the Site is shown in the figure in the upland area between Smith Creek and the Northeast Cape Fear River. Note that the Site location coincides with the lateral extent of the semiconfining unit (labeled as Clay Aquiclude in the figure). The Surficial Aquifer coincides with the Undifferentiated Late Tertiary and Surficial Deposits in the figure.

Figure 3.4-10 shows the Principal Aquifer water levels collected throughout the Wilmington Site in March 2007. As this figure indicates, groundwater flows from upland areas toward the surrounding hydrogeologic boundaries, including streams, the Northeast Cape Fear River, and the low-lying swampy areas of the Western Site Sector and north of the Northwestern Site Sector. In addition, groundwater is drawn to GE/GNF-A Facility pumping wells, as indicated by the areas of depressed groundwater levels around certain pumping wells in **Figure 3.4-10**. The pumping wells on the Wilmington Site provide process water and groundwater remediation for the existing facility. Site potable water supply is provided by three wells just east of the Wilmington Site and NC 133 (Castle Hayne Road). The primary input of groundwater to the Principal Aquifer system is recharge from leakage through the overlying

semiconfining layer and from direct seepage of rainwater in areas where the semiconfining layer is absent. Graphs of the groundwater elevation versus time in the Principal Aquifer were reviewed for seasonal patterns. As shown in the example graphs in **Figure 3.4-11**, a general seasonal pattern occurs whereby groundwater levels tend to be higher during winter, with an approximate seasonal variation of 3 to 5 ft (1 to 1.5 m); however, the pattern is not consistent, suggesting that the groundwater levels also respond to other influences, such as rainfall, drought, and pumping.

Hydraulic conductivity information derived from field tests (i.e., slug and pumping tests) performed at the Wilmington Site indicate that there is a general increasing trend in hydraulic conductivity from the west to east across the facility. The measured data are summarized in **Figure 3.4-12**. Test data generated in the northwest area of the Wilmington Site indicate mean hydraulic-conductivity values of approximately 3 ft/day (1 m/day) (RTI, 1998, 1999a). In contrast, aquifer tests in pumping well WW-9A in the central–eastern Site area indicate a hydraulic conductivity in the 40 ft/day (12 m/day) range (RTI, 1996). The average of hydraulic conductivity measurements for the waste treatment facility area (see **Figure 3.4-14** for location) fall between the ranges measured for the western and the eastern areas of the Wilmington Site, with a geometric mean of 16.8 ft/day (5.12 m/day) (RTI, 1999b). This observation agrees with the assessment by Bain (1970) that there is a regional geologic contact dividing the portion of New Hanover County where the Wilmington Site is located. To the east of this contact, the Principal Aquifer corresponds to the more-permeable, upper sandy portion of the Peedee Formation, identified as the "Sandstone Aquifer" on the cross section shown in **Figure 3.4-9**. The conductivity to the east is correspondingly in the upper range of measured hydraulic values for the Site. To the west of this geologic contact, the older strata of the Peedee Formation outcrop, and these strata have an increasing silt and clay component and, thus, lower hydraulic conductivities than the upper sandy portion of the Peedee Formation.

As discussed above, there is no semiconfining layer across most of the Main portion of the GLE Study Area. Therefore, the Surficial Aquifer and Principal Aquifer hydraulically behave as one unit in that area. The discussion in **Section 3.4.1.2.1** of Surficial Aquifer groundwater flow directions and flow velocities in the GLE Study Area also pertains to the Principal Aquifer across most of the Main portion of the GLE Study Area where the semiconfining layer is absent.

3.4.1.2 Preexisting Groundwater Impacts

3.4.1.2.1 Regional Groundwater Impacts

Figure 3.4-13, **Table 3.4-2**, and **Appendix J**[1], *The EDR Radius Atlas*, provide results from an environmental records search listing locations with known or potential environmental issues within a radius of 3 miles (4.8 km) of the Proposed GLE Facility (EDR, 2007). The search includes federal data sources, such as the national priority list and RCRA treatment storage and disposal facilities; state data sources, such as leaking underground storage tanks and voluntary cleanup sites; and other data sources. Sites listed in the search may have known environmental impacts, or they may be associated with operations with the potential for impacts (e.g., storage of hazardous substances). Therefore, although listed in the appendix, most sites do not have associated groundwater impacts. Several locations within 3 miles (4.8 km) are included; however, they are all greater than 1 mile (1.6 km) from the Proposed GLE

[1] The existing facility at the Wilmington Site is listed in the environmental records search report presented in **Appendix J**; **Section 3.4.1.2.2** provides detailed information about the Site. The overview map in the **Appendix J** report shows a Diamond Shamrock Martin Marietta facility just north of the existing Wilmington Site (point B). This location is mapped incorrectly. The actual location is further northeast in Castle Hayne, NC, as shown on **Figure 3.1-14** as the Martin Marietta Materials Castle Hayne Quarry. The Crown facility (point 11) in **Appendix J** is also mapped incorrectly (the actual address is 2540 rather than 3540 Castle Hayne Rd). The actual location is more than 3 miles (4.8 km) from the Proposed GLE Facility. **Figure 3.4-13** reflects these changes (i.e., these two facilities are not plotted on **Figure 3.4-13** because they are located outside the 3-mile radius).

Facility. In addition, groundwater flow directions are generally away from the Proposed GLE Facility location, thus rendering potential groundwater impacts unlikely. **Table 3.4-2** lists locations that are within 3 miles (4.8 km) of the Proposed GLE Facility and may be upgradient from the Wilmington Site and the associated Site groundwater pumping system.[2] (Note that these locations are not upgradient from the Proposed GLE Facility location.) Although these locations may be upgradient from the Wilmington Site, the available environmental information and significant distances of these locations from the Site indicate that they are not likely to affect the existing Site facilities or the Proposed GLE Facility groundwater supplies (see **Table 3.4-2**). Furthermore, there are no detections from off-site sources in perimeter monitoring wells, including those located on the upgradient (i.e., south and southeastern) side of the Site. Given these factors, there is no apparent or expected interaction between groundwater from locations shown in **Figure 3.4-13** and the Wilmington Site.

3.4.1.2.2 Wilmington Site Groundwater Impacts

The industrial operations at the Wilmington Site over the past 40 years have resulted in several specific and well-understood impacts to groundwater. These impacts are being monitored and/or remediated by programs that have been established in coordination with the governing regulatory agencies. Identified areas of impact are associated with previous manufacturing activities and disposal activities that took place during the early operations at the Site, as summarized below. Upon discovery of each of these impacts, GE notified the NC DWQ. GEH/GNF-A continues to provide periodic updates to the NC DWQ, including monitoring reports, memoranda, meetings, and personal communications. In addition, GNF-A monitors groundwater from 88 monitoring wells across the Wilmington Site for specific constituents, in accordance with U.S. Nuclear Regulatory Commission (NRC) Materials License SNM-1097. The groundwater monitoring results are routinely provided in updates to the Environmental Report associated with that license (GNF-A, 2007).

Tables 3.4-3 and 3.4-4 summarize groundwater impacts at the Wilmington Site from organic, inorganic, physical, and radiological constituents based on data collected from 2002 through 2006, as well as on the complete available dataset (a dataset representing a total of approximately 24 years through 2006). The tables include a comparison with the NCDENR 2L groundwater standards (15A NCAC 2L .0202). Values exceeding these NCDENR 2L standards (also referred to herein as exceedances) are shown in bold and with an asterisk. Comparison of the complete dataset to those data gathered within the past 5 years shows that average concentrations for most analytes have decreased over time. As discussed in **Section 3.4.1.1.2.3**, Site potable water supply is provided by three wells just east of the Wilmington Site and NC 133 (on a separate parcel owned by GE). These wells are unaffected by the preexisting groundwater impacts discussed below, and the potable system is monitored for compliance with applicable regulatory requirements.

Several ongoing groundwater monitoring programs are conducted at specific areas of the Eastern Site Sector and Northwestern Site Sector, as shown in **Figure 3.4-14** and discussed below. **Figures 3.4-15, 3.4-16, and 3.4-17** show locations where measured groundwater concentrations are above and below the NCDENR 2L standard for organic constituents, inorganic and physical constituents, and gross-alpha activity, respectively. Identified areas of impact are associated with previous manufacturing and disposal activities that took place during early operations at the Site, as summarized below. Monitoring wells surround each of the areas with known groundwater impacts (see **Figure 3.4-14**). As discussed below, some of the described areas are specifically monitored for groundwater quality by GNF-A, in accordance with NRC Materials License SNM-1097. In addition, monitoring wells in non-impacted areas exist on the perimeter of areas with known exceedances. These wells provide early warning of any potential spreading of impacts outside of areas known to have exceedances, and some of these perimeter area wells are

[2] Evaluation of groundwater flow directions in the Principal Aquifer are based on the Site numerical groundwater flow model, which is further described in **Section 4.4.1**, *GroundwaterImpacts*.

specifically monitored for groundwater quality by GNF-A in accordance with NRC Materials License SNM-1097.

- **Northwest Site Area.** Disposal of lubricants in this area during the 1960s and 1970s resulted in groundwater impacts from trichloroethylene (TCE) and its degradation products cis-1,2 dichloroethylene (cDCE) and vinyl chloride (VC). *The Corrective Action Plan for the Northwest Site Area*, dated April 27, 1999, documents a monitored natural attenuation corrective action approach that was approved by NCDENR on November 5, 1999 (RTI, 1999a). The remaining groundwater exceedances are predicted to continue to attenuate via natural processes, and the concentrations are predicted to pose no significant risk to human health or the environment in the future. An associated monitoring program has been designed to verify the continued attenuation and migration patterns of the groundwater constituents and the absence of significant human-health and ecological risk. Storage of calcium fluoride (CaF_2), which typically contained trace amounts of uranium residues, in the northwest Site area resulted in uranium and fluoride reaching groundwater. The area was excavated in 1996 and backfilled in 2000. The NRC amended the facility Materials License SNM-1097 in April of 2000 by granting unrestricted release of the previous Northwest Calcium Fluoride (CaF_2) Storage Area (Leeds, 2000). Monitoring in nearby wells for the primary constituents (i.e., fluoride and uranium) demonstrates the continued attenuation of the groundwater impacts and the absence of significant exposure risk.
- **Waste Treatment Area.** Waste treatment operations in this area resulted in the release of nitrate to the Principal Aquifer. Repairs to the facility were implemented upon discovery of the release, and the facility currently is no longer used for storage of nitrate-bearing liquids. Monitoring in the area also has included fluoride and uranium; however, no Principal Aquifer groundwater impacts from these two constituents have been documented in this area. Groundwater monitoring in the area has demonstrated that the nitrate in the Principal Aquifer is naturally attenuating and that the area of nitrate exceedances is likely stable and not expanding due to nitrate migration. A routine monitoring program continues to demonstrate the relative stability of the groundwater impacts in the area. In addition to this Principal Aquifer nitrate monitoring program, wells in this area are also monitored for groundwater quality by GNF-A, in accordance with NRC Materials License SNM-1097.
- **Fuel Containment Operation (FCO) Cleanroom Area.** This monitoring program was established to evaluate a release of acid process solutions discovered in the FCO cleanroom area in the mid 1990s. In 1999, equipment-replacement activities were conducted at the previous release location, and impacted soil was excavated as part of this renovation process and disposed off-site. Monitored groundwater quality parameters include pH, fluoride, nitrate, and five indicator metals (i.e., chromium, zirconium, tin, nickel, and copper). The area impacted was within the area beneath the active FCO manufacturing building.
- **Fuels Manufacturing Operations/Fuels Manufacturing Operations Expansion (FMO/FMOX) Facility Area.** In 1991, process liquid containing fluoride, nitrate, and uranium was accidentally released into the subsurface through a construction joint in the FMOX facility. The impacted soil beneath the building was excavated, and a groundwater-collection sump (the Horizontal Collection System) was installed to recover groundwater with exceedances from the shallow, upper Surficial Aquifer. An additional sump (SD-1SW) was installed in a former storm drain to recover shallow groundwater from the area. A monitoring well network (the FX-series wells) was subsequently installed around the FMO/FMOX facility. Routine sampling of groundwater from these wells has continued since 1992. The primary groundwater exceedances include fluoride, nitrate, and uranium. The primary objective of the routine monitoring program is to detect changes in groundwater quality by sampling wells located around the perimeter of the FMO/FMOX facility; these data are also specifically collected in accordance with NRC Materials License SNM-1097.

- **Aeration Basin/Process Lagoon Area.** The existing facility process water treatment system includes an aeration basin and process lagoon system. This area is monitored through monitoring wells on a regular basis, and shallow, localized groundwater impacts from selected inorganic and radiological constituents have at times been detected. This monitoring is specifically performed by GNF-A in accordance with NRC Materials License SNM-1097.

- **East/Central Site Organic Exceedances.** Historic releases of organic solvents led to groundwater exceedances in the east/central areas of the Wilmington Site. Most wells displayed on **Figure 3.4-14** outside labeled monitoring areas are used to monitor groundwater for volatile organic compounds (VOCs) in accordance with the *Remedial Action Plan for Organic Compounds in Groundwater* (RTI Report No. 5040-01F, December 14, 1992) and the *Corrective Action Plan for Organic Compounds in Groundwater* (RTI Report No. 5040/006/01F, March 30, 1994). *A Comprehensive Site Assessment and Corrective Action Plan for Organic Compounds in Groundwater - Vicinity of the Northern Property Boundary Area* (RTI Report No. 5040/022/01F, May 9, 1996) was prepared in the second quarter of 1996 and specifically addresses groundwater exceedances near the northern property boundary area and its inferred source area. The primary objective of the associated monitoring program is to evaluate the distribution and migration of VOCs in the Principal Aquifer beneath the Site and to evaluate the effectiveness of remediation activities. Remediation and containment of the areas with VOC exceedances continue through the withdrawal of groundwater from Site recovery and process water wells.

3.4.1.2.3 Wilmington Site Groundwater Remediation

Active remediation activities provide hydraulic containment of impacted Principal Aquifer groundwater in the Eastern Site Sector. **Figure 3.4-10** shows the pumping wells that compose this remediation system. The pumped groundwater is treated and used by the existing Wilmington Site facilities as process water. The groundwater elevation contours in **Figure 3.4-10** reveal a hydraulic trough-of-depression, which demonstrates that the pumping system maintains lowered groundwater elevations and hydraulic containment on the Site. The pumping conditions in these wells are routinely monitored, and the system is accordingly adjusted to provide effective hydraulic containment.

Additional remediation is provided by two sumps collecting shallow groundwater in the FMO/FMOX facility area. These sumps include a horizontal collection system and a former stormwater sewer vault, where groundwater is recovered for treatment.

3.4.1.2.4 GLE Study Area Groundwater Quality

As shown in **Figure 3.4-14**, several wells are within the GLE Study Area and provide groundwater-quality data. Earlier (1997) and recent (2007) laboratory data for these wells show groundwater concentrations below NCDENR 2L standards for all analytes measured. **Table 3.4-5** shows data collected in 2007 that confirm the high groundwater quality in the GLE Study Area (all laboratory results are below the NCDENR 2L standards). The GLE Study Area is adjacent to known impacted areas in the northwest Site area to the west and the waste treatment area to the east (see **Figure 3.4-14**); however, groundwater-flow patterns prevent migration from these impacted areas into the GLE Study Area. Furthermore, the Site groundwater remediation system (see **Section 3.4.1.2.3**) maintains eastward groundwater gradients in the eastern portion of the GLE Study Area, thus containing the existing impacts within the Eastern Site Sector.

3.4.2 Surface Waters

3.4.2.1 Streams, Lakes, and Impoundments

3.4.2.1.1 Streams

The Wilmington Site is located within the Northeast Cape Fear River Sub-basin of the Cape Fear River Basin. The Cape Fear River Basin covers 9,149 mi^2 (23,700 km^2), making it the largest river basin in North Carolina (NCDENR, 2004). The Cape Fear River Basin covers 24 counties and is estimated to have 6,300 miles (10,100 km) of streams and rivers. The Northeast Cape Fear River Sub-basin covers 1,750 mi^2 (4,533 km^2) and portions of 7 counties (**Figure 3.4-18**). The headwaters of the Northeast Cape Fear River start near Mt. Olive, NC, in Wayne County and flow in a southerly direction past the Wilmington Site in New Hanover County. Six miles (10 km) south of the Site, the Northeast Cape Fear River joins the Cape Fear River to form the Cape Fear River Estuary (see **Section 3.4.2.1.3** for more information on estuaries and oceans).

The Northeast Cape Fear River is the nearest named waterbody to the Wilmington Site and is located along the southwestern property boundary. **Figure 3.4-19** shows the streams and other surface waters encompassed by and adjacent to the Wilmington Site. The Northeast Cape Fear River is approximately 125-miles (201-km) long and has an average gradient of 0.27 ft/mile (0.05 m/km) (NRC, 1984; NCDENR, 2004). In the vicinity of the Wilmington Site, the river is approximately 600- to 1,100-ft (180- to 335-m) wide and has an average flow of 2,070 cubic feet per second (ft^3/s) (59 cubic meters per second [m^3/s]) (NRC, 1984) (see **Section 3.4.2.11**). The water is black, tannic, and brackish, with consistently low pH and depressed dissolved oxygen levels (see **Section 3.4.2.2**); conditions that are characteristic of a tidally influenced river in the North Carolina Coastal Plain.

Several streams and an industrial effluent channel facilitate drainage on the Wilmington Site (see also **Section 3.4.2.10.1**). Unnamed Tributary #1 to Northeast Cape Fear River is a stream that receives drainage from the industrial Eastern Site Sector. In addition, groundwater discharge and surface water runoff from the eastern and northern portions of the Western Site Sector also contribute to flow. This perennial-flowing stream discharges into the Northeast Cape Fear River at the property boundary.

Based on field observations, a portion of Unnamed Tributary #1 to Northeast Cape Fear River downstream of the Site dam was historically altered from both damming and dredging. The maturity of the trees indicates that this area has not been altered in at least 40 years. The lowest portion of this tributary is tidally influenced. This stream may be locally known as Brickyard Creek; however, the name is not officially recognized by any federal or State regulatory agency. For the purposes of this Report, all streams will be referred to according to the schedule of stream classifications and the naming conventions set forth in 15A NCAC 02B.0301.

Upstream of Unnamed Tributary #1 to Northeast Cape Fear River is an industrial effluent channel originating in the Eastern Site Sector. The effluent channel carries treated process wastewater effluent and treated sanitary wastewater[3] effluent from National Pollutant and Discharge Elimination Systems (NPDES)–permitted discharges (see **Section 3.4.2.8.1**), as well as stormwater from the industrial portions of the Eastern Site Sector to Unnamed Tributary #1 to Northeast Cape Fear River (**Figure 3.4-19**). The Site dam marks the approximate boundary between the industrial effluent channel and the natural stream channel. The effluent channel is either a completely man-made feature, meaning that the channel was dug in an upland area, or it is a man-altered feature, meaning that it was a natural drainage swale that has been enlarged and straightened. Review of historic information, including aerial photos from New Hanover County taken in 1949, 1956, and 1966, does not conclusively reveal the origin or original natural

[3] "Sanitary wastewater" is referred to in the NPDES permit as "domestic wastewater."

configuration of this channel. Currently, the effluent channel is maintained to facilitate the drainage from the industrial Eastern Site Sector.

Unnamed Tributary #2 to Northeast Cape Fear River, locally known as Jackey's Creek, originates within the Swamp Forest community of the Western Site Sector and flows off-site to the Northeast Cape Fear River (see **Section 3.5**, *Ecological Resources*, for more information regarding the Swamp Forest community). This stream is a natural channel that drains the northern portion of the Western Site Sector and the majority of the Northwestern Site Sector. In addition to channeling of water from the surrounding wetland area, this tributary receives runoff from forested communities and a small amount of runoff from gravel roads on the Site. The lower portion of Unnamed Tributary #2 to Northeast Cape Fear River is tidally influenced where it joins with the Northeast Cape Fear River north of the Wilmington Site.

Several smaller unnamed tributaries to the Northeast Cape Fear River also originate in the Western Site Sector. These streams are located within the Swamp Forest community prior to joining the Northeast Cape Fear River. These unnamed tributaries are natural channels and are tidally influenced.

Unnamed Tributary #1 to Prince George Creek, locally known as Broadwater Branch, originates in the Eastern Site Sector. This stream receives stormwater runoff from parking lots, buildings, and undeveloped areas in this sector. Unnamed Tributary #1 to Prince George Creek also receives groundwater discharge. This stream flows in a northern direction off of the Site to its confluence with Prince George Creek, which discharges into the Northeast Cape Fear River approximately 9.5 river miles (15.2 km) upstream of the Wilmington Site.

Unnamed Tributary #2 to Prince George Creek, locally known as Persimmon Creek, begins north of the Wilmington Site, but receives drainage from the majority of the North-Central Site Sector. This stream flows in a northerly direction through undeveloped forest lands into Prince George Creek.

More information on the streams of the Wilmington Site is available in **Section 3.4.2.10**.

3.4.2.1.2 Lakes and Impoundments

The Wilmington Site contains three impoundment areas (individually, two active final process lagoons and their associated aeration basin, four inactive wastewater treatment facility lagoons, and one firefighting supply pond), two stormwater wet detention basins, and three ephemeral, woodland ponds. The locations of these waterbodies are depicted in **Figure 3.4-19.**

Two clay-lined final process lagoons and an aeration basin serve as part of the Site's treatment system for process wastewater. The lagoons are periodically dredged and inspected. The water discharged from the lagoons has reached ambient air temperature by the time it is discharged to the effluent channel immediately above the Site dam; therefore, there are no thermal impacts to the receiving waters. The two wastewater treatment facility lagoons are in the process of being decommissioned, and wastewater is no longer routed to these ponds. More information on the wastewater treatment system for the Wilmington Site is available in **Section 3.12**, *Waste Management*. The final lagoon (a firefighting supply pond) is an emergency water supply for fire suppression at the Site.

Two stormwater wet detention basins have recently been added to the Site to treat stormwater runoff from three warehouses in the southwestern portion of the Eastern Site Sector and from a parking lot in the northeastern portion of the Eastern Site Sector. These basins are designed to improve the water quality of the runoff from the impervious surfaces before being discharged to receiving streams.

No ponded water was observed in the ephemeral, woodland ponds during field investigations conducted in drought conditions between June and September 2007. Two ponds, located in the Western Site Sector,

had pollen-stained rings on trees and dried sphagnum on the bottom, which indicate the last level of standing water. These ponds likely contained water during the winter and spring and possibly the summer of years with average or above-average precipitation. The third ephemeral pond located in the North-Central Site Sector had no signs of recent water storage. This pond likely holds water during above-average precipitation years or during extreme weather events. More information on these ponds is presented in **Section 3.5**, *Ecological Resources*.

3.4.2.1.3 Estuaries and Oceans

Approximately 6 miles (10 km) downstream of the Wilmington Site, the Northeast Cape Fear River joins the Cape Fear River, which widens into the Cape Fear River Estuary before discharging into the Atlantic Ocean 20 miles (32 km) further south. Salinity typically ranges between 0 and 10 parts per thousand (ppt) in the upper portion of the estuary and increases steadily to 20 ppt near the mouth of the estuary before emptying to the Atlantic Ocean. The median flushing time of the Cape Fear River Estuary is 6.7 days, and the water leaving the estuary generally flows to the south and west of the estuarine mouth in the Atlantic Ocean (Mallin et al., 2005).

3.4.2.2 Surface Water Quality Characteristics

Water quality standards are mandated by the Clean Water Act (CWA) and "define the goals for a waterbody by designating its uses, setting criteria to protect those uses, and establishing provisions to protect water quality from pollutants" (U.S. EPA, 2007c). EPA has passed this mandate to the NC DWQ to establish water quality standards for surface waters in North Carolina. The Northeast Cape Fear River is designated as Class-C swamp waters downstream of its confluence with Prince George Creek and as Class-B swamp waters between Prince George Creek and the NC 210 bridge (**Figure 3.4-20**). Class-C waters are protected for secondary recreation (e.g., boating), fishing, and wildlife, and Class-B waters are protected for primary recreation (e.g., swimming), in addition to fishing and wildlife. "Swamp waters" is a supplemental classification used to recognize those waters that have naturally occurring low velocities, low pH, and low levels of dissolved oxygen. Unless otherwise classified, unnamed tributaries have the same designated use as their receiving stream. Therefore, the unnamed tributaries to the Northeast Cape Fear River on the Wilmington Site are classified as Class-C swamp waters. Prince George Creek, including Unnamed Tributary #1 to Prince George Creek located on the Site, is also classified as Class-C swamp waters. NC DWQ has established water quality standards and action limits associated with each surface water classification (15A NCAC 02B .0211).

Although the Northeast Cape Fear River and its tributaries are designated for freshwater use, it is important to note that the river and the lower portion of its tributaries are influenced by salt water from the Cape Fear Estuary and Atlantic Ocean. The tidal stage and quantity of freshwater input significantly affect the salinity and concentrations of sulfate and chloride in the Northeast Cape Fear River and its tributaries (i.e., low-flow conditions or high tidal stage allow for mixing of brackish water much farther upstream than their converses). The routine mixture of brackish waters in the Northeast Cape Fear River and tributaries suggest that salinity, chloride, and sulfate are most likely increased above typical freshwater conditions during the majority of the year (USACE, 2005).

3.4.2.2.1 NCDENR Data

The NC DWQ collects water quality monitoring data on the Northeast Cape Fear River at two stations, one upstream (STORET Station B9580000) and one downstream (STORET Station B9740000) of the Wilmington Site, and the Lower Cape Fear River Program (LCFRP) monitors water at one station (STORET Station B9670000) near the Wilmington Site (see **Figure 3.4-20**). The monitoring data collected at the stations monitored by the NC DWQ are available through the EPA STOrage and RETrieval (STORET) database (U.S. EPA, 2007b). Data from the station monitored by the LCFRP were not available in STORET and were obtained from the NC DWQ and the University of North Carolina at

Wilmington Data Visualization Tool (NCDENR, 2004; UNCW, 2007). General descriptions of these monitoring stations are provided below:

- STORET Station B9580000, Northeast Cape Fear River at US 117 at Castle Hayne, is located just above the confluence of Prince George Creek, approximately 17 miles (27 km) upstream of the Wilmington Site, and serves as a measure of background water quality for the Site. The station has been routinely monitored by the NC DWQ since January 1969 and is sited just downstream of the Elementis Chromium wastewater treatment facility.
- STORET Station B9740000, Northeast Cape Fear River at US 421 at Wilmington, is located approximately 6 miles (10 km) downstream of the Wilmington Site. This station has been monitored by the NC DWQ since March 1974 and is sited upstream of the Cape Fear River confluence.
- STORET Station B9670000, Northeast Cape Fear River at the pier (referred to as the GE Dock) on the southern boundary of the Wilmington Site is located downstream of the confluence with Unnamed Tributary #1 to Northeast Cape Fear River. The LCFRP has monitored this site for standard water quality characteristics since 1995.

On average, STORET stations B9580000 and B9740000 exhibit low dissolved oxygen and pH levels. At these stations, salinity ranges from freshwater to brackish, and high quantities of total suspended solids (TSS) (with respect to typical inland streams) are routinely measured. Chloride concentrations at the downstream Wilmington station (STORET Station B9740000) are expected to be higher than at the upstream station (STORET Station B9580000) due to the tidal influence and proximity to the ocean (NCDENR, 2007a; U.S. EPA, 2007b). **Table 3.4-6** displays the minimum, mean, and maximum water quality characteristics measured by NC DWQ and reported in STORET for these stations for the 1997 to 2006 period of record. Based on these data, maximum copper, iron, and zinc concentrations exceeded their North Carolina water quality standards of 0.007 mg/L, 1 mg/L, and 0.05 mg/L, respectively, at both the upstream and downstream stations. However, average concentrations of these three metals were below North Carolina water quality standards. Copper concentrations exceeded the standard in 8.6% of samples at the downstream station and 7.4% of samples taken at the upstream station. Similar numbers of exceedances were observed for iron and zinc levels at both the upstream and downstream stations, ranging from 4.4% to 20% of samples (U.S. EPA, 2007b). The similarity of the datasets generated for both the upstream and downstream sampling stations indicate that these elevated metals results are independent of the location of the Wilmington Site**.**

STORET Station B9670000 (monitored by the LCFRP) exhibits similar characteristics to the two DWQ sites, such as low dissolved oxygen and pH levels. **Table 3.4-7** displays a summary of the water quality characteristic results reported by the LCFRP for this station. The results collected from this station are within the ranges observed at the upstream and downstream STORET stations. Salinity ranges from fresh water to brackish, and TSS concentrations are higher than typical inland streams (NCDENR, 2004; UNCW, 2007). Metals are not monitored at this station.

3.4.2.2.2 GEH Monitoring Data

In order to assess the potential impact of Site operations on surface water, GEH monitors surface waters for radiological and non-radiological parameters at three locations.

3.4.2.2.2.1 Radiological Monitoring

GEH monitors gross alpha, gross beta, and uranium concentrations in the effluent channel at the Site dam (SDAM), Northeast Cape Fear River near Castle Hayne, NC (UPST), and Northeast Cape Fear River at GE Dock (GEDK) stations, downstream of the effluent channel (see **Figure 3.4-20**). UPST and GEDK are approximately the same sampling locations as STORET stations B9580000 and B9670000,

respectively. **Table 3.4-8** summarizes the Wilmington Site radiological monitoring performed from January 1997 to June 2006.

At the Site dam station (SDAM), the maximum concentration of uranium detected was 0.13 mg/L and the mean concentration of uranium was 0.024 mg/L, only slightly above the GEH on-site analytical laboratory practical quantitation limit of 0.02 mg/L. The mean concentration of gross alpha was 49.9 picocuries/L (pCi/L) and gross beta was 58.7 pCi/L at the Site dam station. The concentrations of uranium in samples from both Northeast Cape Fear River stations (GEDK and UPST) were below the practical quantitation limit of 0.02 mg/L. Average concentrations of gross alpha and gross beta at GEDK and UPST were below NC DWQ water quality standards levels of 15 and 50 pCi/L, respectively (15A NCAC 02B .0211).

3.4.2.2.2.2 Non-radiological Monitoring

GEH monitors non-radiological parameters at the SDAM, as well as at Northeast Cape Fear River stations located upstream (UPST) and downstream (GEDK) of the Wilmington Site (**Table 3.4-9**). Monitored characteristics from both Northeast Cape Fear River stations (UPST and GEDK) are similar to those collected by the NC DWQ (see **Table 3.4-6**) and LCFRP (see **Table 3.4-7**). Minimum values of dissolved oxygen concentrations were below (i.e., not meeting) the water quality standard of 4.0 mg/L at stations upstream and downstream of the Wilmington Site in both the GEH and NCDENR datasets; however, mean concentrations were all above (i.e., meeting) the standard. Therefore, these periodically low oxygen conditions are likely a natural occurrence characteristic of swamp waters. Chloride concentrations are reported by GEH above the freshwater water quality standard of 230 mg/L at GEDK; as stated in **Section 3.4.2.2.1**, the likely source of the chloride is salt water derived from the Atlantic Ocean. These results are consistent with the results from STORET Station B9740000 (see **Table 3.4-6**). Based on the data collected by GEH, mean copper concentrations exceeded the North Carolina water quality standard of 0.007 mg/L at both stations on the Northeast Cape Fear River (UPST and GEDK); however, this statistical calculation includes one-half of the sample-specific practical quantitation limit (PQL) as a surrogate for non-detect results, and the PQL for the majority of the GEH dataset was 0.025 mg/L (i.e., one-half the PQL exceeds the water quality standard). Copper concentrations exceeded the standard in 5.1% of the samples at the downstream station and 8.3% of the samples at the upstream station. These detections occurred prior to 2001. Because of the elevated PQLs in the GEH dataset, these statistical results for copper should not be compared to the dataset generated by NCDENR (see **Table 3.4-6**).

3.4.2.3 Pre-Existing Environmental Conditions

The surface hydrology of the Wilmington Site has been altered by historical agriculture practices, historical and current silviculture, and current industrial operations. The Site was initially established in 1967 on land that had historically been a rice plantation. In the Southeastern Coastal Plain between 1783 and the early nineteenth century, rice plantations used the tidal flow method. Growing rice with this method required the planter to clear the riverside swamps of timber and undergrowth and then surround them with earthen levees. Dams and ditches were then constructed to control the flow of water to the plantation. Tidal fluctuations in river height were used to irrigate the fields and control weeds and pests (NPS, 2007). These historical alterations of the surface waters on the Wilmington Site are evident today.

During the 1950s and 1960s, large portions of the Wilmington Site were ditched and drained (based on aerial photography obtained from New Hanover County). Throughout the development of the Wilmington Site, the landscape has continually been modified to meet the operational needs. Areas used as borrow material for the construction of the industrial facilities were excavated, and the effluent channel and supporting ditches were created or deepened to facilitate drainage from the industrial Eastern Site Sector. The industrial area consists of manufacturing buildings, wastewater treatment facilities, power supply lines, roads, parking lots and landscape areas. Historical borrows areas are present in the Northwestern,

North-Central, and South-Central site sectors. Timber management continues on large tracts of land within the Site, particularly in the North-Central Site Sector.

Currently, surface waters on the Site are not impaired, nor have any signs of water quality deterioration been observed. As discussed in **Sections 3.4.2.1 and 3.4.2.10**, the surface runoff from the Site eventually discharges into the Northeast Cape Fear River. The NC DWQ is responsible for evaluating the condition of the streams and determining if water quality standards are being met. The Northeast Cape Fear River from NC 210 (upstream of the Wilmington Site) to Ness Creek (downstream of the Wilmington Site) is Not Rated for aquatic life because the dissolved oxygen concentration was below the State water quality requirement of 4 mg/L in 23% and 10% of samples, respectively, collected from 1998 to 2003 at two monitoring sites (NCDENR, 2004). The Northeast Cape Fear River is classified as a swamp water, which "acknowledges natural characteristics of swamps such as low dissolved oxygen" (NCDENR, 2005). However, significant wastewater permit limit violations based on a 2-year monitoring period from two different wastewater treatment plants downstream and upstream of the Wilmington Site (NPDES permit Nos. NC0039527 and NC0049743, respectively; see **Table 3.4-10** and **Figure 3.4-21**) may have also contributed to the low dissolved oxygen (NCDENR, 2005). Also, the Northeast Cape Fear River between Prince George Creek and NC 210 (upstream of the Wilmington Site) is listed as impaired on North Carolina's 2006 303(d) list. This section of the river has a fish consumption advisory for mercury. The source of mercury is unknown (NCDENR, 2007e). Total mercury exceeded State and federal limits for both aquatic life and human consumption. Elevated levels were found in largemouth bass, bowfin, and chain pickerel (NCDENR, 2004). Prince George Creek and its tributaries are Not Rated for aquatic life (NCDENR, 2005). None of the streams on the Wilmington Site are classified as impaired waters.

3.4.2.4 Historical and Current Hydrologic Data from Non-Related Projects

There are no reservoirs or dams currently existing or planned within the Northeast Cape Fear River Sub-basin. Local drinking water and industrial process water is supplied by groundwater (see **Section 3.4.5**).

3.4.2.5 Surface Water Rights and Resources

North Carolina water laws are based on the "riparian rights" concept, rather than appropriated water rights[4]. According to this concept, "a riparian owner is entitled to the natural flow of a stream running through or along his land in its accustomed channel, undiminished in quantity and unimpaired in quality, except as may be occasioned by reasonable use of the water by other like owners." The existing Wilmington Site facilities do not rely on surface water for water supply, nor will the Proposed GLE Facility. Nevertheless, some types of water resource projects are subject to State or federal regulations that establish parameters and procedures to determine what a "reasonable" use is (NCDENR, 2007d).

3.4.2.6 Quantitative Description of Surface Water Use

No surface water uses (e.g., withdrawals, consumptions) are made at the Site. All water used at the facility for both the potable water system and the process water system is provided via groundwater. Consumptive and non-consumptive uses of all water resources are described in **Section 3.4.5**. NPDES-permitted discharges of treated process wastewater and sanitary wastewater are directed to the effluent channel, which flows to the Northeast Cape Fear River. These discharges are described in more detail in **Section 3.12**, *Waste Management*.

3.4.2.7 Non-consumptive Surface Water Use

The Northeast Cape Fear River is a wide and naturally deep river that has been used for navigational purposes (see **Section 3.2.1.2** *Waterways [Regional Transport Corridors]*). The Northeast Cape Fear River and its tributaries are also used for a variety of recreational interests, including sport fishing,

[4] Appropriated water rights refer to the "first in time, first in right" allocation system used in the western United States.

boating, swimming, and wildlife observation; however, no recreational uses are permitted in streams located on the Wilmington Site. More information on the aquatic resources of the Northeast Cape Fear River and its tributaries is discussed in **Section 3.5**, *Ecological Resources*.

3.4.2.8 Pollutant Sources

3.4.2.8.1 Point Sources

Under NPDES permit number NC0001228, GNF-A is currently permitted to discharge 1.8 million gallons per day (gpd; 6.8 million liters per day [lpd]) of treated process wastewater and 0.075 million gpd (.28 million lpd) of sanitary wastewater. Monitoring efforts to maintain compliance with the NPDES permits include effluent water quality sampling. Pollution-prevention efforts such as waste minimization are routinely practiced, and as of June 1, 2007, no significant non-compliance violations were reported in the EPA Permitting Compliance System database since the NPDES permit issue date of April 1, 2004 (U.S. EPA, 2007a). More information on wastewater treatment for the Wilmington Site is discussed in **Section 3.12**, *Waste Management.*

The Wilmington Site is a major permitted wastewater discharge (greater than 1 million gpd [3.7 million lpd]) on the lower Northeast Cape Fear River; however, eight other permitted wastewater operations currently discharge to the Northeast Cape Fear River and one permitted wastewater operation discharges to Prince George Creek in New Hanover County (see **Figure 3.4-21**). A summary of these NPDES facilities (i.e., type) and discharge (i.e., class and volume) is presented in **Table 3.4-10**. Two of these facilities are major permitted wastewater discharges on the lower Northeast Cape Fear River: Invista, S.A.R.L. and Elementis Chromium. Invista discharges non-contact cooling water, concentrate from reverse osmosis treatment process, and non-process area stormwater. The Invista outfall is located across and slightly upstream from the Wilmington Site. As of June 1, 2007, no significant non-compliance violations were reported for this outfall since the NPDES permit issue date of February 14, 2005. Elementis Chromium operates an industrial inorganic chemical manufacturing facility approximately 18 miles (29 km) upstream from the Wilmington Site. As of June 1, 2007, no significant non-compliance violations were reported for this facility since the NPDES permit issue date of April 15, 2002 (U.S. EPA, 2007a).

3.4.2.8.2 Non-point Sources

In 2007, the Wilmington Site was issued a revised stormwater permit (Permit No. NCS000022) by the NC DWQ. The permit requires semi-annual monitoring of stormwater runoff from the Site and provides benchmark values that are used as guidelines for the Site's Stormwater Pollution Prevention Plan. Based on this permit, analytical monitoring is required at stormwater discharge outfalls (SDO) 9, 13, and 14 (**Figure 3.4-22**). Samples must be collected during representative storm events and performed twice a year, once in the spring (April–June) and once in the fall (September–November). SDOs 9, 13, and 14 are analyzed for oil and grease, pH, and TSS. Lead concentrations are determined from SDO 9 only. The 2007 results are shown on **Table 3.4-11**, along with the results from monitoring performed under the previous stormwater permit, which required 1 year of quarterly stormwater samples for a different set of analytes, as displayed in the table.

The previous stormwater permit did not provide benchmark values or permitted ranges as a reference to evaluate stormwater sampling results. Therefore, the permit requirements were met by the stormwater sampling events, which took place quarterly in 2003. Stormwater samples were analyzed for ammonia, combined nitrite and nitrate, fluoride, uranium, dichloroethylene (DCE), TCE and VC. Refer to **Table 3.4-11** for detailed sampling results**.**

With the exception of TSS at SDO 14 during the fall 2007 stormwater sampling event, the results indicate that stormwater quality data at SDOs 9, 13, and 14 are within the benchmark values provided in the current NPDES stormwater permit. While TSS was within range during the spring sampling event, TSS exceeded the benchmark value of 100 mg/L during the fall. The source of the somewhat elevated TSS concentration at SDO 14 has been evaluated, and it was concluded to be nearby construction activities occurring at the time of the sampling event. Those construction activities were in accordance with an approved Stormwater Erosion and Control Plan and have since concluded; therefore, future elevated TSS concentrations are not expected.

3.4.2.9 Federal and State Regulations

3.4.2.9.1 Waters of the United States

The CWA requires regulation of discharges into "Waters of the United States." EPA is the principal administrative agency of the CWA; however, the USACE has the responsibility for implementing, permitting, and enforcing provisions of this Act. Sections 404 and 401 of this Act are applicable to surface waters at the Wilmington Site.

Section 404 of the CWA authorizes the USACE to issue permits for the discharge of dredged or fill material into Waters of the United States. The USACE regulatory program is defined in 33 CFR 320-330. Before an activity occurs, applicable permits must be obtained and any compensatory mitigation must be determined. If the USACE determines that a 404 permit is required because a proposed project involves impacts to wetlands or waters, then a 401 Water Quality Certification is also required. The USACE also determines which type of permit (i.e., Nationwide, Regional, General, or Individual permit) is applicable to a project.

Section 401 of the CWA delegates authority to the states to issue a 401 Water Quality Certification for all projects that require a federal permit (such as a CWA Section 404 Permit). The 401 Water Quality Certification is essentially verification by the State that a given project will not degrade State Waters or otherwise violate water quality standards.

The Northeast Cape Fear River is a navigable water of the United States, as defined as "those waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible to use to transport interstate or foreign commerce" (33 CFR 329, *Definition of. Navigable Waters of the US*). Both a 404 permit and 401 Water Quality Certification are required for impacts to surface waters that are considered either a traditional navigable water or a tributary to traditional navigable water. The streams on the Wilmington Site (excluding the effluent channel) are tributaries to the Northeast Cape Fear River, and any impact to these streams requires a 404 permit and 401 Water Quality Certification. The Proposed Action would require a 404 permit and a 401 Water Quality Certification to be obtained prior to commencement of the Proposed Action. Specific impacts to surface water from the Proposed Action and mitigation options to minimize those impacts are discussed in **Section 4.4** (*Water Resources Impacts*) and **Chapter 5** (*Mitigation Measures*) of this Report, respectively.

Under Section 10 of the Rivers and Harbors Act of 1899, the building of wharfs, piers, and other structures is prohibited without approval, and excavation or fill within navigable waters requires the approval of the USACE. Section 10 of this Act requires permits to be issued whenever CWA Section 404 permits are issued for rivers or streams that are defined as navigable, such as the Northeast Cape Fear River. The Proposed Action would not impact navigable streams; therefore, a Section 10 permit would not be required.

3.4.2.9.2 National Pollutant Discharge Elimination Systems (NPDES)

EPA created the NPDES to track and control point sources of pollution in accordance with the CWA. The primary method of control is issuing permits to dischargers with limitations on wastewater flow and constituents. EPA delegated permitting authority to the State of North Carolina in 1975. The NPDES program establishes limits for flow (i.e., quantity discharged), conventional pollutants (e.g., biochemical oxygen demand, pH, TSS, fecal coliform, oil, grease), toxicants (e.g., metals, volatile organics), and non-conventional pollutants (e.g., ammonia, nutrients) (NCDENR, 2007b).

Existing NPDES permits are renewed every 5 years. Major modifications to existing NPDES permits include, but are not limited to, changes to compliance schedules, increases in flow or pollutant loads, changes to permit limits, corrections of technical errors, or material and substantial alterations to the permitted facility or on-site activity. Permit modifications must be accompanied by a complete permit application (NCDENR, 2007c).

The Wilmington Site has two NPDES permits: Permit No. NC0001228 for wastewaters (process water and sanitary water) and Permit No. NCS000022 for stormwater. The Proposed Action would likely require modifications of the existing NPDES permits to account for an increase in sanitary wastewater and additional stormwater discharge. Details regarding the effluent characteristics and potential stormwater outfall location for the Proposed Action are discussed in **Section 4.13** (*Waste Management Impacts*) and **Section 4.4** (*Water Resources Impacts*) of this Report, respectively.

3.4.2.9.3 Coastal Zone Management Act

Section 307(c) of the Coastal Zone Management Act of 1972, as amended (16 U.S.C. 1456(c)), requires any non-federal applicant for a federal license or permit conducting an activity that can affect land or water uses in a state's coastal zone to furnish a certification that the proposed activity will comply with the state's coastal zone management program. To comply with this federal regulation, North Carolina passed the CAMA, which is administered by the NC DCM. CAMA permits must be obtained for development of an AEC. An AEC is an area of natural importance that may have environmental, social, economic, or aesthetic value that makes it valuable to the state or that may be easily destroyed by erosion or flooding. AECs include wetlands, ocean shorelines, and areas in proximity to fishing waters or public water supplies. The NC DCM determines whether or not a project is within a designated AEC. If a project is within an AEC and a CAMA permit is required, the NC DCM acts as the lead permitting agency and coordinates the 404/401 permits. For projects within an AEC, thus requiring a CAMA permit, the NC DCM acts as the lead permitting agency and coordinates the 404/401 permits.

Based on a letter received from the NC DCM (see **Appendix B**, *Regulatory Correspondence*), an AEC within the GLE Study Area would include any development below mean high water of the tributaries to the Northeast Cape Fear River and 30-ft (9.1-m) landward of the mean high water table of these tributaries. Development in these areas would require a CAMA permit. Even if the development is outside the AEC, the NC DCM has the option to review the Proposed Action through a federal consistency review. The Coastal Zone Management Act requires that a federal agency (when it proposes any activity that will have any foreseeable effect of any coastal uses or natural resources within the coastal zone) provide the State of North Carolina with a Consistency Determination. The federal agency has the opportunity to demonstrate how the proposed activity complies, to the maximum extent practicable, with the enforceable policies of the State's approved coastal management program. The information and data that must be supplied in a Consistency Determination is specified in 15 CFR 930.39 (*Content of a consistency determination*).

3.4.2.10 Site-Specific Surface Water Characteristics

General surface water characteristics are discussed in **Section 3.4.2.1.1** for streams and rivers, **Section 3.4.2.1.2** for lakes and impoundments, and **Section 3.4.2.1.3** for estuaries and oceans. Information on the floodplain and its relationship to the Site, including flood frequency distribution and flood control measures, is discussed in **Section 3.4.3**.

3.4.2.10.1 Streams

Approximately 18,262 ft (5,566 m) of linear stream channel are located within the Wilmington Site. The effluent channel accounts for another 4,631 ft (1,412 m) of industrial effluent channel. These surface waters are illustrated in **Figure 3.4-19**. The streams on the Wilmington Site are classified as Class-C swamp waters by the NCDENR (**Section 3.4.2.2**). In general, the headwaters of these streams originate on the Wilmington Site, meaning that the drainage areas for most of the streams are located within the GEH property boundary. **Table 3.4-12** summarizes the total length of stream and the percent-drainage area for the Wilmington Site. Wilmington Site surface water drainage is illustrated in **Figure 3.4-23**.

Approximately 42% of the Wilmington Site drains to Unnamed Tributary #1 to Northeast Cape Fear River (including the drainage area of the effluent channel). The drainage area includes the majority of the Eastern and South-Central site sectors, as well as portions of both the North-Central and Western site sectors. The headwaters and discharge location for Unnamed Tributary #1 to Northeast Cape Fear River are contained within the Wilmington Site.

Approximately 11% of the Site, including the northern portion of the Swamp Forest, drains to Unnamed Tributary #2 to Northeast Cape Fear River. The stream drains the majority of the Northwestern Site Sector. The stream originates in the Western Site Sector, but flows through an off-site Swamp Forest before discharging into the Northeast Cape Fear River.

Various unnamed tributaries to the Northeast Cape Fear River in the Western Site Sector Swamp Forest drain approximately 11% of the Wilmington Site. These streams are fully contained within the Wilmington Site boundary.

Unnamed Tributary #1 to Prince George Creek receives drainage from the eastern-most portion of the Eastern Site Sector. Approximately 12% of the Wilmington Site drains to this stream. Although Unnamed Tributary #1 to Prince George Creek originates on the Wilmington Site, the stream drains off-site and receives off-site surface waters before discharging to Prince George Creek.

Surface water drainage for the remaining portions (24%) of the Wilmington Site is not associated with a specific stream on the Site. Of the remaining drainage areas, approximately 20% of the Site drains north to Unnamed Tributary #2 to Prince George Creek. In the North-Central Site Sector, most of the surface water runoff drains through a system of man-made ditches, which help form the headwaters of Unnamed Tributary #2 to Prince George Creek just north of the Wilmington Site boundary. Approximately 4% of the Site drains to a swale in the South-Central Site Sector that discharges directly to the Northeast Cape Fear River.

3.4.2.10.2 Outfalls

No new NPDES-permitted outfalls or cooling water outfalls will occur from the Proposed Action. Wastewater will be discharged through the existing NPDES outfalls. This Report does not include site-specific information, such as velocity distribution, waterbody cross section, and bathymetry near the outfall, because an existing outfall will be used and this information is not necessary for the impact assessment.

3.4.2.10.3 Erosion Characteristics and Sediment Transport

Estimates of erosion potential at the Wilmington Site were made using the Revised Universal Soil Loss Equation (RUSLE) (USDA, 1995). This relationship takes into consideration soil type (USDA, 1977), land cover (NC CGIA, 1996), topography (USGS, 1995), and precipitation factors and is used to predict long-term annual average erosion by water on disturbed lands (Yoder et al., 2004). Most soil types across the Site do not have a high erosion potential (see **Section 3.3.4.2**, *Wilmington Site and GLE Study Area Soils*). Land cover across the Site consists of developed land for the existing infrastructure and forests, shrub, and wetland areas for the undeveloped areas (see **Section 3.5**, *Ecological Resources*). To determine input parameters for the RUSLE (Wischmeier and Smith, 1978), a geographic information systems (GIS) algorithm (Blaszczynski, 2000) was used in conjunction with soils, land cover, and topography data. In addition, Site observations and literature reviews were used to determine factors for the equation (USDA, 1995).

In **Figure 3.4-24**, estimated soil erosion rates (tons/acre/year) across the Site are represented in logarithmic groups by color gradation. Resulting calculations reveal little area on Site, with erosion rates greater than 1 ton/acre/year, except along edges of the developed areas. Areas of high erosion potential lie in the landlocked portion of the Site surrounding the infrastructure in the Eastern Site Sector. An area with erosion rates on the order of approximately 0.05 to 0.5 tons/acre/year crosses longitudinally through the center of the Site, along an east to west slope in the land along the border of, but not within, the Western Site Sector and the 100- and 500-year flood boundaries (**Section 3.4.3**). The effluent channel cuts through this area and potentially provides means of sediment transport from the Site to the Northeast Cape Fear River. The soil, land cover, and topography within the Western Site Sector along the border with the Northeast Cape Fear River combine to create land areas less susceptible to erosion (<0.05 tons/acre). Note that the western Site boundary at the Northeast Cape Fear River within the South-Central Site Sector actually consists of a bluff with steep slopes down to the river. Although elevated slope gradients are present in the soils data used in the erosion calculations for this site sector, a higher erosion potential may be possible in this bluff area due to the coarseness of the data used in the RUSLE equation.

For comparison, regional estimates of soil erosion in the North Carolina Coastal Plain generally range from 4 to 13 tons/acre/year (9 to 30 megagrams [Mg]/ha/year). Considerably less sediment actually discharges to surface waters due to processes such as retention in drainage ditches or low-order streams and on other land surfaces (Lecce et al., 2006). For Coastal Plain watersheds, sediment delivery ratios, which relate the amount of sediment transported to waterways to the amount of sediment eroded, typically fall below 10%, with decreasing rates with increasing drainage area (Lecce et al., 2006; Phillips and Slattery, 2006). Considering the low erosion rates and sediment delivery ratios and the main transport mechanism for sediment from the Wilmington Site being an effluent channel with natural topography and the Site dam, the Site is not expected to contribute large amounts of sediment to the Northeast Cape Fear River.

3.4.2.11 Hydrologic Data

There is no continuous flow data available for the streams on the Wilmington Site. The information in this section summarizes the best available information for the Northeast Cape Fear River.

3.4.2.11.1 Historic Monthly Flow Data

At the Wilmington Site, the Northeast Cape Fear River experiences diurnal tides ranging from 1 to approximately 5 ft (.3 to 1.52 m). The USGS determined that the volume of water passing the Wilmington Site during a particular ebb and flow tidal cycle is 220 million ft^3 (6.2 million m^3) and 310 million ft^3 (8.8 million m^3), respectively, whereas the freshwater inflow was estimated at only 11 million ft^3 (312,000 m^3) during the same period (NRC, 1984).

Two USGS stream gages are located on the Northeast Cape Fear River (see **Figure 3.4-18**). USGS gage 02108566, Northeast Cape Fear River at Burgaw, is the closest in proximity to the Wilmington Site and is sited approximately 42 river miles (67 km) upstream of the Wilmington Site. The gage is operated in cooperation with Pender County and measures drainage from 970 mi^2 (2,513 km^2) of the Northeast Cape Fear River watershed. During the years of gage operation from 2003 to 2007, the median and mean stream flows were 671 ft^3/s(18.4 m^3/s) and 971 ft^3/s (27 m^3/s), respectively. Peak daily stream flow at the gage was 6,560 ft^3/s (186 m^3/s) and occurred on October 13, 2005. The average stage height is 3.5 ft (1.1 m), and the highest daily mean stage height was 16.52 ft (5.1 m). Monthly mean discharges for this stream gage are located in **Table 3.4-13**.

USGS gage 02108000 is located on the Northeast Cape Fear River near Chinquapin, approximately 70 miles (113 km) upstream of the Wilmington Site. At this gage, the Northeast Cape Fear River has an associated drainage area of 599 mi^2 (1,551 km^2). During the years of gage operation from 1940 to 2007, the median and mean stream flows were 408 and 724 ft^3/s (12 and 21 m^3/s), respectively. Peak daily stream flow at the gage was 29,900 ft^3/s (847 m^3/s) on September 18, 1999. The average stage height is 5.32 ft (1.62 m), and the highest daily mean stage height was 23.31 ft (7.10 m). Monthly mean discharges for this stream gage are located in **Table 3.4-14**.

3.4.2.11.2 Historical Drought Stages and Monthly Discharge

At the USGS gage 02108566, the minimum mean daily discharge was recorded on October 14, 2004, at 190 ft^3/s (5 m^3/s). The 7-day, once in 10-year, low-flow discharge (7Q10) is not available for this station because the station has only been in operation since 2003. At the USGS gage 02108000, the minimum mean daily discharge was recorded October 10–11, 1954, at 5.3 ft^3/s (0.15 m^3/s). The 7Q10 for this station is 12.1 ft^3/s (0.343 m^3/s), equivalent to about 0.02 ft^3/s (0.0006 m^3/s) per mi^2 (Weaver and Pope, 2001).

3.4.2.11.3 Short Duration Flow Fluctuations

There are no diurnal releases such as from hydroelectric projects or other facilities upstream of the Wilmington Site; therefore, the only variations in flow are from tidal influence.

3.4.2.12 Lakes and Impoundments

The Wilmington Site contains two active final process lagoons and their associated aeration basin, four inactive wastewater treatment facility lagoons, one fire-fighting supply pond, two stormwater wet detention basins, and three ephemeral, woodland ponds. The Proposed GLE Facility would require a new stormwater-detention pond. More information on this facility is discussed in **Chapter 4** of this Report (*Environmental Impacts*). There are no cooling water or water supply reservoirs either currently associated with or proposed on the Wilmington Site; therefore, the following categories are not relevant to the Proposed Action: elevation-area capacity curves, reservoir operating rules, annual yield and dependability; inflow/outflow/storage volumes; net loss calculations; current patterns; and temperature distribution.

3.4.2.13 Estuaries and Oceans

The Cape Fear River Estuary is located 6 miles (10 km) downstream of the Wilmington Site, and the Atlantic Ocean is located 20 miles (32 km) downstream of the Wilmington Site. Monthly river discharges are discussed in **Section 3.4.2.1.1** of this Environmental Report. The volume of water discharged from the Site is not expected to affect either the quality or quantity of surface waters in the estuary and ocean; therefore, the following categories are not relevant to this project: shoreline and bottom descriptions, tidal current patterns, and non-tidal circulation patterns.

3.4.3 Floodplains

3.4.3.1 Floodplain Distribution

The primary sources of flooding in New Hanover County are 1) storm surge created by tropical storms and hurricanes in the Atlantic Ocean and 2) heavy rainfall from these and other storms. Surges from storm events have been known to cause flooding in the Cape Fear River and its tributaries as far north as the New Hanover–Pender County line (upstream of the Wilmington Site; see **Figure 3.4-18**). Stream overflow during heavy rainfalls has also been reported to cause flooding in Prince George Creek, near the Wilmington Site. Because of the "estuarine nature" of the Cape Fear and Northeast Cape Fear rivers, overflows from tributaries "have a negligible effect on the stages of these rivers in Wilmington" (downstream from the Site) (FEMA and State of North Carolina, 2006a). Therefore, these river systems have a natural buffering capability when faced with tributary overflows.

Figure 3.4-25 shows the GLE Study Area at the Wilmington Site, the digital elevation model (DEM) elevations, and the 100- and 500-year flood boundaries. In the vicinity of the Wilmington Site, the extents of the 100- and 500-year floodplains are very similar. The extents of these flood boundaries shown in this figure are the approximate extents shown in the Flood Insurance Rate Maps (FIRMs) for the area (**Appendix K**, *FEMA Flood Insurance Rate Maps*). Elevations for the 100- and 500-year floods were delineated from digital elevation data produced in partnership by the State of North Carolina and the USGS. The Wilmington Site boundary was obtained from the New Hanover County Information Technology Department.

The 100- and 500-year flood boundaries form the approximate boundary of the Western Site Sector of the Wilmington Site. Based on data presented in **Figure 3.4-25** and **Figures K-1 and K-2** in **Appendix K**, the Main portion and the North Road portion of the GLE Study Area are located outside of the 100- and 500-year flood boundaries and above the elevations of these projected flood events. The South Road portion of the GLE Study Area borders swampland that is adjacent to the Northeast Cape Fear River system and is within the flood boundaries. Much of this swampland may flood during extreme rain events upstream. Because the Northeast Cape Fear River is totally dominated by coastal surge effects, flood profiles and associated discharges were not calculated in the 2006 Flood Insurance Study (FIS): *A Report of Flood Hazards in New Hanover County, North Carolina, and Incorporated Areas*. Discharge data are available for Prince George Creek, which is north of the Wilmington Site. At Prince George Creek and Castle Hayne Road (the nearest location where calculations were performed for the 2006 FIS), the drainage area peak discharge was calculated to be 2,040 ft^3/s (57.7 m^3/s) for the 100-year flood and 3,200 ft^3/s (90.6 m^3/s) for the 500-year flood. The drainage area at this location was determined to be 10.9 mi^2 (28 km^2; FEMA and State of North Carolina, 2006a, 2006b).

Nearby floodplains are designated as "Zone AE," where base flood elevations have been determined to average 7 ft North American Vertical Datum (NAVD), rounded to the nearest whole number (FEMA and State of North Carolina, 2006b). However, coastal stillwater elevations listed in the 2006 FIS indicate that a value of 7.9 ft NAVD for the 100-year flood and 9.3 ft NAVD for the 500-year flood should be used for construction purposes[5] (FEMA and State of North Carolina, 2006a). Coastal stillwater elevations factor in potential impacts from storm surge, including tidal and wind setup effects. The minimum elevation in the Main portion of the GLE Study Area is approximately 20 ft NAVD (the northwestern portion of the GLE Study Area), which is 12 ft (3.65 m) above the 100-year coastal stillwater flood elevation and 11 ft (3.35 m) above the 500-year coastal stillwater flood elevation. The South Road portion of the GLE Study

[5] According to benchmark data for the Wilmington/Cape Fear area published by NOAA, the difference between ft NAVD and ft above msl is very small (NOAA, 2003). For example, 9.30 ft NAVD (the 500-year floodplain boundary) is equivalent to 9.33 ft msl. Therefore, for the purposes of this report, ft NAVD and ft msl are used interchangeably.

Area within the North-Central Site Sector is adjacent to the 500-year flood boundary and the Western Site Sector. The existing service road, which would be paved for use as the proposed South access road, is at an elevation of approximately 16 to 25 ft NAVD (i.e., 7 to 16 ft [2 to 5 m] above the 500-year coastal stillwater flood elevation). However, the Proposed Action would include an upgrade of the existing stream crossing within the South Road portion of the GLE Study Area, and the elevation of the streambed of Unnamed Tributary #1 to Northeast Cape Fear River at that location is approximately 6 ft (1.8 m) NAVD, which is within the 100-year flood boundary. The minimum elevation of the portion of the GLE Study Area that includes the proposed North access road in the Eastern Site Sector is the streambed of the Unnamed Tributary #1 to Prince George Creek (see **Figure 3.4-25**) at approximately 20 ft NAVD; however, the future roadbed would be constructed over the tributary at an elevation of approximately 25 to 30 ft NAVD.

According to the 2006 FIS for New Hanover County, base flood elevations for the area encompassing the Site were determined using detailed methods. These methods were reported as follows:

> "Hydrologic analyses were carried out to establish the peak discharge-frequency relationship for each flooding source studied in detail affecting the county…The log-Pearson Type III method was used to determine floodflow frequencies for the streams. Because there are no stream gages within the study area, generalized criteria were developed from records ranging from 14 to 39 years from gages in the coastal plain gaging network in North Carolina. Peak discharges were verified by an independent determination using U.S. Weather Bureau rainfall frequency data and synthetic unit hydrograph procedures. The hydrologic analyses for the Cape Fear River basin …were performed using the urban and rural regression equations developed by the USGS …The Coastal Plain equation was used to estimate the 1% annual chance flow for the streams in New Hanover County. The hydrologic approach used for this Flood Insurance Study are the U.S. Geological Survey (USGS) regression equations for North Carolina described in USGS Water Resource Investigation (WRI) reports 1-4207 and 96-4084 … Analyses of historical high-water marks obtained from interviews of county residents were used to confirm the accuracy of the regression equation estimates … For the streams studied by detailed methods, water-surface elevations of floods of the selected recurrence intervals were computed through use of the Army Corps of Engineers' HEC-RAS step-backwater computer program version 3.1" (FEMA and State of North Carolina, 2006a).

For coastal analyses (i.e., calculating coastal stillwater elevations), the joint probability method was used to determine storm surge heights. Five parameters were considered, including central pressure depression, radius to maximum winds, forward speed of the storm, shoreline crossing point, and crossing angle. Historical data from storms impacting the southern coast of North Carolina were used with this method. These data were attained primarily from the National Weather Service and the Mariners Weather Log (FEMA and State of North Carolina, 2006a). More detailed descriptions of methodologies used to calculate floodplain distributions for New Hanover County are presented in the 2006 FIS, published by FEMA and the State of North Carolina. Based on a review of the North Carolina Floodplain Mapping Program Web site, no letters of map change (i.e., LOMCs) were identified that influence the designations discussed above.

In 1999, Hurricane Floyd generated historic peak flood elevations for New Hanover County. USGS stream gages in nearby sub-basins revealed that flooding caused by Hurricane Floyd "was likely greater than 100 years and very possibly greater than 500 years" (FEMA and State of North Carolina, 2006a). However, based on observations by employees working on the Wilmington Site, the GLE Study Area was not known to have flooded during Hurricane Floyd, nor was there any flooding of existing manufacturing operations at the Wilmington Site.

3.4.3.2 Flood-Control Measures

Based on the 2006 FIS for New Hanover County, the only flood-control measure applicable to the proposed Site is "floodplain regulations [that] preclude extensive flood damage to future development." No additional flood-control measures are implemented for the Wilmington Site. In other parts of New Hanover County, sand beach restoration, berm/sand dunes, stream channelization, and a public warning system have been implemented as protection measures (FEMA and State of North Carolina, 2006a).

3.4.3.3 Regulatory Issues

A floodplain development permit from New Hanover County is required before commencement of any development activities within Special Flood Hazard Areas (New Hanover County, 2006). Modification of the existing stream crossing in the South Road portion of the GLE Study Area includes Special Flood Hazard Areas (e.g. the 100-year and 500-year floodplains); therefore, the Proposed Action would likely require this permit. Final determination for the need of the permit can not be determined until final design plans are complete.

3.4.4 Wetlands

3.4.4.1 Description

There are several working definitions of wetlands. The CWA includes wetlands in its definition of Waters of the United States, or jurisdictional waters, along with other waterbodies, such as lakes, rivers, and streams. For the purposes of the CWA, wetlands are areas that are inundated or saturated by surface waters or groundwater at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions (33 CFR 328.3, *Definition of Waters of the United States, Definitions*). This 3-criteria (i.e., hydrology, vegetation, and soils) definition will be used to determine potential regulatory requirements, as determined by the USACE and discussed in more detail in **Section 4.4.4** of this Report (*Wetland Impacts*).

A second definition of wetlands was developed by the FWS and classifies wetlands from an ecosystem standpoint. This classification system is used for mapping wetlands for the National Wetlands Inventory (NWI) (Cowardin et al., 1979). In order to provide a conservative assessment, these data were used for a preliminary analysis of potential wetlands on the Wilmington Site. NWI maps show the location, size, and type of wetland within defined geographical areas. NWI maps attempt to show all types of wetlands, not just ones regulated by the USACE. These maps are not field-verified and do not always accurately depict wetlands under dense forest canopies or wetlands that have been drained or altered. The most recent digital NWI mapping indicates approximately 758.3 acres (307 ha) of wetlands within the Wilmington Site property boundary, comprising 13 different classes of wetlands (U.S. FWS, 1990). These wetlands are depicted in **Figure 3.4-26** and summarized in **Table 3.4-15**. Two of these wetland classes (PFO1Cd and PFO4Bd), comprising 298 acres (121 ha), are described as being partially drained or ditched. These areas, located in the North-Central and Eastern site sectors, were assessed in the field to determine if they contained the three criteria as defined as by the USACE.

Field surveys to assess current Site conditions were conducted between July and September 2007. Alterations to surface topography and installation of drainage features have caused some of the areas classified as wetland communities based on the NWI database to no longer exhibit wetland hydrology. Specifically, regarding the NWI classifications shown on **Figure 3.4-26**, the majority of the area classified as PFO4Bd and PFO1Cd currently has limited wetland hydrology. This area will be discussed in more detail in **Section 4.4.4** of this Report (*Wetland Impacts*). Wetland area PUBGx in the Northwestern Site Sector was a borrow area that has been planted with pine and does not have wetland hydrology or surface water. Two areas classified as PUBKr are current or former impoundments for the treatment of wastewater from the Site (see **Section 3.4.2.1.2** and **Section 3.12**, *Waste Management*, for

more information). Similarly, PUB3Hx contains a secondary water supply for fire suppression. These three wetland areas are located in the Eastern Site Sector. Wetlands areas PFO1Cd and PFO1/2F, located mainly in the Eastern Site Sector, are palustrine wetlands associated with stream channels (see **Figure 3.4-19**).

3.4.4.2 Federal and State Regulations

Wetlands are regulated by Sections 404, 401, and 402 of the CWA (33 USC 1251) and Section 10 of the Rivers and Harbors Act of 1899 (33 USC 402). The CWA requires regulation of discharges into Waters of the United States. EPA is the principal administrative agency of the CWA; however, the USACE has the responsibility for implementing, permitting, and enforcing provisions of this Act. The Rivers and Harbors Act of 1899 (33 USC 402) prohibits the creation of any obstruction to the navigable capacity of any Waters of the United States without approval of the USACE.

Section 404 of the CWA authorizes the USACE to issue permits for the discharge of dredged or fill material into Waters of the United States, including wetlands. The USACE regulatory program is defined in 33 CFR 320-330. Before an activity occurs, applicable permits must be obtained and any compensatory mitigation must be determined. The USACE cannot issue a Section 404 permit until a Section 401 certification is issued.

Under Section 401 of the CWA, a Section 401 General Water Quality Certification is also required for any activity that may result in a discharge into Waters of the United States or for which a federal permit or license is issued. In North Carolina, the NC DWQ is responsible for issuing a Water Quality Certification. This permit certifies that a project will not degrade waters of the state or otherwise violate State water quality standards (15A NCAC 2B.0200). As previously stated in **Section 3.4.2.9.1**, the Proposed Action would require a 404 permit and a 401 Water Quality Certification for impacts within the GLE Study Area. A final permit strategy can not be developed until construction plans are complete. These impacts are discussed in **Section 4.4** of this Report (*Water Resources Impacts*).

The CWA, under Section 402, also provides guidelines and limitations for effluent discharges from point-source discharges that are administered by the NPDES (15 NCAC. 02H). NPDES permits in North Carolina are obtained by the NC DWQ. As previously stated in **Section 3.4.2.9.2**, the Wilmington Site has two NPDES permits for its current operations, one for wastewater and one for stormwater. The Proposed Action could require a modification to these existing NPDES permits for operations. An additional NPDES permit would be required for stormwater discharges into Waters of the United States associated with construction activities.

3.4.5 Water Use

3.4.5.1 Regional Water Use

Table 3.4-16 shows water usage information for the region surrounding the Wilmington Site, including New Hanover, Brunswick, and Pender counties. Groundwater is an important source of water, providing a significant fraction of the public water supply and self-supplied domestic water. Residential wells are known to exist in developments north (Wooden Shoe subdivision) and south of the Eastern Site Sector, and along the mixed commercial-residential stretch of NC 133 (Castle Hayne Road) east of the Site. The only known public supply wells within 2 miles (3.2 km) of the GLE Study Area are the Wilmington Site potable wells discussed in **Section 3.4.1.1.2.3**. Between 2 and 3 miles (3.2 and 4.8 km) from the GLE Study Area to the east-northeast and south are 11 transient non-community public supply wells and 10

community public supply wells[6], and one additional transient non-community public supply well is located west of the GLE Study Area on the opposite side of the Northeast Cape Fear River[7] (NCDENR, 2006). Surface water from the Cape Fear River is a major drinking water supply for the city of Wilmington; however, the surface water intake is in Bladen County. The New Hanover County public supply usage in **Table 3.4-16** does not reflect the surface water withdrawn in Bladen County, although most of the water is used in Wilmington within New Hanover County. Groundwater use for industry and irrigation is also significant, particularly in New Hanover County, where these uses account for more than 25% of the overall water use. Water use for livestock is significant only in Pender County. Water use for thermoelectric power generation dominates the overall water usage (97%), and this water primarily comes from surface water. However, most thermoelectric water use is non-consumptive (for cooling and steam generation), and thus, the water is returned to the surface water system (Hutson et al., 2005).

Because the groundwater supply for the Wilmington Site is provided by the Peedee Aquifer, conditions in the Peedee Aquifer were further evaluated in terms of the long-term sustainability of the water resource. Comparing groundwater elevation changes over time provides a method for assessing long-term changes and stresses on an aquifer. **Figures 3.4-27 and 3.4-28** show the Peedee Aquifer's groundwater elevations in 1975 and 2007, respectively. **Figure 3.4-29** shows the approximate rate of groundwater elevation decrease based on data from individual wells in USGS and NCDENR Division of Water Resources (NC DWR) water level databases (Wilson, 2007). This decrease rate is calculated by subtracting the oldest from the most-recent available water level and dividing this difference by the time period between measurements (i.e., negative values indicate rates of water-level decline, and positive values indicate rates of water-level rise). Only wells with a historical water level record greater than 5 years were included. The piezometric surfaces in **Figures 3.4-27 and 3.4-28** and the rate change pattern in **Figure 3.4-29** were produced using an inverse distance-weighted interpolation method. As these figures show, water level declines in the Peedee Aquifer have occurred primarily in counties to the west of the Wilmington Site (i.e., western Brunswick, Bladen, and Columbus counties), as well as in counties to the northeast (i.e., Onslow, Jones, Lenoir, and Craven counties). Apparent changes in the Peedee Aquifer in New Hanover County area have been minimal, suggesting that the aquifer should be able to provide additional water for the region without unsustainable depletion of the groundwater resource. There are no sole-source aquifers designated within North Carolina.

3.4.5.2 Site Water Use

Groundwater is used at the existing Wilmington Site for industrial process water, groundwater containment/remediation, and drinking water. **Figure 3.4-10** shows the locations of groundwater pumping wells at the Site. Site potable water supply is provided by three wells just east of the Wilmington Site and NC 133 (see **Figure 3.4-10**). **Figure 3.4-30** and **Table 3.4-17** provide a summary of annual groundwater withdrawals at the Site, which average around 0.6 million gpd (2.27 million lpd).

Water levels measured in wells that tap the Peedee Aquifer at the Wilmington Site were evaluated in terms of the long-term sustainability of the water resource. **Figure 3.4-31** shows annual average water levels in monitoring wells installed in the Peedee Aquifer at the Site. Water-level data were available for 82 wells for the period from 1997 through 2006. As this figure shows, water levels in the aquifer do not show a long-term downward trend, indicating that the existing water use does not exceed the sustainable yield of the aquifer in this area.

[6] Community public supply wells serve 15 or more connections or regularly serve 25 or more year-round residents (e.g., cities, towns, subdivisions). Transient non-community public supply wells serve 25 or more people at least 60 days per year (e.g., restaurants, churches, DOT rest areas). Non-transient, non-community public supply wells serve at least 25 of the same persons 6 or more months per year (e.g., schools, daycares, industries [such as the three Wilmington Site potable wells]).

[7] Specific public water supply well locations are not shown, consistent with the policies and procedures recommended by the United States Government Accountability Office (U.S. GAO, 2006).

3.4.5.3 Regulatory Framework

North Carolina General Statute G.S. 143-215.22H requires water users to register their water withdrawals and to update those registrations at least every 5 years if they meet the following criteria.

- Any non-agricultural water user who withdraws 100,000 gallons (378,541 liters) or more in any one day of groundwater or surface water or who transfers 100,000 gallons (3,785,411 liters) or more in any one day of surface water from one river basin to another river basin.
- Any agricultural water user who withdraws 1,000,000 gallons (3,785,411 liters) or more in any one day of groundwater or surface water or who transfers 1,000,000 gallons (3,785,411 liters) or more in any one day of surface water from one river basin to another river basin.

The groundwater withdrawals by current operations at the Wilmington Site have been registered with NCDENR.

NCDENR has established the Central Coastal Plain Capacity Use Area in an effort to limit overuse of groundwater resources in a region extending through the Central and Eastern coastal plains, including the following counties: Beaufort, Carteret, Craven, Duplin, Edgecombe, Greene, Jones, Lenoir, Martin, Onslow, Pamlico, Pitt, Washington, Wayne, and Wilson. Groundwater use in much of this region has exceeded the sustainable yield of some of the aquifers with associated groundwater-level declines. Groundwater users within the Capacity Use Area must annually register their usage if they exceed 100,000 gpd (378,541 lpd), and groundwater-use reductions are being phased in for many of these users. New Hanover County, the location of the Wilmington Site, is not within the Central Coastal Plain Capacity Use Area because groundwater use has not resulted in severe groundwater depletion, as is evident in much of the Central Coastal Plain.

Tables

Table a l a a e s s a l a as al la e s

e	T ess	a l	a		T a s ss al es	a		a al e a e a e
			a			a		
Sur icial ui er[a]	3 to 80[c]	8.2[a]	0 [a]	30[a]	40 [a]	3 3 [a]	2 0[a]	
astle a ne on inin nit[c]	0 to 2							
astle a ne ui er[a]	0 to 8	3.	08.8	38.08	2 0	0 888	2 3	0.002
ee ee on inin nit[b]	0 to 0							
ee ee ui er[a]	0 to 404[b]	.02[a]	243[a]	38.2 [a]	28[a]	8 20[a]	3 0 3[a]	0.0 4[a]
lac ree on inin nit[a]	v 34[b]							
lac ree ui er	v [c]	[c]	0[c]	28[c]	00[b]	20 [b]		

Re erences:

[a] Lautier 8 base on e anover ount an runs ic ount ell ata .

[b] Lautier 200 base on ort arolina oastal lain ell ata .

[c] Winner an oble base on ort arolina oastal lain ell ata .

Table a s e al e al s e all a e e l e

a	a e	ess	a abases	es
	Sout East orest ro ucts	2332 air R . astle a ne	D	i teen allon raulic uel release no roun ater contamination etecte inci ent close .
	Robinsons ar are	4332 astle a ne R . astle a ne	D	Gasoline contaminate soils iscovere soils e cavate inci ent close .
0	RW oore E uipment o.	ort si e n ustrial ar Wilmin ton	S	our un er roun stora e tan s re istere asoline iesel oil erosene an permanentl close no lea s reporte .
	orticultural rops Researc	3800 astle a ne R . astle a ne	DS S	Si un er roun stora e tan s re istere uel oil asoline ot er no lea s reporte .

See **e** .

otes:

D ort arolina Department o Environment an atural Resources DE R nci ent ana ement Database listin roun ater or soil contamination inci ents.

S DE R re istere un er roun stora e tan atabase.

DS .S. Environmental rotection enc E acilit n e S stem acilit Re istr S stem listin acilit in ormation.

Re erence: EDR 200 **e** .

Table a l e a e al a a e e a e

	be bse a s	be a s	a a [a]	e e	ea e e [b]	a e e	
a a s al s e s							
l alinit	0	2	L	D	2	3 4	m L
mmonia as		2	L	D	4.8	8	m L
mmonium as			L	.2	.0	20	m L
lori e	0	2	2 0	2	.		m L
romium	03		0.0	D			m L
opper				D	0.04	0. 4	m L
otal Dissolve Soli s	288	2	00	D	20		m L
ecal oli orm		4	L	D	2 .0	320	c 00mL
luori e	24	8	2	D			m L
ron	3		0.3	0.044			m L
Lea	4	4	0.0	D			m L
an anese	3		0.0	D			m L
ic el	03		0.	D			m L
itrate as		2	0	D			m L
itrite as	34	33		D			m L
otal r anic arbon	2 2	43	L	D	8.	322	m L
p	2 8	20	. 8.		[c]		S. .
otal Soli s			L	38	38	38	m L
Sul ate	0	2	2 0	D	22.	2	m L
otal Suspen e Soli s			L	D	D	D	m L
in	03		L	D	0.02	0.8	m L
otal ranium		3	L	D	0.	2 .4	m L
irconium	02		L	D	2.	.	m L

(continued)

Table a l e a e al a a e e a e e

	be bse a s	be a s	a a [a]	e e	ea e e [b]	a e e	
a s e s							
en ene	48	0		D	0.2		u L
romoben ene	48	0	L	D	D	D	u L
romoc loromet ane	48	0	L	D	D	D	u L
romo ic loromet ane	48	0	0.	D	D	D	u L
romo orm	48	0	0.00443	D	D	D	u L
romomet ane	48	0	L	D	D	D	u L
n ut lben ene	48	0	0	D	0. 8		u L
sec ut lben ene	48	0	0	D	0.	.	u L
tert ut lben ene	48	0	0	D	0.	0.	u L
arbon etrac lori e	48	0	0.2	D	D	D	u L
loroben ene	48	0	0	D	D	D	u L
loroet ane	48	0	2800	D	0.	.	u L
loro orm	48	0	0	D	0.	4	u L
loromet ane	48	0	2.	D	D	D	u L
o lorotoluene	48	0	40	D	D	D	u L
p lorotoluene	48	0	L	D	D	D	u L
2 Dibromo 3 c loropropane	48	0	0.02	D	D	D	u L
Dibromoc loromet ane	48	0	L	D	D	D	u L
2 Dibromoet ane	48	0	0.0004	D	D	D	u L
Dibromomet ane	48	0	L	D	D	D	u L
m Dic loroben ene	48	0	0	D	D	D	u L
o Dic loroben ene	48	0	24	D	D	D	u L
p Dic loroben ene	48	0	.4	D	D	D	u L
Dic loroet ane	48	0	0	D	0. 0		u L
Dic loro i luoromet ane	48	0	400	D	D	D	u L
2 Dic loroet ane	48	0	0.38	D	0.	0.3	u L
Dic loroet lene	48	0		D	0.43		u L

(continued)

Table a l e a e al a a e e a e e

	be bse a s	be a s	a a [a]	e e	ea e e [b]	a e e	
cis 2 Dic loroet lene	48	0	0	D	.4		u L
trans 2 Dic loroet lene	48	0	00	D	0.44		u L
Dic loromet ane	48	0	4.	D	D	D	u L
2 Dic loropropane	48	0	0.	D	D	D	u L
3 Dic loropropane	48	0	L	D	D	D	u L
2 2 Dic loropropane	48	0	L	D	D	D	u L
Dic loropropene	48	0	L	D	D	D	u L
3 Dic loropropene	3 0	0	0.	D	D	D	u L
cis 3 Dic loropropene	48	0	L	D	D	D	u L
trans 3 Dic loropropene	48	0	L	D	D	D	u L
Et ane	0	2	L	D	0.0	.	u L
Et ene	0	2	L	D	4.8	30	u L
Et lben ene	48	0	0	D	0.24	42.	u L
luorotric loromet ane	48	0	2 00	D	D	D	u L
e ac lorobuta iene	48	0	L	D	D	D	u L
soprop lben ene	48	0	0	D	0.2	2 .4	u L
p soprop ltoluene	48	0	L	D	0.	2.	u L
et ane	0	2	L	0.0	2	800	u L
ap t alene	48	0	2	D	8.		u L
n rop lben ene	48	0	0	D	0.	2.	u L
St rene	48	0	00	D	0.	2.	u L
2 etrac loroet ane	48	0	L	D	D	D	u L
2 2 etrac loroet ane	48	0	L	D	D	D	u L
etrac loroet lene	48	0	0.	D	D	D	u L
oluene	48	0	000	D	0.20	2 .8	u L
2 3 ric loroben ene	48	0	L	D	D	D	u L
2 4 ric loroben ene	48	0	L	D	D	D	u L
ric loroet ane	48	0	200	D	D	D	u L

(continued)

Table a l e a e al a a e e a e e

	be bse a s	be a s	a a [a]	e e	ea e e [b]	a e e	
2 ric loroet ane	48	0	L	D	D	D	u L
ric loroet lene	48	0	2.8	D			u L
2 3 ric loropropane	48	0	0.00	D	D	D	u L
2 4 rimet lben ene	48	0	3 0	D	0.20	28.	u L
3 rimet lben ene	48	0	3 0	D	0.	3.	u L
in l lori e	48	0	0.0	D			u L
o lene	48	0	L	D	0.	22.	u L
otal lenes	48	0	30	D	0. 2	.3	u L
m p lenes	48	0	L	D	0.2	43.	u L
a l al s e s							
Gross lp a	33	28		D			pci l
Gross eta	32	28	L	D	4	8 0	pci l
otal ranium		3	L	D	0.02	0.	m L
ranium 234	2	3	L	D	0.0002	0.00	m L
ranium 23	2	3	L	D	0.0 4	0. 2	m L
ranium 23 bun ance	3		L	0.00	0.0	0.034	m L
ranium 238	2	3	L	0.00 8	0.4	.	m L

[a] 2L Stan ar ort arolina Groun ater ualit Stan ar s liste in 02L.0202.

[b] on etect results ere inclu e in t e mean calculations as al o t e laborator reporte practical uantitation limit L or ra iolo ical inor anic an p sical constituents an as one i t t e laborator reporte L or or anic constituents.

[c] ean p values can be calculate b convertin t e p measurements to t eir correspon in ro en ion concentration c per ormin t e statistical calculation on t ose concentrations an convertin t e statistical result bac to p per t e e uation p lo 0 c . is statistical calculation is appropriate ere c values o not ran e over several or ers o ma nitu e. or t e roun ater ata presente in t is table t e c values ran e over 2 or ers o ma nitu e t ere ore t e mean calculation is not applicable ue to e treme ei tin o t e calculation to ar t e i er c values lo er p values .

Gross alp a a uste particle activit e clu in ra ium 22 an uranium 02L.0202 .

ot applicable.

D e anal te as not etecte above t e laborator reporte practical uantitation limit.

L onstituent not liste in 02L .0202.

oncentration s o n in bol e cee s t e 2L Stan ar .

Re erences: GE an R atabases an anal ses.

Table a e ll l e a e al a ase

	be bse a s	be a s	a a [a]	e e	ea e e [b]	a e e	
a a s al s e s							
ci it as a 3			L	2 30	2 30	2 30	m L
l alinit	344	3	L	D	3	4 0	m L
luminum		4	L	0.02	0.2	0. 3	m L
mmonia as	44	4	L	D	.0	283.8	m L
mmonium as			L	.2	.0	20	m L
ntimon			L	D	D	D	m L
rsenic	4	4	0.0	0.000 4	0.00 8	0.0028	m L
arium	4	4	2	0.02	0.0 3	0.2	m L
er llium	4	4	L	D	D	D	m L
icarbonate as a 3	0	2	L	D	.8	380	m L
ioc emical en Deman a s		2	L	D	.		m L
a mium			0.00	D			m L
alcium	3	2	L	D	.	340	m L
arbonate as a 3	0	2	L	D	D	D	m L
emical en Deman		2	L	D	.0	3	m L
lori e	3 8		2 0	D	28.8		m L
romium	2		0.0	D			m L
opper	2	8		D	0.		m L
otal Dissolve Soli s	020	20	00	D	238		m L
D sprosium			L	D	0.00 0	0.02	m L
Europium			L	D	0.0032	0.008	m L
ecal oli orm	8		L	D	42.8	00	c 00mL
luori e	8	2 8	2	D			m L

(continued)

Table a e ll l e a e al a ase e

	be bse a s	be a s	a a [a]	e e	ea e e [b]	a e e	
Ga olinium			L	0.00038	0.00 3	0.038	m L
a nium			L	D	0.000 2	0.002 4	m L
ron	8	43	0.3	D			m L
Lea	4	2	0.0	D			m L
a nesium	3	2	L	D	.2	0.	m L
an anese	0		0.0	D			m L
ercur	4	4	0.00 0	0.0000 4	0.00024	0.0003 4	m L
ic el	2 8		0.	D			m L
itrate as	84	220	0	D			m L
itrite as	3	3		D			m L
otal r anic arbon	483	4	L	D	0.0	322	m L
r anic itro en	3	3	L	D	0.	. 8	m L
p	0 0	284	. – 8.		[c]		S. .
osp ate			L	0.02	0.48	3.	m L
otal osp orus	4		L	0.03	0.2	.8	m L
otassium	3	2	L	D	.	2 .3	m L
rotactinium	4	4	L	D	0.00000 4	0.00003	m L
Selenium	4	4	0.0	0.00 3	0.00 0	0.0 2	m L
Silica as Si 2	4	4	L	D	8.2	30.8	m L
Silver	4	4	0.0	D	D	D	m L
So ium	3	2	L	D	.	420	m L
otal Soli s	8		L		2	8	m L
Sul ate	2 2		2 0	D	4 .		m L
otal Suspen e Soli s	44	4	L	D	.	22	m L
allium	4	4	L	D	0.000 3	0.00038	m L

(continued)

Table a e ll l e a e al a ase e

	be bse a s	be a s	a a [a]	e e	ea e e [b]	a e e	
orium	4	4	L	D	0.00042	0.000 2	m L
in	2	0	L	D	.	00	m L
otal ranium	20 4	232	L	D	.	2	m L
inc			.0	0.00			m L
irconium	3 4	2	L	D	8 .0	3 0	m L
a s e s							
en ene	3	8		D	0.3		u L
romoben ene	3	8	L	D	D	D	u L
romoc loromet ane	3	8	L	D	D	D	u L
romo ic loromet ane	3	8	0.	D	0.30		u L
romo orm	3	8	0.00443	D	D	D	u L
romomet ane	3	8	L	D	D	D	u L
n ut lben ene	3	8	0	D	0.4		u L
sec ut lben ene	3	8	0	D	0.2	4.	u L
tert ut lben ene	3	8	0	D	0.2	.4	u L
arbon Disul i e			00				u L
arbon etrac lori e	3	8	0.2	D	D	D	u L
loroben ene	3	8	0	D	0.2	0.2	u L
loroet ane	3	8	2800	D	0.2	8.	u L
loro orm	3	8	0	D	0. 4		u L
loromet ane	3	8	2.	D	0.2	0.	u L
o lorotoluene	3	8	40	D	D	D	u L
p lorotoluene	3	8	L	D	D	D	u L
2 Dibromo 3 c loropropane	2 8	0	0.02	D	D	D	u L
Dibromoc loromet ane	3	8	L	D	D	D	u L

(continued)

Table a e ll l e a e al a ase e

	be bse a s	be a s	a a [a]	e e	ea e e [b]	a e e	
2 Dibromoet ane	2 8	0	0.0004	D	D	D	u L
Dibromomet ane	3	8	L	D	D	D	u L
m Dic loroben ene	3	8	0	D	0.2	0.	u L
o Dic loroben ene	3	8	24	D	0.2	0.	u L
p Dic loroben ene	3	8	.4	D	D	D	u L
Dic loro i luoromet ane	3	8	400	D	D	D	u L
Dic loroet ane	3	8	0	D	.4		u L
2 Dic loroet ane	3	8	0.38	D	0.30		u L
Dic loroet lene	3	8		D	0.		u L
cis 2 Dic loroet lene	380	8	0	D	.		u L
trans 2 Dic loroet lene	3	8	00	D	0. 8		u L
Dic loromet ane	3	8	4.	D	0.30		u L
2 Dic loropropane	3	8	0.	D	0.30		u L
3 Dic loropropane	3	8	L	D	D	D	u L
2 2 Dic loropropane	3	8	L	D	D	D	u L
Dic loropropene	3	8	L	D	D	D	u L
3 Dic loropropene	2 0	8	0.	D	D	D	u L
cis 3 Dic loropropene	2 8	0	L	D	D	D	u L
trans 3 Dic loropropene	2 8	0	L	D	D	D	u L
Et ane		23	L	D	0.0	.	u L
Et ene		23	L	D	3.2	30	u L
Et lben ene	3	8	0	D	0.4	3	u L
luorotric loromet ane	3	8	2 00	D	D	D	u L
e ac lorobuta iene	3	8	L	D	0.2	0. 2	u L
soprop lben ene	3	8	0	D	0.3	2 .4	u L

(continued)

Table a e ll l e a e al a ase e

	be bse a s	be a s	a a [a]	e e	ea e e [b]	a e e	
p soprop ltoluene	3	8	L	D	0.30	2.	u L
et ane		23	L	0.0	02	2 0	u L
ap t alene	3	8	2	D	.0		u L
n rop lben ene	3	8	0	D	0.30	4.	u L
St rene	3	8	00	D	0.2	2.	u L
2 etrac loroet ane	3	8	L	D	D	D	u L
2 2 etrac loroet ane	3	8	L	D	D	D	u L
etrac loroet lene	3	8	0.	D	0.2		u L
oluene	3	8	000	D	0.43	42	u L
ribut l p osp ate		4	L	D	.4		u L
2 3 ric loroben ene	3	8	L	D	0.2	4.82	u L
2 4 ric loroben ene	3	8	L	D	0.2	0.8	u L
ric loroet ane	3	8	200	D	0.30	8.4	u L
2 ric loroet ane	3	8	L	D	0.30	0. 3	u L
ric loroet lene	383	8	2.8	D			u L
2 3 ric loropropane	3	8	0.00	D			u L
2 4 rimet lben ene	3	8	3 0	D	0.3	28.	u L
3 rimet lben ene	3	8	3 0	D	0.30	23.2	u L
in l lori e	3	8	0.0	D			u L
m lene	3 3	3	L	D	D	D	u L
o lene	30 3	0	L	D	0.	22.	u L
p lene	3 3	3	L	D	0.20	2.24	u L
otal lenes	3	8	30	D	.4		u L
m p lenes	2 00	0	L	D	0. 8	43.	u L

(continued)

Table a e ll l e a e al a ase e

	be bse a s	be a s	a a [a]	e e	ea e e [b]	a e e	
a l al s e s							
Gross lp a	44			D			pci L
Gross eta	44 3		L	D	.	000	pci L
ec netium ctivit	3	8	L	D	3.	4.	pci L
otal ranium	8	232	L	D	0. 0	2	m L
ranium 234	8		L	D	0.000	0.008	m L
ranium 23	8 4		L	D	0.0	0.	m L
ranium 23 bun ance	288	2	L	0.003	0.020	0.03	m L
ranium 238	8 4		L	D	0.38	30.	m L

[a] 2L Stan ar ort arolina Groun ater ualit Stan ar s liste in 02L.0202.

[b] on etect results ere inclu e in t e mean calculations as al o t e laborator reporte practical uantitation limit L or ra iolo ical inor anic an p sical constituents an as one i t t e laborator reporte L or or anic constituents.

[c] ean p values can be calculate b convertin t e p measurements to t eir correspon in ro en ion concentration c per ormin t e statistical calculation on t ose concentrations an convertin t e statistical result bac to p per t e e uation p lo 0 c . is statistical calculation is appropriate ere c values o not ran e over several or ers o ma nitu e. or t e roun ater ata presente in t is table t e c values ran e over 4 or ers o ma nitu e t ere ore t e mean calculation is not applicable ue to e treme ei tin o t e calculation to ar t e i er c values lo er p values .

Gross alp a a uste particle activit e clu in ra ium 22 an uranium 02L.0202 .

ot applicable.

D e anal te as not etecte above t e laborator reporte practical uantitation limit.

L onstituent not liste in 02L .0202.

oncentration s o n in bol e cee s t e 2L Stan ar .

ote: Some anal tes liste on **Table** are not liste above because no anal ses a been per orme or t e anal te rom 2002 t rou 200 .

Re erences: GE an R atabases an anal ses.

Table ea a e al es l s

a le a	e e al e s			e als	a s
	a as	a e as	l e	T al a	s a al es
L	0.	D 0.02	0.2	D 0.000	D 0.
L 2	0.	D 0.02	0.	0.000	D 0.
L 2	0.	D 0.02	0.2	0.000	D 0.
L 3	D 0.	D 0.02	0.2	D 0.000	D 0.
L 3	D 0.	D 0.02	0.	0.00 08	D 0.
L 3	0.	D 0.02	0.	D 0.000	D 0.
L 3 uplicate	D 0.	D 0.02	0.	D 0.000	D 0.
L 4	D 0.	D 0.02	D 0.	0.0003	D 0.
L 4	D 0.	D 0.02	0.	D 0.000	D 0.
0	0.	D 0.02	0.3	D 0.000	D 0.
iel lan L 2	D 0.	D 0.02	D 0.	D 0.000	D 0.

D ot etecte . e number ollo in t e D is t e anal sis speci ic practical uantitation limit L .
ot applicable.
s olatile or anic compoun s.
Well locate ust outsi e t e boun ar o t e GLE Stu rea.

otes:

- bove anal tical results or roun ater samples collecte September 200 .
- Wells L an L 2 ere r in September 200 an en re c ec e in anuar 2008 t ere ore samples ave not been collecte .
- Groun ater samples collecte rom ells L L 2 L 2 L 3 L 3 an L 4 in an rom 0 in ere anal e or s an no anal tes ere etecte .

Re erence: R atabase an anal ses.

Table a e al a a b eas[a] a e ea e a s e

a			s ea e l e				s ea e l e			
a es			eas a e ea e a a as le a e				eas a e ea e a a l			
a a e s	[b]	s	a les		ea	a	a les		ea	a
luminum	L	m L	8	0. 4	0.42	0. 0	0	0.2	0. 8	2.4
rsenic	0.0	m L	8	D	D	D	0	D	0.0002	0.0
iolo ical en Deman a s	L	m L	3	2.2	3.8	.2		.8	.8	.8
a mium	0.002	m L	8	D	D	D	0	D	0.00	0.002
lori e	230	m L	2	.84	0.	3.33	33	.8		
opper	0.00	m L	8	D	0.002		0	D	0.003	
Dissolve o en D	4	m L			.08	2. 0	284		. 0	3. 0
ecal oli orm	400	colonies 00mL	4	D	3	220	2	D		3 00
ron	.0	m L	8	0.2	0.		0	0.34	0.8	
Lea	0.02	m L	8	D	D	D	0	D	D	D
ercur	0.0 2	u L		D	D	D		D	D	D
ic el	0.88	m L	8	D	D	D	0	D	D	D
itro en ammonia $_3$ as	L	m L		D	0.	.30	4	D	0. 0	0.8
itrite an itrate $_2$ $_3$ as	L	m L		D	0.2	0.82	4	D	0.3	0.
p	4.3 .0	S	2	. 0	.30[e]	.40	284		. [e]	. 0
Salinit	L	ppt	42	0.00	0.0	0.30	2	0.00	.	8.

(continued)

Table a e al a a eas a e ea e a s e b [a] e

a			s ea e l e				s ea e l e			
a es			eas a e ea e a a as le a e				eas a e ea e a a l			
a a e s	[b]	s	a les		ea	a	a les		ea	a
osp orus as	L	m L		D	0. 0	0.33	4	0.0	0.	0.2
Soli s otal Suspen e SS	L	m L	4	D	4.	28.0	38	D	4.2	4 .0
emperature ater	L	e	2	3. 0	8.	30.0	284	3.30	.	30.4
inc	0.0	m L	8	D	0.0 3		0	D	0.0 8	

D e anal te as not etecte or not etecte above t e reporte practical uantitation limit.

L nal te not liste it a ater ualit evaluation level in 02 .02 .

ppt parts per t ousan .

[a] DE R ort arolina Department o Environment an atural Resources DW Division o Water ualit .

[b] Evaluation Level applicable numeric or narrative ater ualit stan ar or action level 02 .02 .

[c] on etect results ere inclu e in t e mean calculations as al o t e reporte practical uantitation limit.

ecal coli orm e cee ance occurs en 20 percent o ecal coli orm samples in a samplin perio e cee 400 colonies 00 mL. iolations o t e ecal coli orm stan ar are e pecte urin rain all events an in some cases t is violation is e pecte to be cause b uncontrollable non point source pollution. 02 .02 comparison o ma imum values to t is EL is not applicable.

[e] ean p values ere calculate b convertin t e p measurements to t eir correspon in ro en ion concentration c per ormin t e statistical calculation on t ose concentrations an convertin t e statistical result bac to p per t e e uation p lo 0 c .

oncentration s o n in bol oes not meet t e evaluation level.

Re erence: .S. E 200 b.

Table a e al a a eas a e ea e a e
b e e a e ea e a

a						
a es			eas a e ea e a e			
a a e s	[a]	s	a les		ea	a
Dissolve o en D	4	m L			.3	2.
itro en ammonia $_3$ as	L	m L		0.0	0.0	0.28
itrite an itrate $_2$ $_3$ as	L	m L		0.0	0.2	0.
p	4.3	S		.00	.2 [b]	.40
osp orus as	L	m L		0.03	0. 0	0.3
Salinit	L	ppt		0.00	.8	4.
Soli s otal Suspen e SS	L	m L		.00	.00	38.0
emperature ater	L	e		.40	.	3 .

L nal te not liste it a ater ualit evaluation level in 02 .02 .

ppt parts per t ousan .

[a] Evaluation Level applicable numeric or narrative ater ualit stan ar or action level 02 .02 .

[b] ean p values ere calculate b convertin t e p measurements to t eir correspon in ro en ion concentration $_c$ per ormin t e statistical calculation on t ose concentrations an convertin t e statistical result bac to p per t e e uation p lo $_0$ $_c$.

oncentration s o n in bol oes not meet t e evaluation level.

Re erences: W 200 DE R 2004.

Table a l al a e al a a e e a e b a lea e

a			T s ea e l e [a]			
a es			eas a e ea e ea as le a e			
a a e s	b	s	a les		ea	a
otal ranium	L	m L	2	D	D	D
Gross lp a		pci L	43	D	D	D
Gross eta	0[e]	pci L	43	D	.	.0
a			s ea e l e			
a es			eas a e ea e a			
a a e s	b	s	a les		ea	a
otal ranium	L	m L	232	D	D	D
Gross lp a		pci L	44	D	4.	4 .8
Gross eta	0[e]	pci L	44	D	28.	80[e]
a			l e			
a es			l e a el a e e a			
a a e s	b	s	a les		ea	a
otal ranium		m L	8	D	0.024	0. 3
Gross lp a		pci L	0	D	4 .	32
Gross eta		pci L	0	D	8.	330

ot applicable.

D e anal te as not etecte or not etecte above t e reporte practical uantitation limit.

L nal te not liste it a ater ualit evaluation level in 02 .02 .

[a] S is sample at t e astle a ne oat Doc appro imatel t e same location as S RE station 80000.

[b] Evaluation Level applicable numeric or narrative ater ualit stan ar or action level 02 .02 .

[c] on etect results ere inclu e in t e mean calculations as al o t e reporte practical uantitation limit.

e avera e annual ross alp a particle activit inclu in ra ium 22 but e clu in ra on an uranium 02 comparison o ma imum values to t is avera e annual EL is not applicable.

[e] e avera e annual ross beta particle activit e clu in potassium 40 an ot er naturall occurrin ra io isotopes 02 comparison o ma imum values to t is avera e annual EL is not applicable.

GED is sample at t e GE Doc appro imatel t e same location as S RE station 0000.

e e luent c annel is an in ustrial c annel an is not sub ect to ater ualit stan ar s rom 02 .02 .

Re erences: GE an R atabases an anal ses.

Table a l al a a e e a e
b a lea e

a			T s ea e l e [a]			
a es			eas a e ea e ea as le a e			
a a e s	b	s	a les		ea	a
mmonia as $_3$	L	m L	4	D	. 3	2.
ioc emical o en eman a s	L	m L	30	D	2.04	.
lori e	230	m L		D	3	80
romium	0.0 0	m L	3	D	0.0	0.03
on uctivit	L	µm os cm		3	4 0	3 000
opper	0.00	m L	3	D		
Dissolve en	4	m L	48		. 4	.3
ecal coli orm	400	colonies 00mL	30	D	4.0	
luori e	.8	m L	3	D	D	D
ic el	0.088	m L	3	D	0.0 2	0.03
itrate itrite as	L	m L	40	D	0.3	. 8
p	4.3	S. .	48	.02	.44	.84
osp ate	L	m L	2	D	0.	0.22
otal p osp orus	L	m L	3	D	0. 02	0.22
Sul ate	L	m L	3	4.3		32.
emperature	L	e	488	4.4	.	3 .
itanium	L	m L	3	D	0.0 4	0.042
a			s ea e l e			
a es			eas a e ea e a			
a a e s	b	s	a les		ea	a
mmonia as $_3$	L	m L	4	D	. 0	.3
ioc emical o en eman a s	L	m L	33	D	.82	
lori e	230	m L	2	4		
romium	0.0 0	m L	3	D	0.0	0.028
on uctivit	L	µm os cm	2	40	2 28	2 00
opper	0.00	m L	3	D		
Dissolve en	4	m L	3		.2	4.2
ecal coli orm	400	colonies 00mL	33	D	8.	240
luori e	.8	m L	40	D	D	D
ic el	0.088	m L	3	D	0.0 0	0.0 2

(continued)

Table a l al a a e e a e
b a lea e e

a			s ea e l e			
a es			eas a e ea e a			
a a e s	b	s	a les		ea	a
itrate itrite as	L	m L	4	0.0	0.3	. 2
p	4.3	S. .	48	4.42	.3	8.83
osp ate	L	m L	3	D	0. 0	0.204
otal p osp orus	L	m L	3	D	0.0	0.204
Sul ate	L	m L	38	4.3	3	
emperature	L	e	3	4.8	.8	32.
itanium	L	m L	3	D	0.0 3	0.02
a			l e			
a es			l e a el a e e a [e]			
a a e s	b	s	a les		ea	a
mmonia as 3		m L	342	D	3.00	.
romium		m L	2	D	0.0	0.0
opper		m L	2	D	0.0	0. 2
luori e		m L	03	D	.08	4.
ic el		m L	2	D	0.0	0.0
itrate as		m L	344	D	2.24	4
p		S. .	8 4	. 0	.3	2. 0
emperature		e	3	.00	2 .03	38. 0
itanium		m L	20	D	0.0	0. 0

ot applicable.

D e anal te as not etecte or not etecte above t e reporte practical uantitation limit.

L nal te not liste it a ater ualit evaluation level in 02 .02 .

[a] S is sample at t e astle a ne oat Doc appro imatel t e same location as S RE station 80000.

[b] Evaluation Level applicable numeric or narrative ater ualit stan ar or action level 02 .02 .

[c] on etect results ere inclu e in t e mean calculations as al o t e reporte practical uantitation limit.

GED is sample at t e GE Doc appro imatel t e same location as S RE station 0000.

[e] e e luent c annel is an in ustrial c annel an is not sub ect to ater ualit stan ar s rom 02 .02 .

ean p values ere calculate b convertin t e p measurements to t eir correspon in ro en ion concentration c per ormin t e statistical calculation on t ose concentrations an convertin t e statistical result bac to p per t e e uation p lo 0 c .

oncentration s o n in bol oes not meet t e evaluation level.

Re erences: GE an R atabases an anal ses.

Table a l es e e as e a e s a e
e eas a e ea e a e e e ee e a e

e	e	a l	T e	lass[a]	s a e
00038	Elementis romium L	astle a ne anu acturin acilit Waste Water reatment lant WW	n ustrial rocess ommercial	a or	.0
00	o en ursin ome nc.	ermita e ouse Rest ome WW	n ustrial rocess ommercial	inor	0.024
004 43	e anover ount Water Se er District	Lan ill WW	unicipal GD	inor	0.0 4
000 228	Global uclear uel	Global uclear uel mericas WW	n ustrial rocess ommercial	a or	.8
000 2	nvista S. .R.L.	nvista S. .R.L.	n ustrial rocess ommercial	a or	.2
003 2	e anover ount Water Se er District	Walnut ills WW	unicipal GD	inor	0.
00 8	e anover ount Water Se er District	Wastec site	unicipal GD	inor	not limite
00234	Sout ern States emical nc.	ci lant	n ustrial rocess ommercial	inor	not limite
00028	it o Wilmin ton	S eene Water reatment lant W	Water reatment lant	inor	not limite
00 30	Worsle ompanies nc.	Di ie o o.	n ustrial rocess ommercial	inor	0.004

DES ational ollutant an Disc ar e Elimination S stem

[a] a or isc ar e is reater t an GD inor isc ar e is less t an GD.

Re erence: .S. E 200 a.

Table a e al a a e l e

a e l a l a e al es			
all			
Receivin Water:	E ape ear	E ape ear	rince Geor e
mmonia m L as	D – 0.	0. – .8	D – 0.43
itrite itrate m L as	D – 0.4	0.44 – 0.8	D
luori e m L	D – 0.8	D – 0.24	D
ranium p i L [a]	D – 0. 8	D – . 0	D
Dic loroet lene m L	D	D	D
cis 2 Dic loroet lene m L	D – 0.000	D	D
trans 2 Dic loroet lene m L	D	D	D
E m L	D – 0.00 3	D	D
in l lori e m L	D	D	D

e al a l a e al es				
all				
Lea total recoverable m L	0.0338	0.004 – 0.008		
il an Grease m L	30	D	D	D
otal Suspen e Soli s m L	00	– 28	D –	0 – 338
p stan ar units	4.3 –	. – .	. – .8	.8 – .

nal sis not permit re uirement.

D e anal te as not etecte or not etecte above t e reporte practical uantitation limit.

[a] e uranium result is t e sum o t e separate reporte isotopic anal tical laborator results or 233 234 23 an 238 .

[b] o benc mar values or permit compliance limits ere provi e or in t e DES Storm ater ermit.

[c] enc mar alues ui elines or t e permittee s Storm ater ollution revention lan S .

e source o t e ma imum total suspen e soli s SS concentration at SD 4 as been evaluate an it is ue to nearb construction activities occurrin at t e time o t e samplin event. ese construction activities ere in accor ance it t eir approve Storm ater Erosion an ontrol lan an ave since conclu e t ere ore uture elevate SS concentrations are not anticipate .

Re erences: GE an R atabases an anal ses.

Table e e a e a e a a e s s

a e b	es a e se[a]	e ee e e s	a a e ea e e e
nname ributar to ort east ape ear River	lass s amp aters	t 2 340 m	42
nname ributar 2 to ort east ape ear River	lass s amp aters	3 3 4 t 02 m	
nname ributar to rince Geor e ree	lass s amp aters	8 t 48 m	2
E luent annel	n ustrial e luent[b]	4 3 t 4 2 m	[c]
iscellaneous tributaries to ort east ape ear River	lass s amp aters	423 t 3 m	
t er[e]			24

ot pplicable

[a] Desi nate use is assi ne b t e ort arolina Division o Water ualit . lass aters are protecte or secon ar recreation e. . boatin is in an il li e. S amp aters is a supplemental classi ication use to reco ni e t ose aters t at ave naturall occurrin lo velocities lo p an lo levels o issolve o en.

[b] n e luent c annel is a iscernable con ine an iscrete conve ance t at is use or transportin treate aste ater to a receivin stream. 02 .0202

[c] e raina e area or t e e luent c annel is inclu e it nname ributar to ort east ape ear River.

ributaries are visible on aerial p oto rap in **e** .

[e] ortions o t e Wilmin ton Site rain t rou a series o itc es an s ales an are not associate it a speci ic aterbo on t e Site. n t e ort entral Site Sector appro imatel 20 o t e Wilmin ton Site rains nort to nname ributar 2 to rince Geor e ree e remainin 4 rains to a s ale in t e Sout entral Site Sector ic isc ar es irectl to t e ort east ape ear River.

Re erences: GE an R atabases an anal ses.

l ea s a e e eas a e ea e ea a

ea	l ea b ee e se al la e e e be – e be											
	a	eb	a		a		l		e			e
2003	o Data	o Data	o Data	o Data	o Data	o Data	o Data	o Data	o Data	o Data	o Data	24 0
2004			22		32	3	2 4	4		2 2	2	
200	82	30	02	34	0	2	42	2	3			o Data
ean o mont l isc ar e	82	30	0	0	2 0	4	3	00	02	30	48	24 0

ncomplete lo ata t ere ore mont l means coul not be etermine .

Re erence: SGS 200 .

3.4-14. Monthly Mean Discharge for the Northeast Cape Fear River near Chinquapin, NC

Year	Monthly mean dischange in cubic feet per second (Calculation Period: August 8, 1940 to September 9, 2006)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1940	no data	no data	no data	no data	no data	no data	no data	373	36	18	56	97
1941	166	279	1063	708	123	90	653	271	39	18	32	170
1942	231	413	1213	342	97	240	157	1276	1049	2448	436	856
1943	975	1190	1113	1229	471	252	1112	124	40	17	37	166
1944	963	1415	1743	1307	210	29	85	390	90	197	126	485
1945	576	761	539	151	106	101	605	1726	2063	376	391	1136
1946	1533	968	576	444	868	293	1080	961	523	1118	517	512
1947	1066	396	879	1294	179	99	380	422	1162	860	1852	1181
1948	1538	3584	1692	444	148	383	185	267	42	412	1189	2225
1949	1291	1408	837	745	1418	972	1111	1109	979	141	514	433
1950	483	312	398	205	533	233	2683	390	539	585	174	331
1951	411	324	446	493	171	25	144	189	46	43	411	476
1952	465	1003	1532	417	484	109	94	211	169	62	162	245
1953	452	1164	1110	238	231	599	61	45	224	194	242	931
1954	1270	512	577	959	139	69	26	14	11	8	16	60
1955	158	249	261	184	123	99	369	2681	4754	474	370	434
1956	494	1182	870	621	1096	264	187	103	117	352	515	299
1957	341	466	1440	441	193	731	114	51	322	528	770	2018
1958	1854	1016	1421	1135	1158	410	315	245	262	800	363	608
1959	836	1372	2743	1896	333	226	1127	643	534	997	1061	1300
1960	1602	2154	1531	1088	538	235	680	1961	1509	947	330	488
1961	603	1147	981	1599	732	1953	1464	641	419	116	119	269
1962	985	902	1227	972	143	403	3922	740	576	474	1357	563
1963	2029	1657	1055	404	394	325	273	498	257	223	593	827
1964	1697	2004	1394	1212	223	289	310	216	1606	1915	400	718
1965	783	1677	1569	497	249	1429	2132	1239	139	134	159	171
1966	938	1541	2609	357	653	370	177	1207	333	103	93	398
1967	1517	1373	474	243	216	94	336	544	733	127	157	630
1968	1827	474	1492	489	130	239	381	231	29	44	188	191
1969	411	591	1366	998	1901	1021	933	2128	275	215	1060	739
1970	932	1570	919	784	268	69	344	488	93	92	315	258
1971	885	1580	2469	1192	894	208	491	1926	517	1480	592	604
1972	1209	2218	939	966	1110	406	854	528	738	660	1215	1596
1973	1611	3832	1611	2958	418	619	328	192	119	39	37	527
1974	591	1485	998	1478	680	470	330	2646	590	169	311	1059
1975	1600	1556	1239	906	465	196	384	100	752	531	273	700

(continued)

3.4-14. Monthly Mean Discharge for the Northeast Cape Fear River near Chinquapin, NC

Year	Monthly mean dischange in cubic feet per second (Calculation Period: August 8, 1940 to September 9, 2006)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	1847	1514	599	216	139	696	587	438	128	86	282	1149
1977	1265	491	1997	313	359	471	54	171	213	223	1059	945
1978	2249	935	1089	2004	1606	230	544	402	71	43	82	469
1979	1296	1027	1732	689	778	1037	660	138	1618	667	406	621
1980	966	995	2317	1518	978	278	417	117	99	348	377	506
1981	723	877	435	263	319	727	137	1588	297	43	75	328
1982	1437	1487	856	400	257	496	264	525	161	174	502	900
1983	1164	2618	3506	2297	387	1009	368	41	65	47	132	1073
1984	831	1136	1896	1445	342	115	621	515	1681	367	185	298
1985	532	1864	675	233	72	21	107	461	70	355	396	472
1986	334	459	511	145	78	99	202	848	144	152	239	1008
1987	2206	1018	1784	1579	543	249	218	274	233	41	65	246
1988	1009	507	413	429	640	231	143	200	264	106	133	124
1989	298	366	1421	1312	1097	493	521	471	285	777	405	1293
1990	1133	739	662	961	431	284	150	773	172	265	474	335
1991	1033	809	1067	986	303	232	708	1825	481	469	319	253
1992	855	515	466	439	174	262	44	2572	300	349	714	1604
1993	2548	954	1473	1314	202	77	58	45	72	77	210	379
1994	818	787	1162	335	68	17	58	236	164	225	166	524
1995	709	1709	1331	224	65	1650	1071	80	65	413	558	386
1996	630	799	1040	611	205	470	1061	681	4489	2486	776	1165
1997	1210	1235	1042	484	426	161	159	203	286	150	613	1090
1998	2377	4399	1951	1451	698	194	71	927	1141	69	112	440
1999	2012	1061	657	429	505	185	347	188	7329	3237	949	558
2000	1125	1497	1203	922	286	304	514	393	1138	427	257	516
2001	332	527	1750	767	173	655	118	756	242	97	47	100
2002	605	601	1204	704	122	59	54	68	185	70	401	493
2003	402	876	1638	1704	964	1750	3192	1368	265	642	1136	1393
2004	506	984	635	700	1106	477	196	1137	909	206	451	550
2005	532	496	729	781	550	200	307	194	85	1151	452	1214
2006	1237	791	401	223	476	525	845	445	3833	no data	no data	no data
Mean of monthly discharge	1040	1180	1210	837	476	412	570	669	719	465	430	669

Reference: USGS, 2007.

Table a al e la s e lass a e la s a e l e

a e e	e la lass a	es	ea a es
	2	alustrine oreste broa leave eci uous nee le leave eci uous semi permanentl loo e	23 .30
	4	alustrine oreste broa leave eci uous nee le leave ever reen temporaril loo e	4.82
		alustrine oreste broa leave eci uous seasonall loo e	.44
		alustrine oreste broa leave eci uous seasonall loo e partiall raine itc e	23.
	4	alustrine oreste nee le leave ever reen broa leave eci uous temporaril loo e	.38
	4	alustrine oreste nee le leave ever reen saturate partiall raine itc e	2 4.43
	SS 4	alustrine scrub s rub broa leave eci uous nee le leave ever reen temporaril loo e	. 2
	SS 4	alustrine scrub s rub broa leave eci uous nee le leave ever reen saturate	2 . 3
	SS	alustrine scrub s rub broa leave eci uous temporaril loo e	0.
	SS4	alustrine scrub s rub nee le leave ever reen broa leave eci uous saturate	32.
	3	alustrine unconsoli ate bottom mi o aline permanentl loo e i e impoun e	0.4
	G	alustrine unconsoli ate bottom intermittentl loo e e cavate	3.2
	r	alustrine unconsoli ate bottom arti iciall loo e arti icial substrate	.40
		otal	8.30

Re erence: .S. WS 0.

Table e al a e sa e

	e	sa e ll all s e a a e e a e									
		bl l	es el l e	s al	a	a l e	es		T e ele e	T al	e e a e
e anover	Groun ater	. 2	3. 8	3.32	.	0.40	0.0	0.0	0.0	.0	4 .0
		2 .3	.	.2	.4	.	0.0	0.0	0.2	4 .0	
	Sur ace Water	0.0	0.0	. 2	. 3	0.0	0.0	0.0	.38	.23	3.0
		0.0	0.0	.3	.3	0.0	0.0	0.0	42.4	3.0	
	otal	. 2	3. 8	.24	3.8	0.40	0.00	0.00	.4	3 .28	00
		2 .3	.	4.4	0.	.	0.0	0.0	42.	00	
en er	Groun ater	.2	2.0	0.0	0.	0.0	. 3	0.0	0.0	.22	.4
		.	2 .4	0.0	0.0	0.	.0	0.0	0.0	.4	
	Sur ace Water	0.0	0.0	0.0	2.24	0.0	0.0	0.0	0.0	2.30	30.
		0.0	0.0	0.0	2 .8	0.0	0.8	0.0	0.0	30.	
	otal	.2	2.0	0.00	2.	0.0	.	0.00	0.00	. 2	00
		.	2 .4	0.0	3 .8	0.	.8	0.0	0.0	00	
runs ic	Groun ater	.2	.4	0.0	2.2	0	0.0	0	0.0	4. 3	0.3
		0.	0.	0.0	0.	0.0	0.0	0.0	0.0	0.3	
	Sur ace Water	0.0	0.0	8.0	8.83	0.0	0.2	0.0	.	34.	.
		0.0	0.0	0.	0.	0.0	0.0	0.0	8.	.	
	otal	.20	.4	8.0	.04	0.00	0.32	0.00	.	3 .	00
		0.	0.	0.	0.	0.0	0.0	0.0	8.	00	
verall otal	Groun ater	0. 3	.	3.32	4. 2	0.4	. 8	0.00	0.0	2 .20	.
		0.	0.4	0.2	0.3	0.0	0.	0.0	0.0	.	
	Sur ace Water	0.0	0.0	0.0	3.0	0.0	0.3	0.0	33.0	.2	8.4
		0.0	0.0	0.	0.8	0.0	0.0	0.0	.0	8.4	
	otal	0. 3	.	3.33	. 2	0.4	.	0.00	33.02	83.4	00
		0.	0.4	0.8	.	0.0	0.	0.0	.0	00	

Re erence: SGS utson et al. 2004 .

Table al a e a als
a e l e

ea	ll all s e a		
	able[a]	ess	T al
8	0.0 0	0. 4	0. 3
	0.028	0.4	0.480
2000	0.042	0. 3	0. 0
200	0.044	0. 8	0. 2
2002	0.03	0. 8	0. 04
2003	0.03	0. 4	0. 8
2004	0.043	0.	0.
200	0.0 0	0.	0. 20
200	0.0	0. 4	0.
vera e	0.04	0.	0. 2

[a] Site potable ater suppl is provi e b t ree ells ust east o t e Wilmin ton Site.

es

Geologic Units			Hydrogeologic Units
System	Series	Formation	Aquifers and Confining Units
Quaternary	Holocene	Undifferentiated	Surficial Aquifer
	Pleistocene		
Tertiary	Pliocene	Undifferentiated	
			Tertiary Aquifer and Confining Unit
	Oligocene	River Bend Formation	
	Eocene	Castle Hayne Formation	Castle Hayne Aquifer and Confining Unit
	Paleocene	Beaufort Formation	
Cretaceous	Upper Cretaceous	Rocky Point Member	Pee Dee Aquifer and Confining Unit
		Peedee Formation	
			Black Creek Confining Unit
		Black Creek Formation	Black Creek Aquifer

Shading indicates unit is present beneath the Wilmington Site.

Reference: Lautier, 1998

Figure 3.4-1. General relationship between aquifers and geologic units in the region.

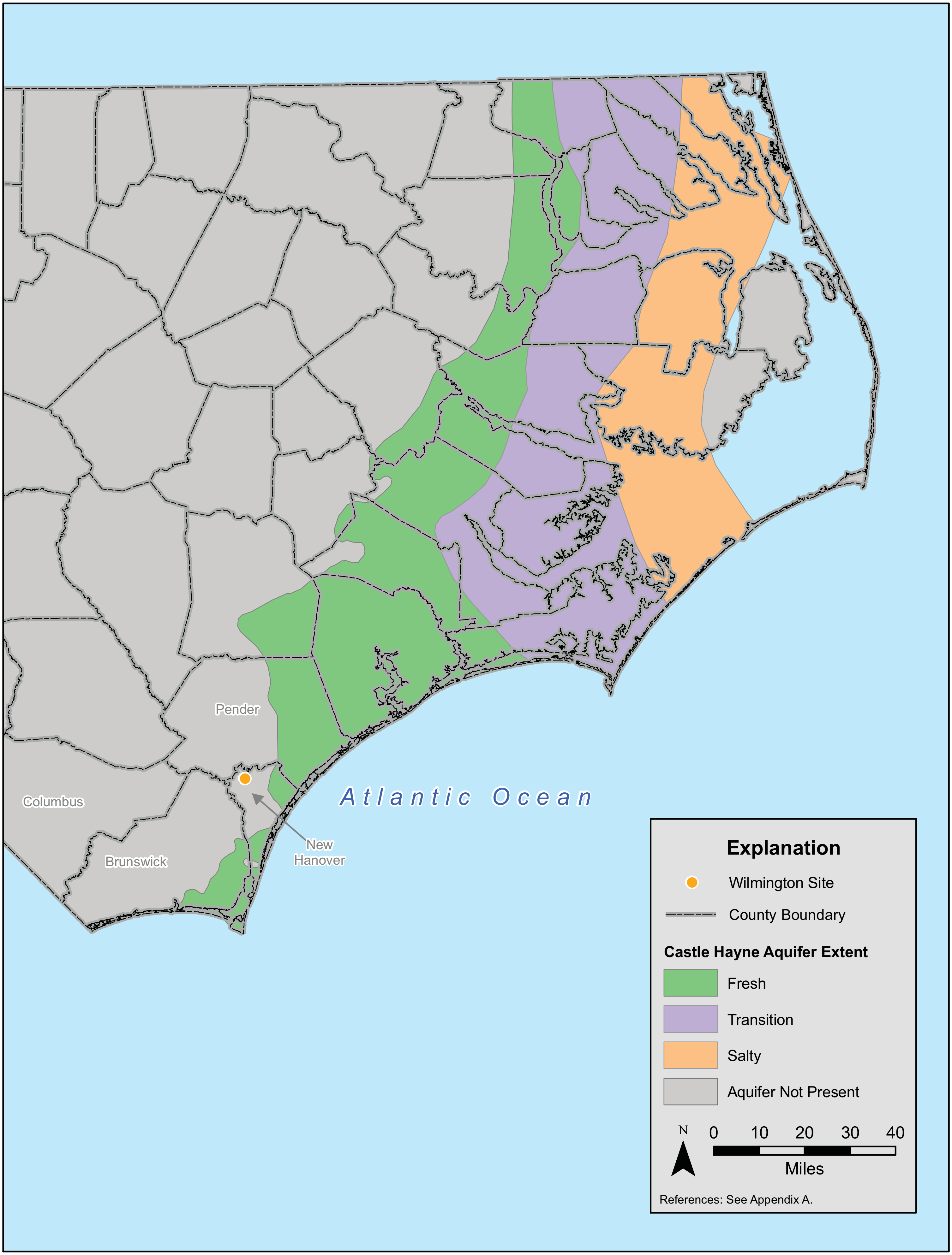


Figure 3.4-2. Extent of the Castle Hayne Aquifer.

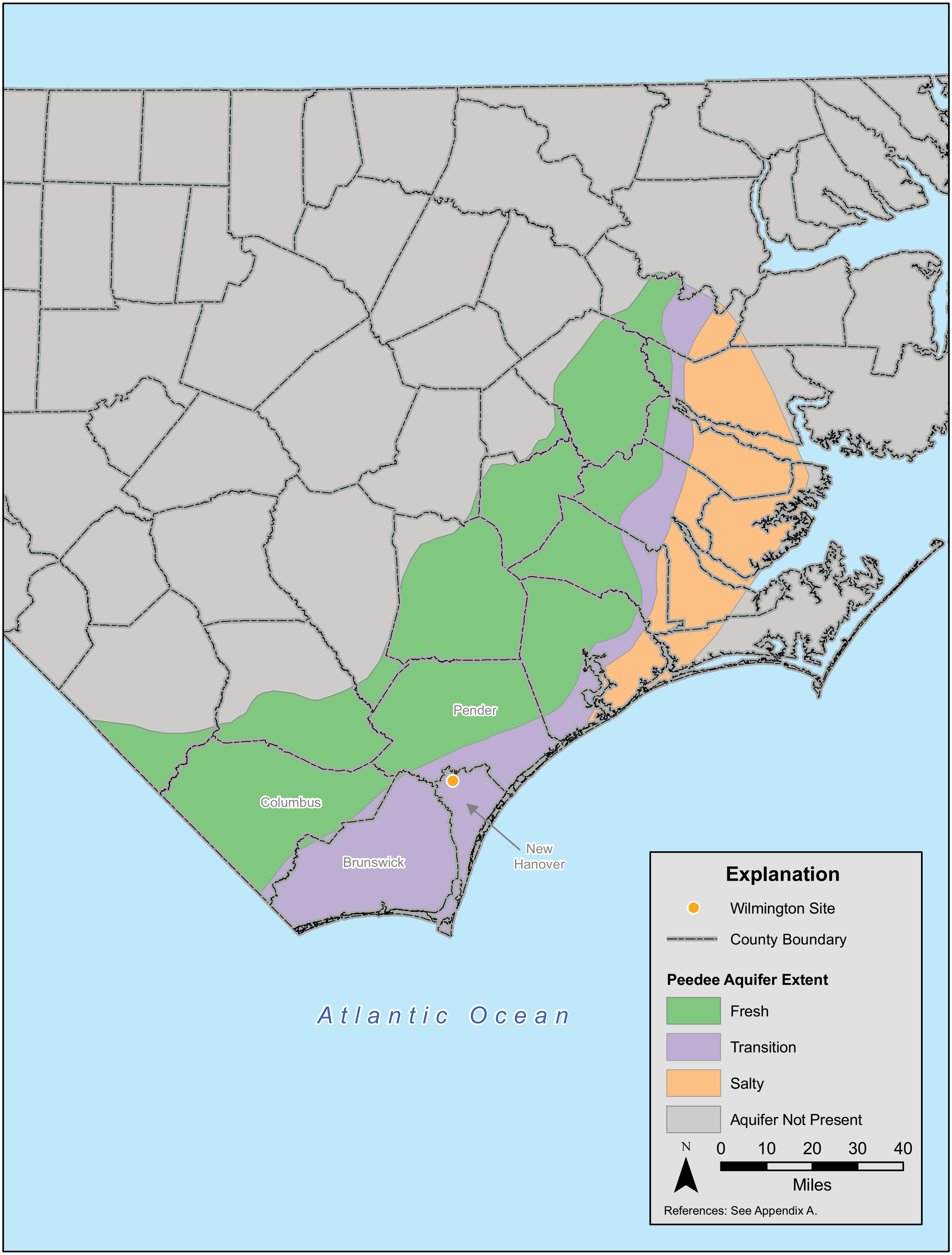


Figure 3.4-3. Extent of the Peedee Aquifer.

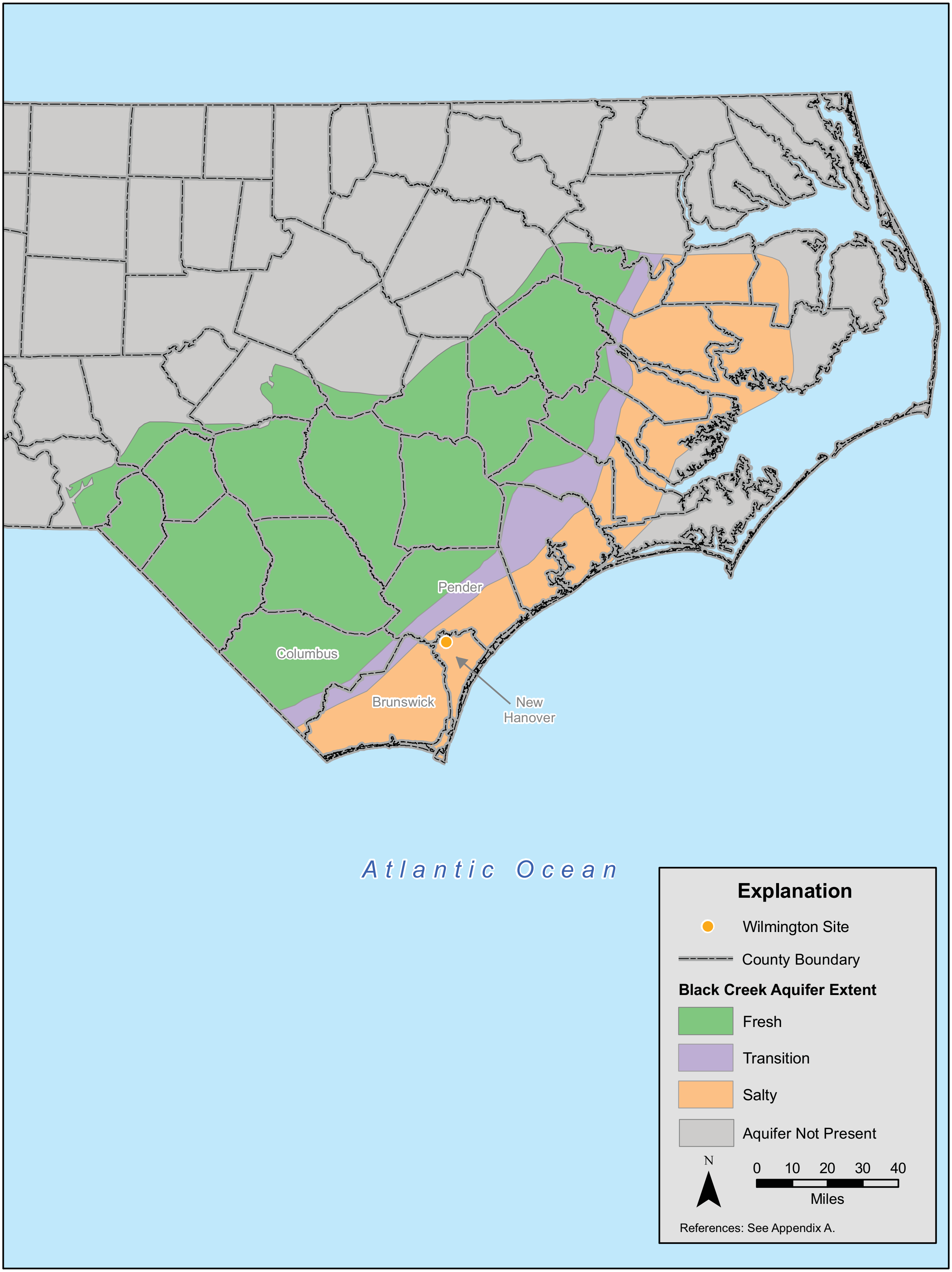


Figure 3.4-4. Extent of the Black Creek Aquifer.

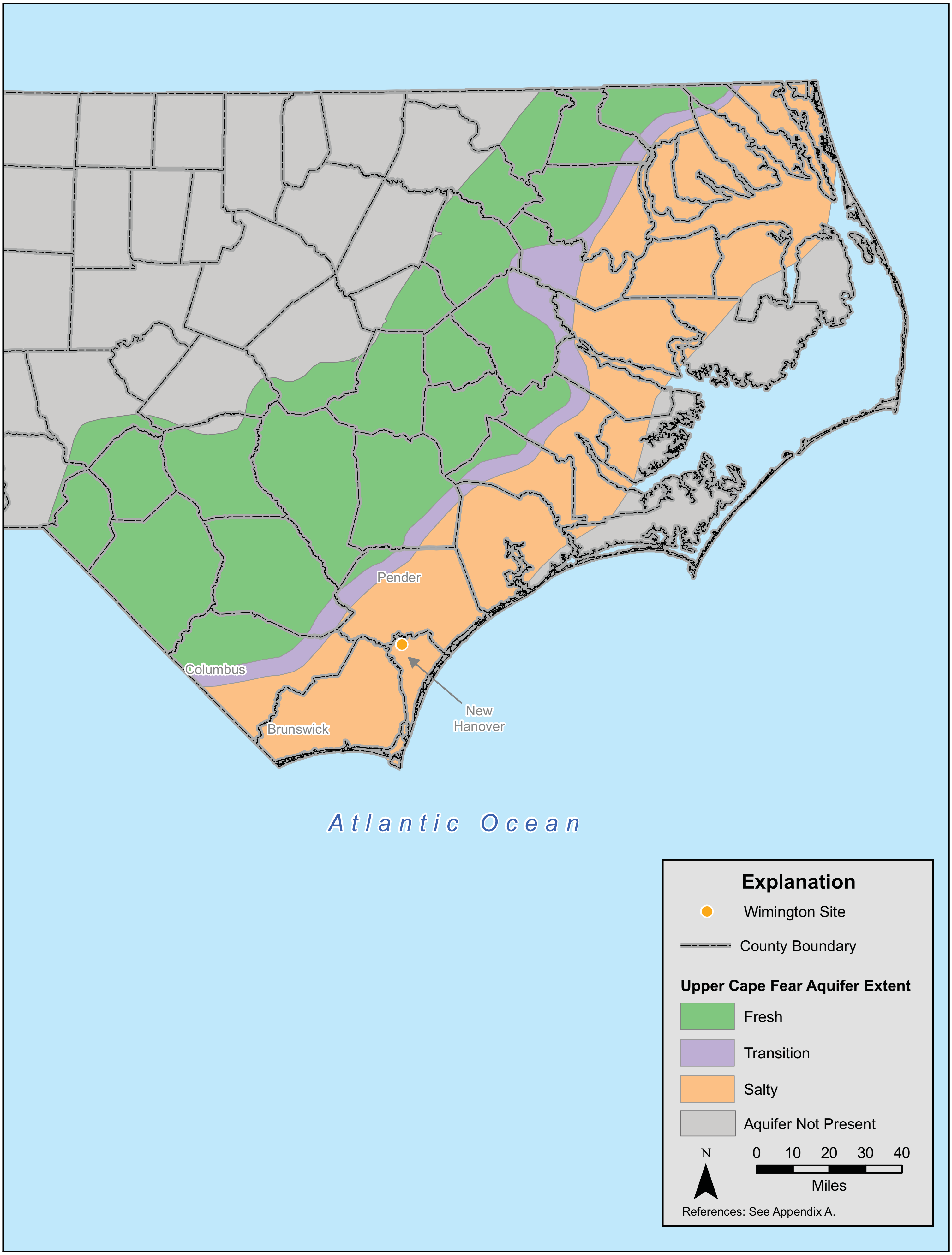


Figure 3.4-5. Extent of the Upper Cape Fear Aquifer.

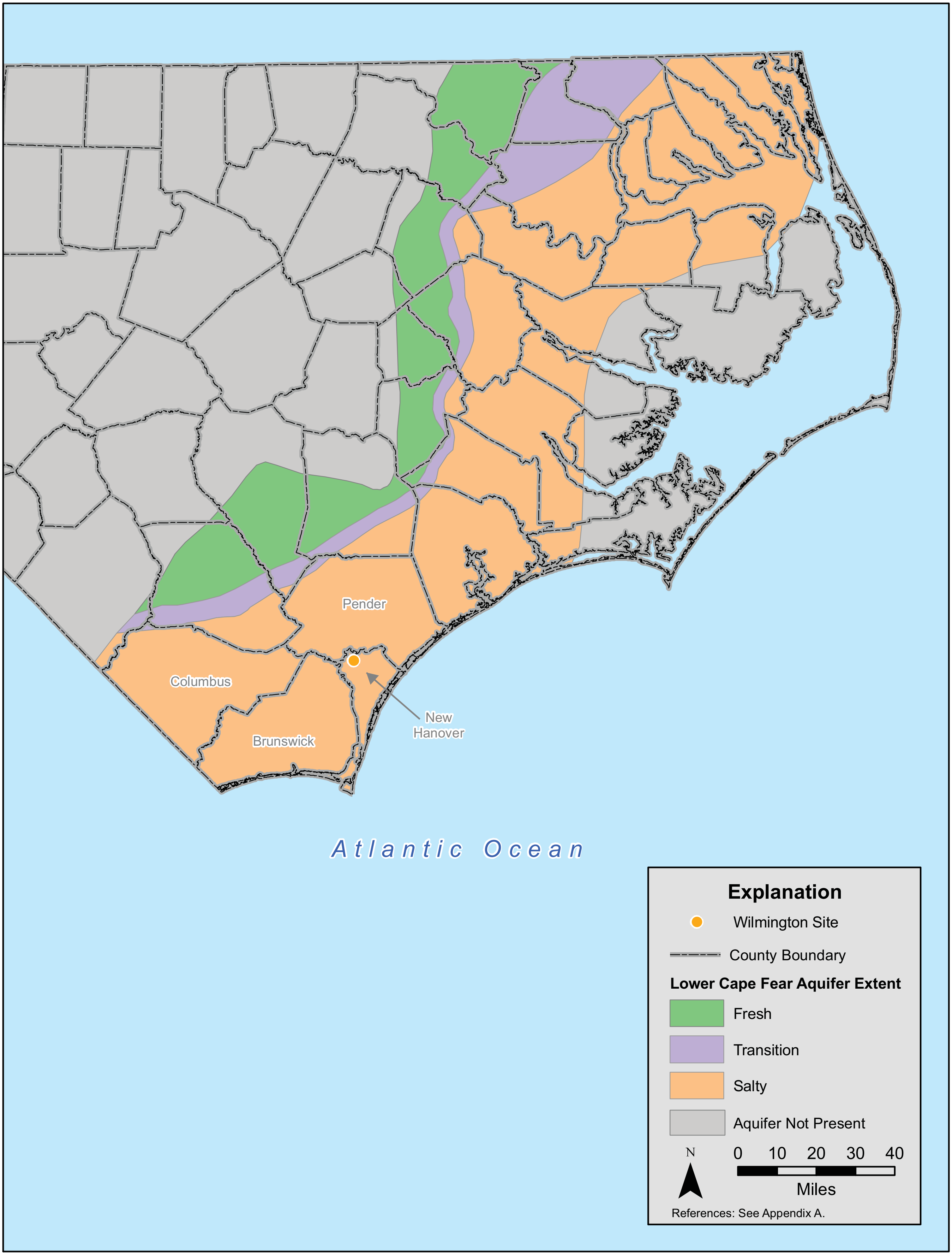


Figure 3.4-6. Extent of the Lower Cape Fear Aquifer.

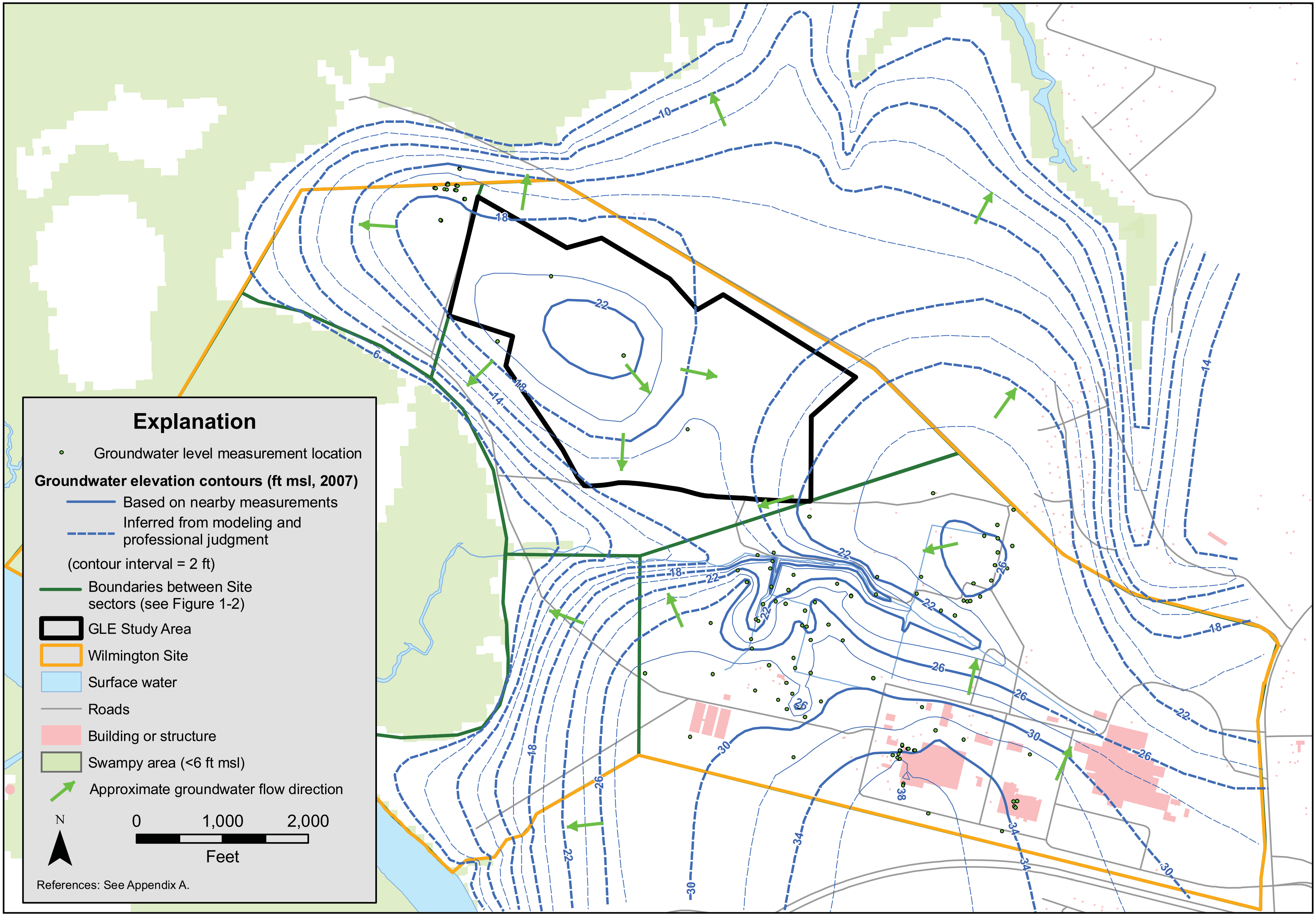
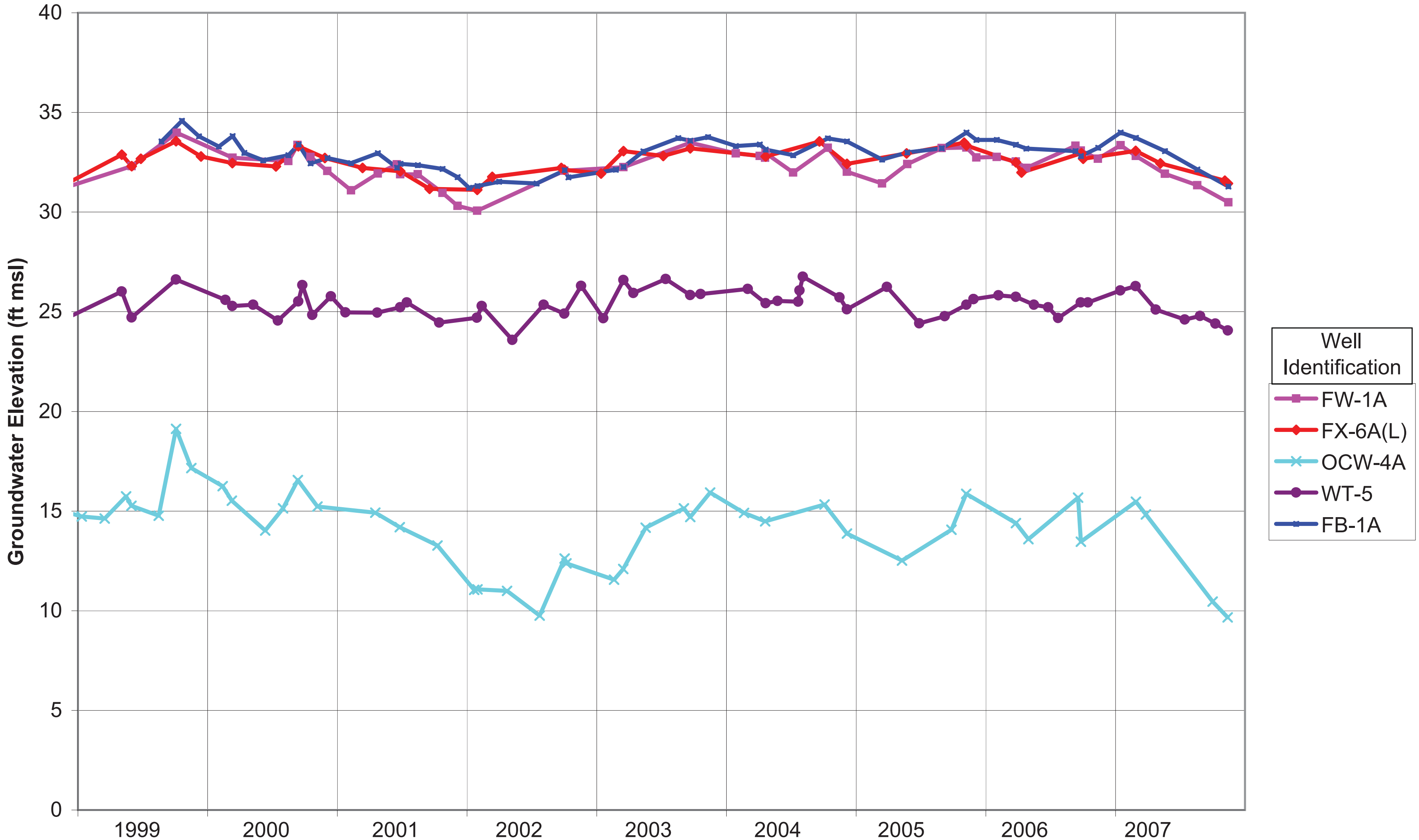


Figure 3.4-7. Surficial Aquifer groundwater elevation contours (2007).



Reference: RTI data and analysis

Figure 3.4-8. Example Surficial Aquifer hydrographs.

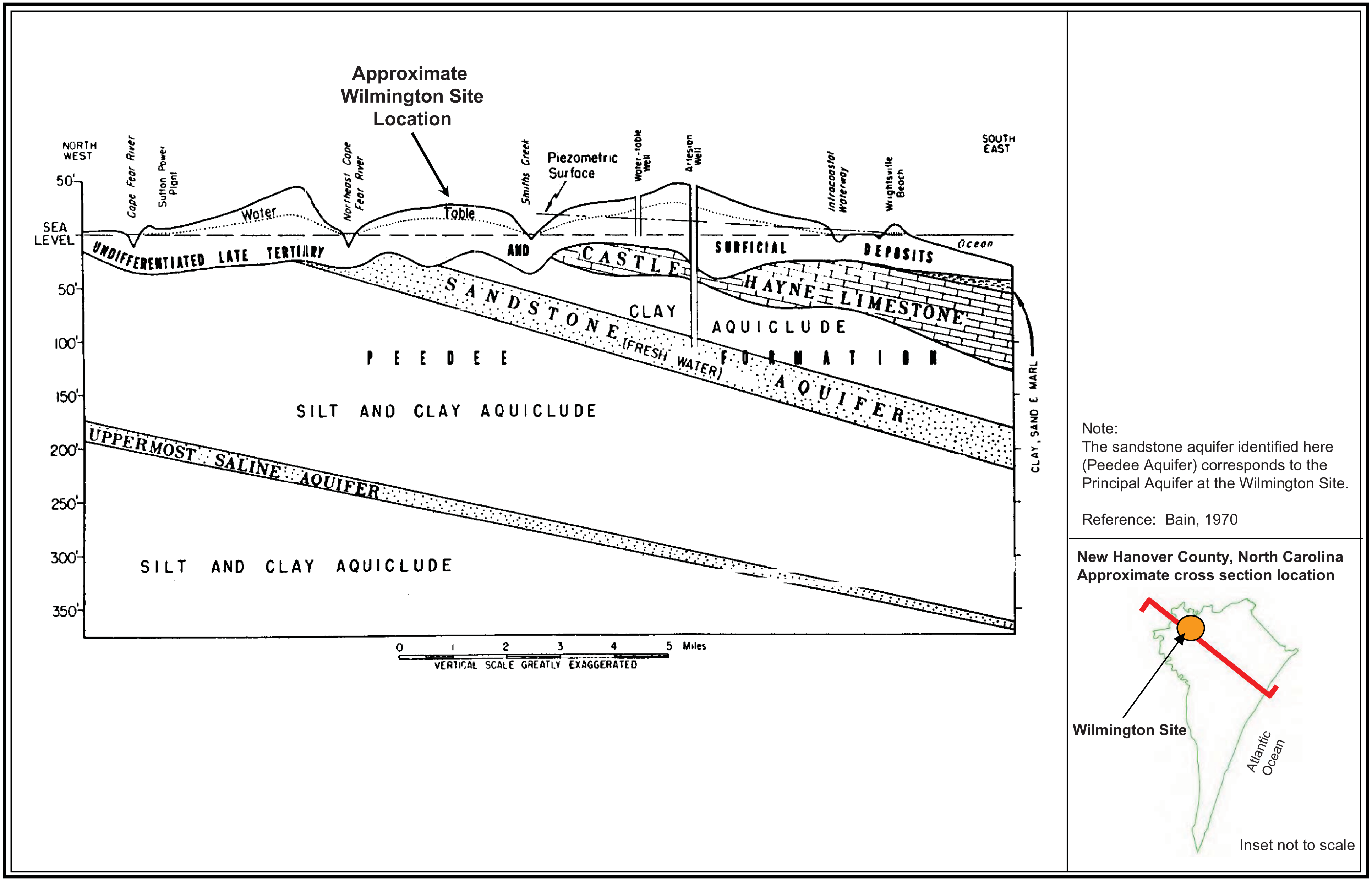


Figure 3.4-9. Hydrogeologic cross section through New Hanover County, NC.

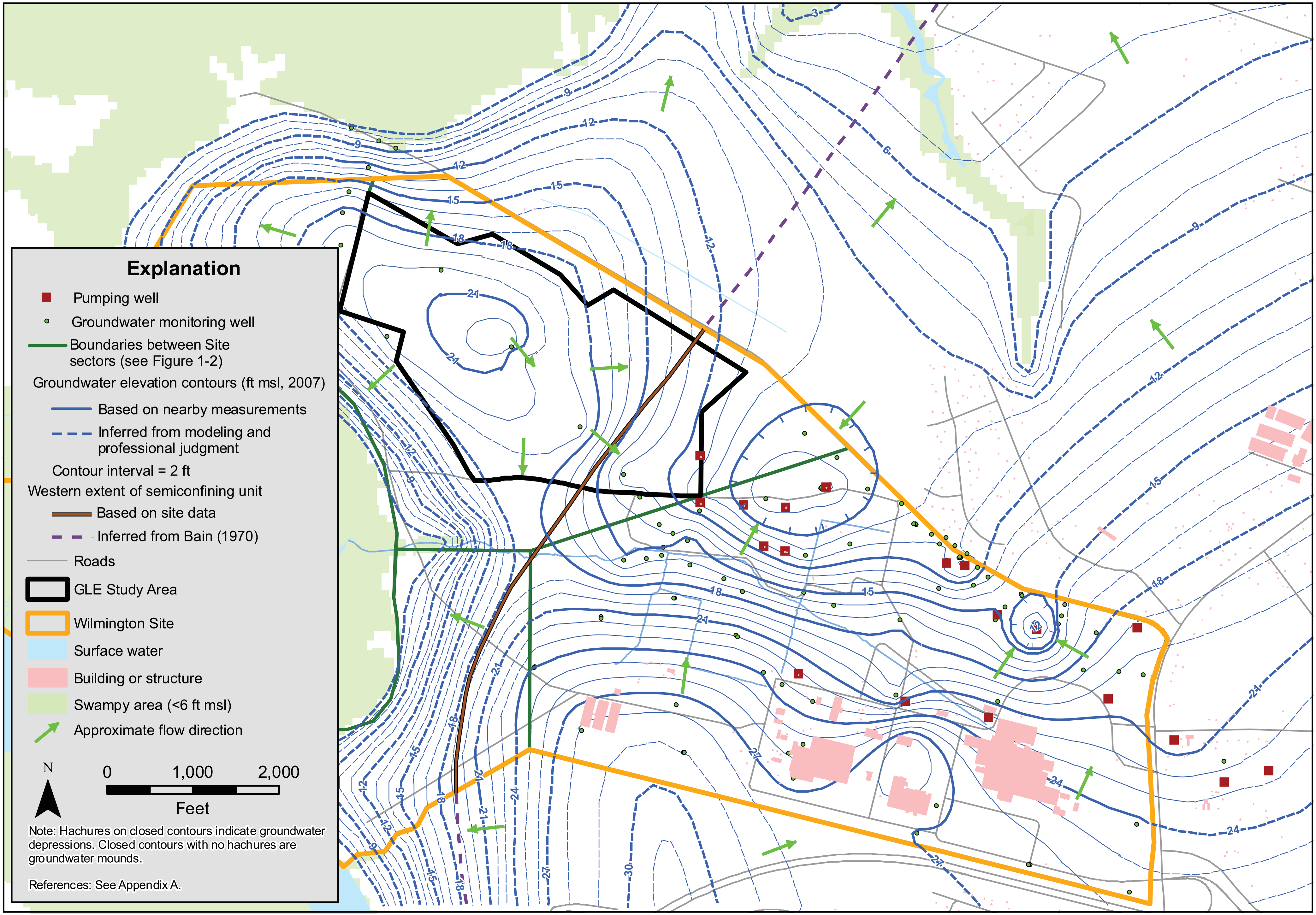


Figure 3.4-10. Principal Aquifer groundwater elevation contours (2007).

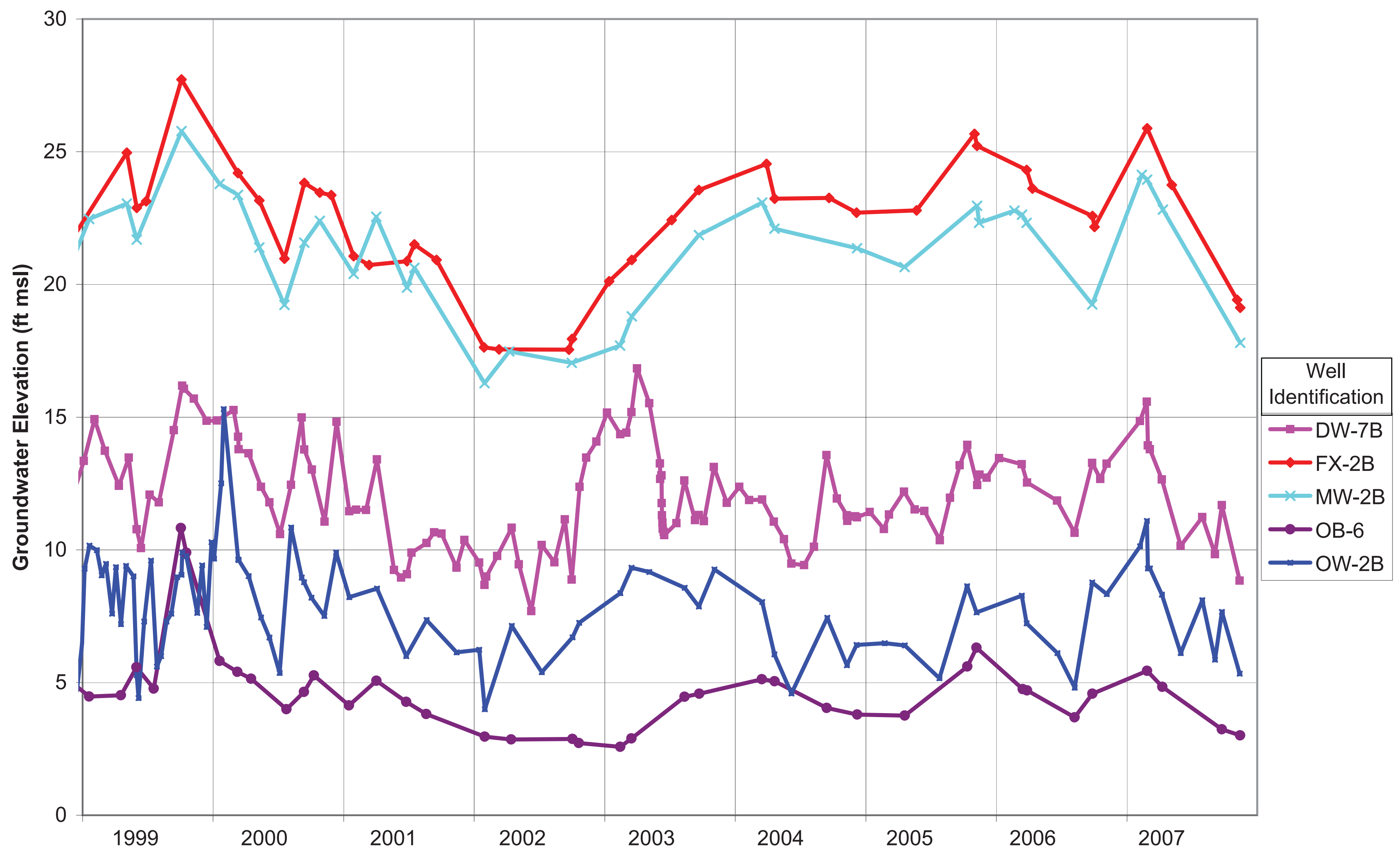


Figure 3.4-11. Example Principal Aquifer hydrographs.

Reference: RTI data and analysis

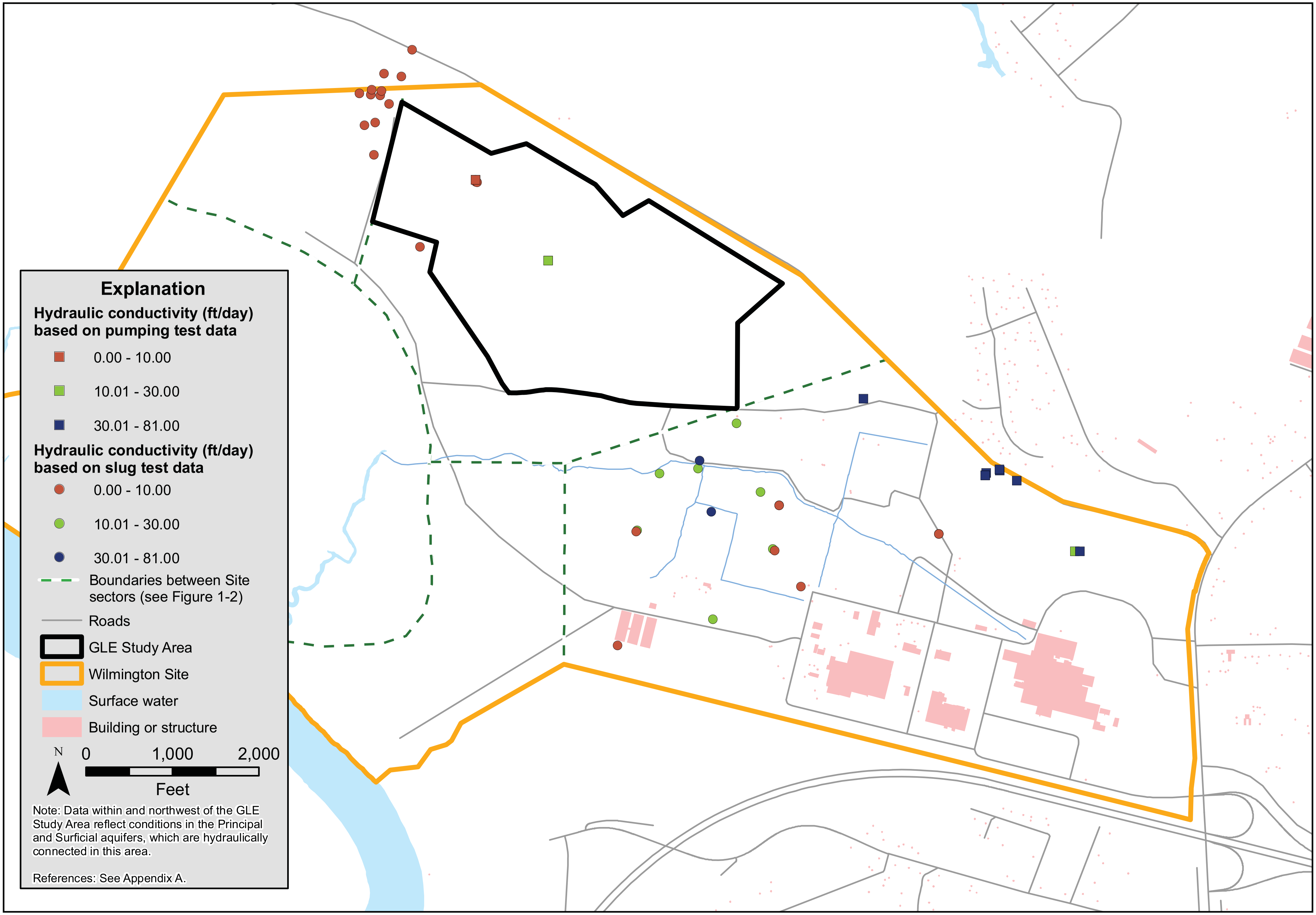


Figure 3.4-12. Measured Principal Aquifer hydraulic conductivity (ft/day).

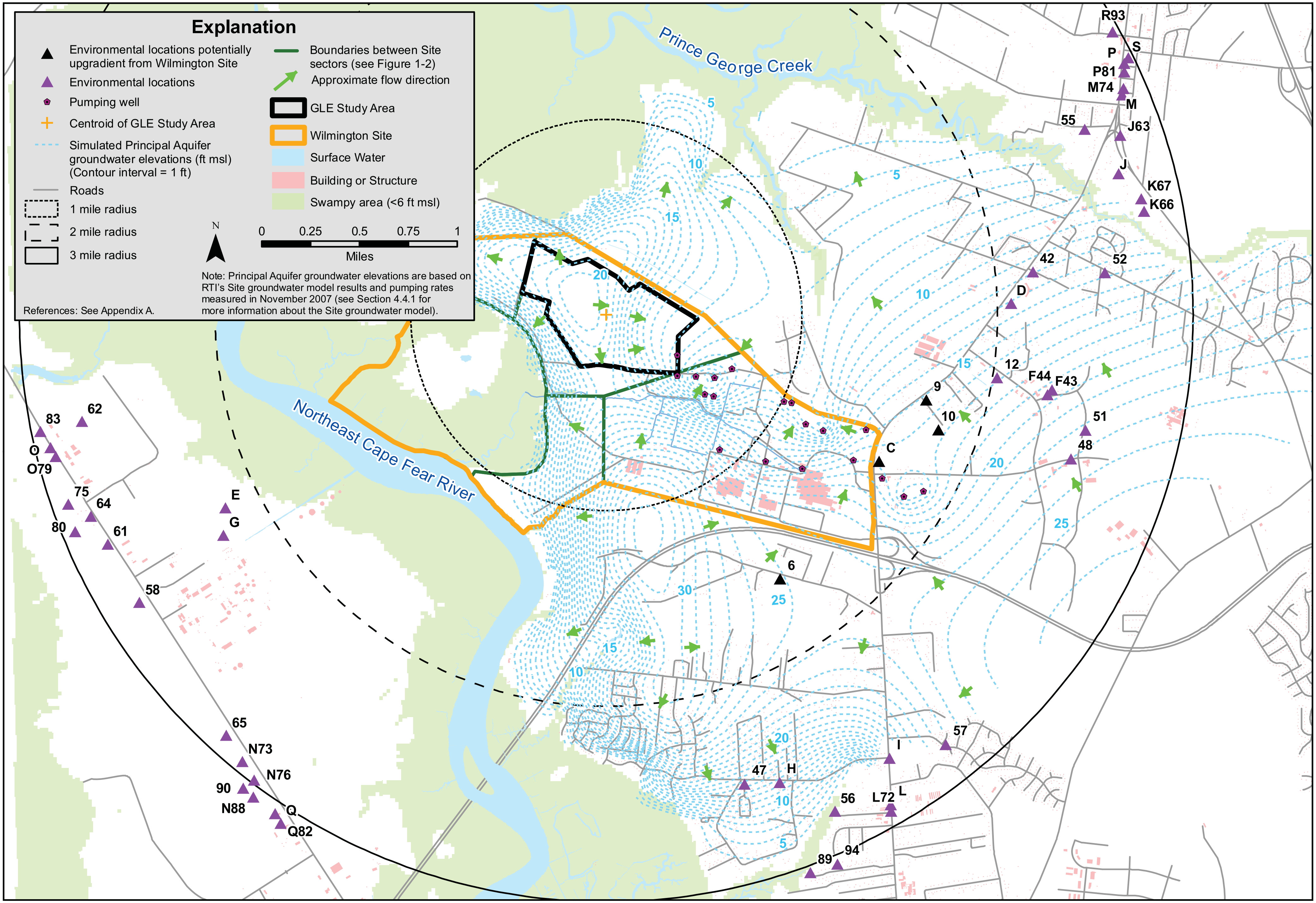


Figure 3.4-13. Locations with known or potential environmental issues in the vicinity of the Site.

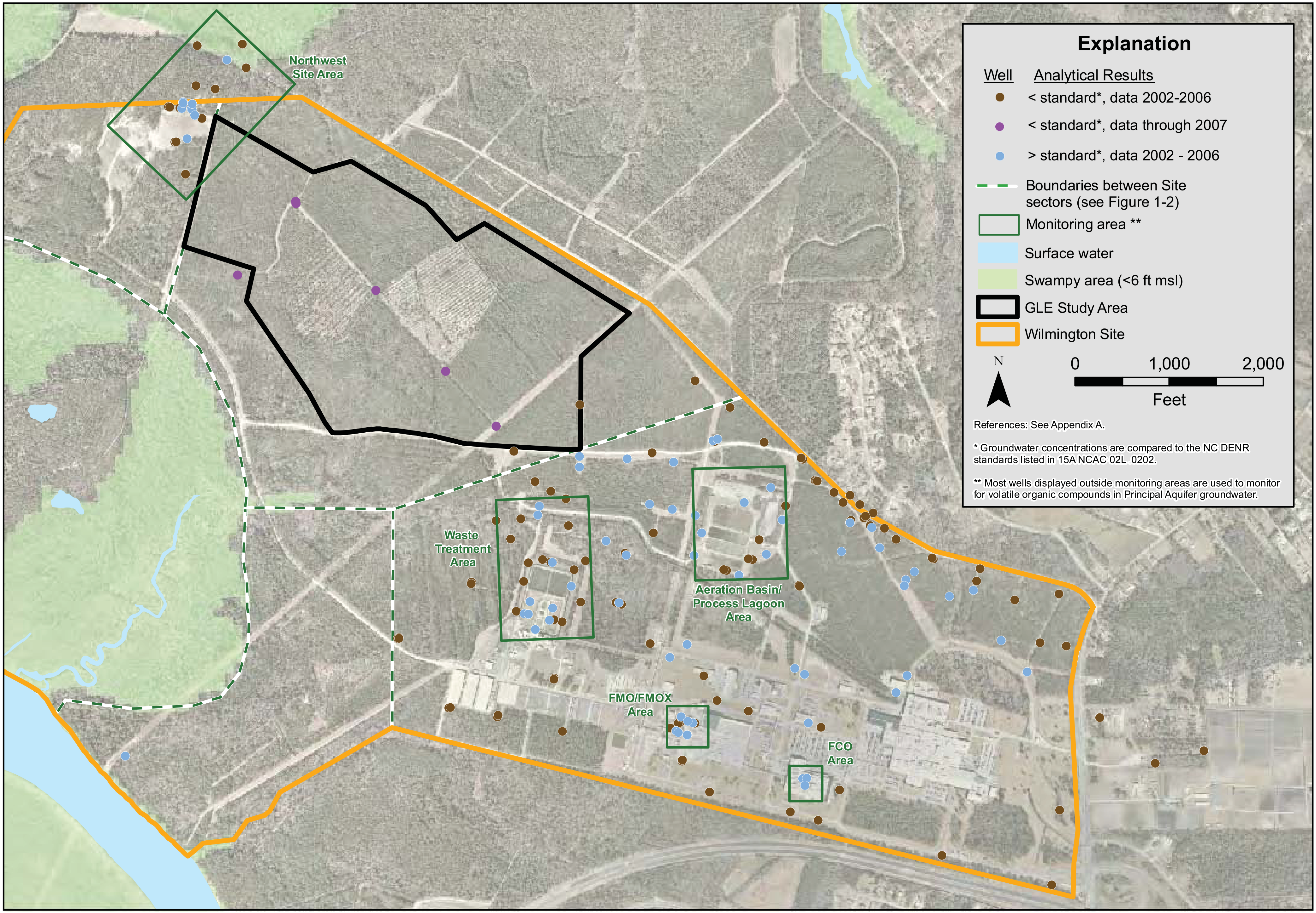


Figure 3.4-14. Summary of groundwater quality data – all monitored constituents.

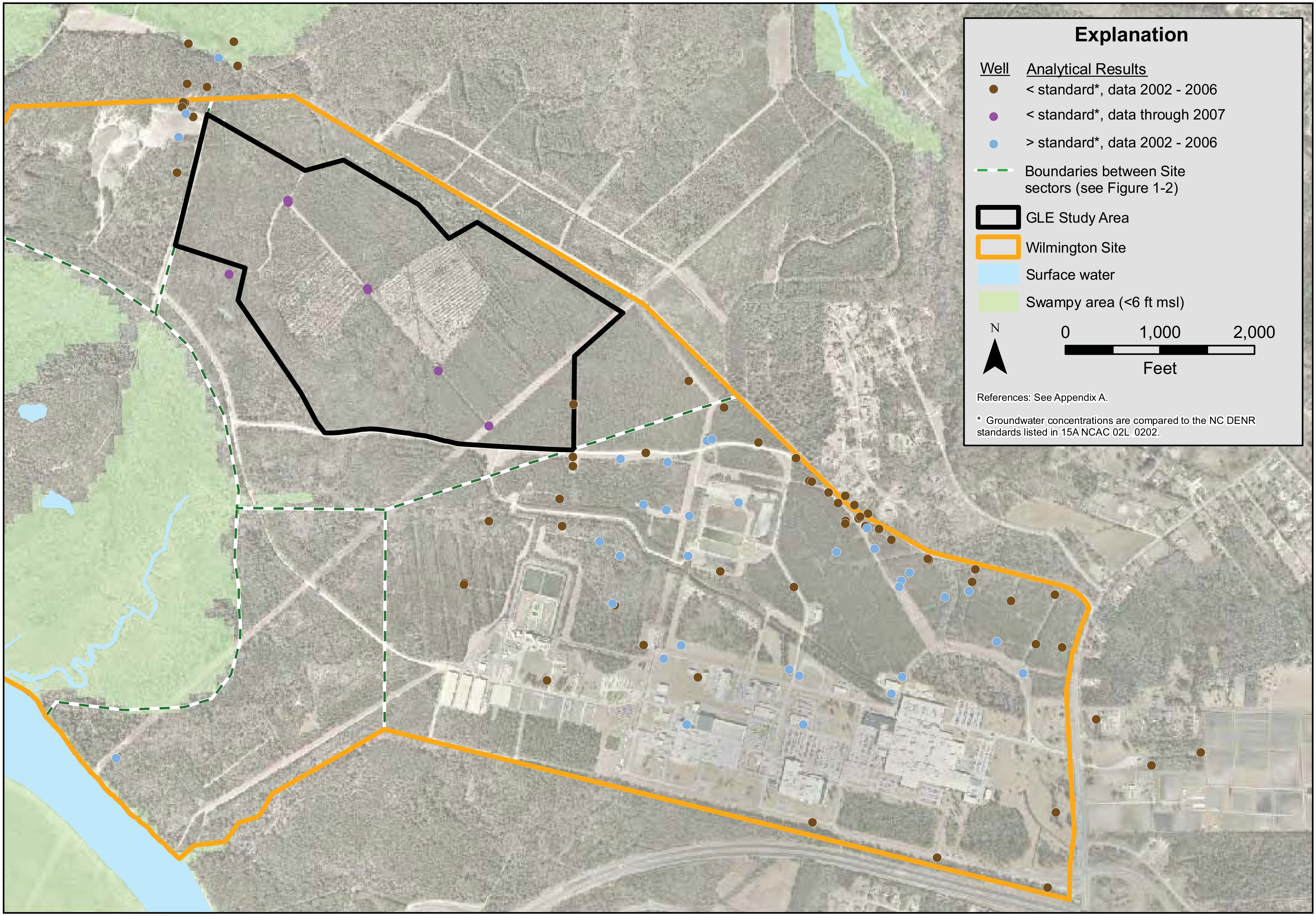


Figure 3.4-15. Summary of groundwater quality data – organic constituents.

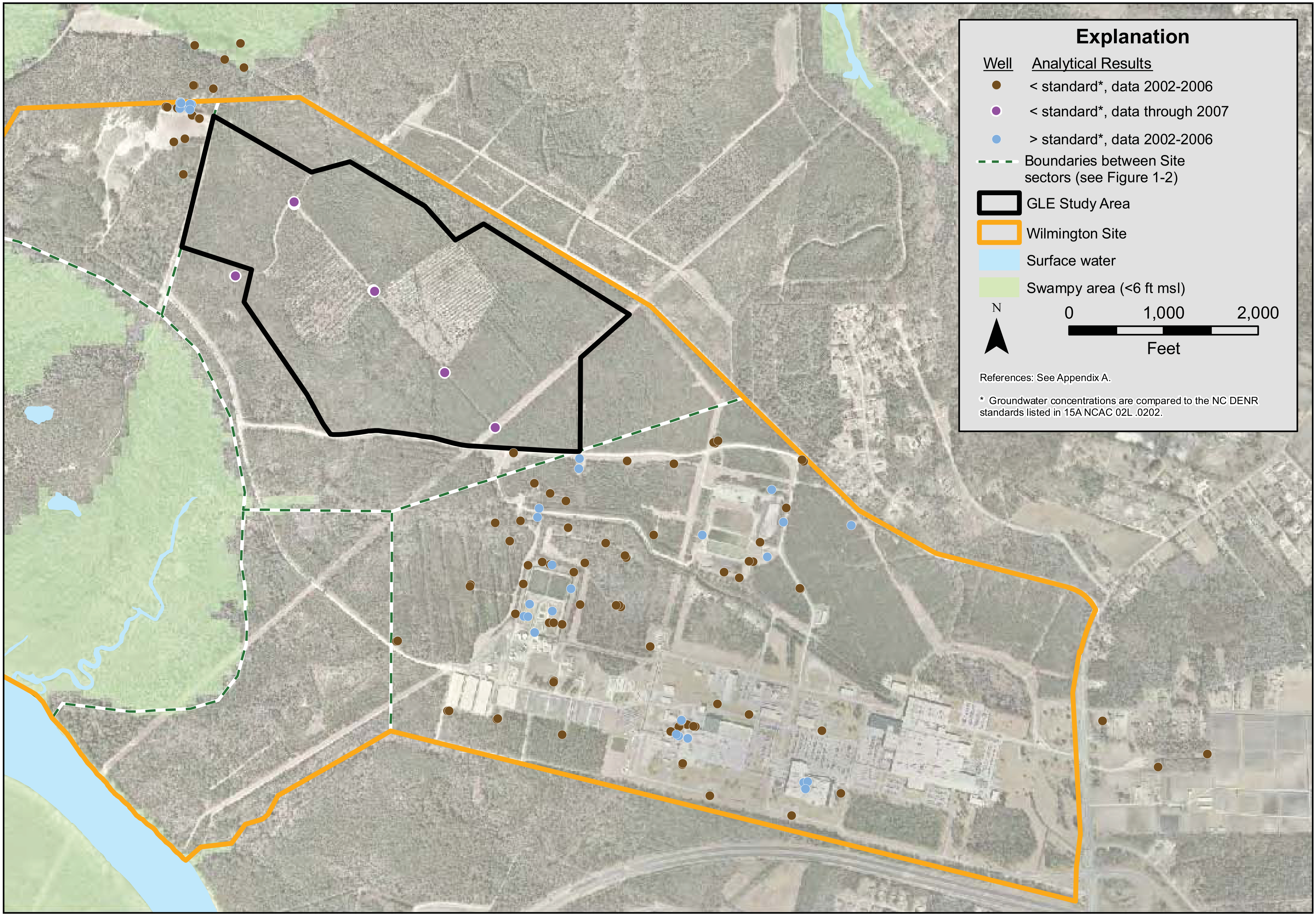


Figure 3.4-16. Summary of groundwater quality data - inorganic and physical constituents.

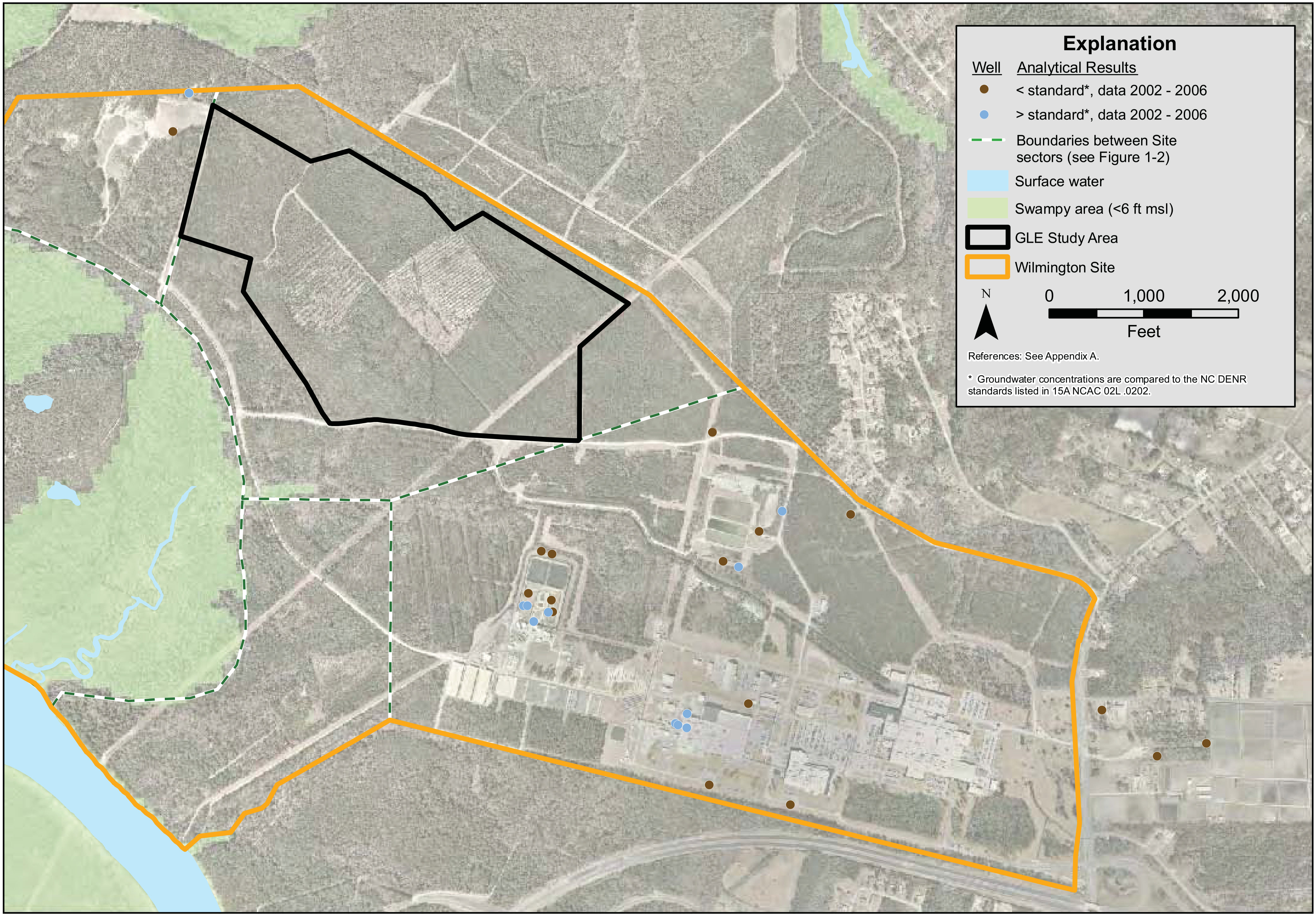


Figure 3.4-17. Summary of groundwater quality data - gross alpha activity.

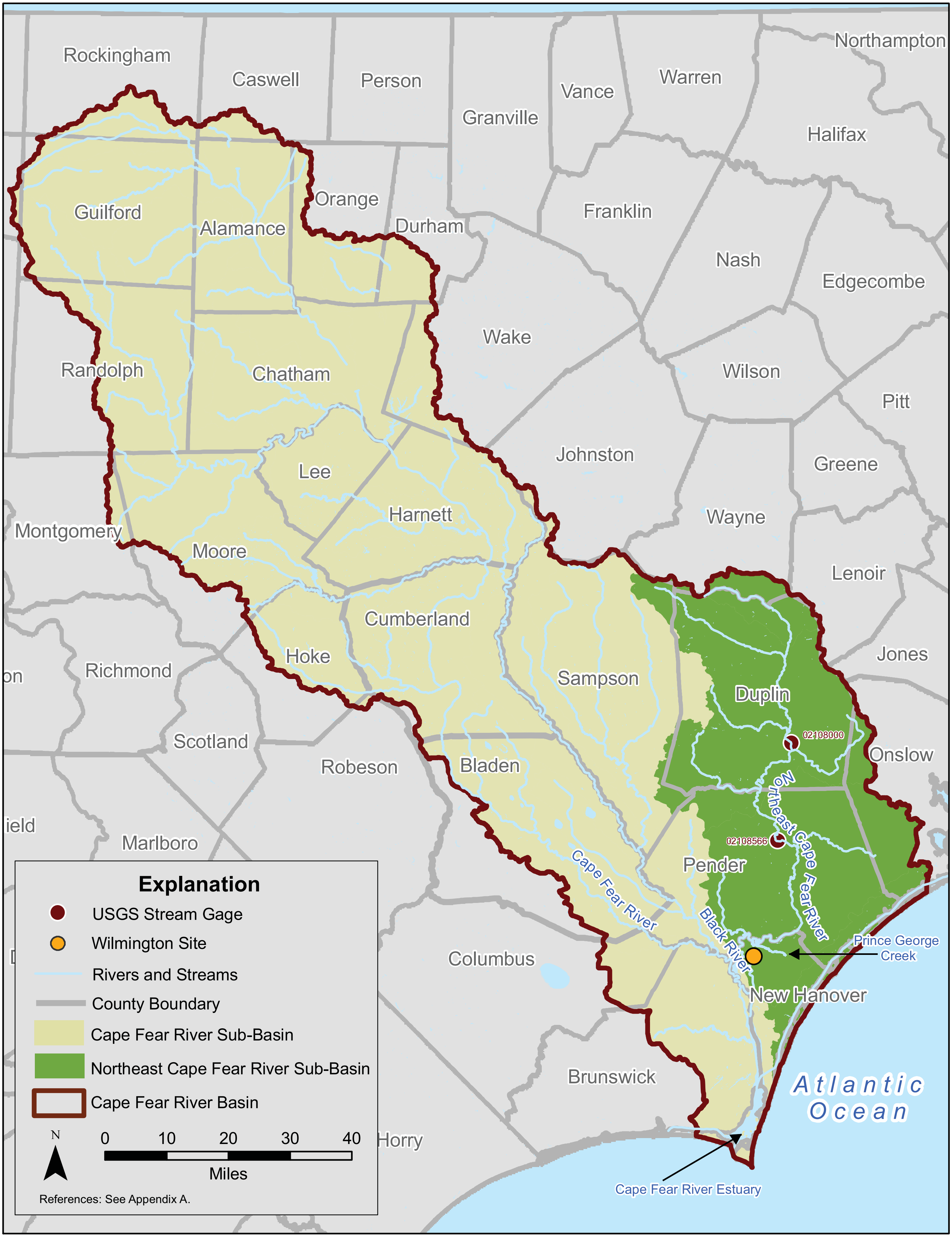


Figure 3.4-18. Regional surface waters.

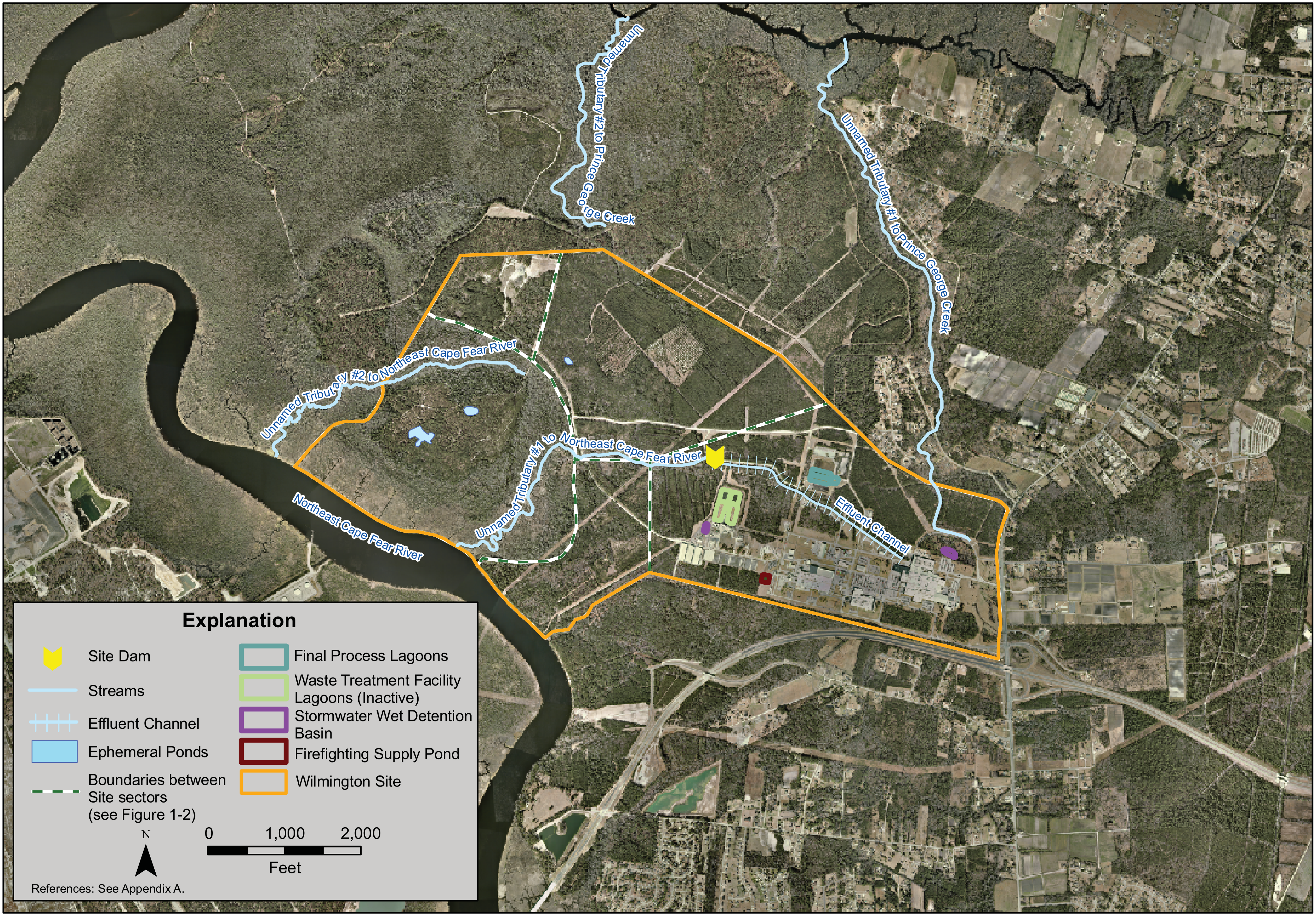


Figure 3.4-19. Wilmington Site surface waters.

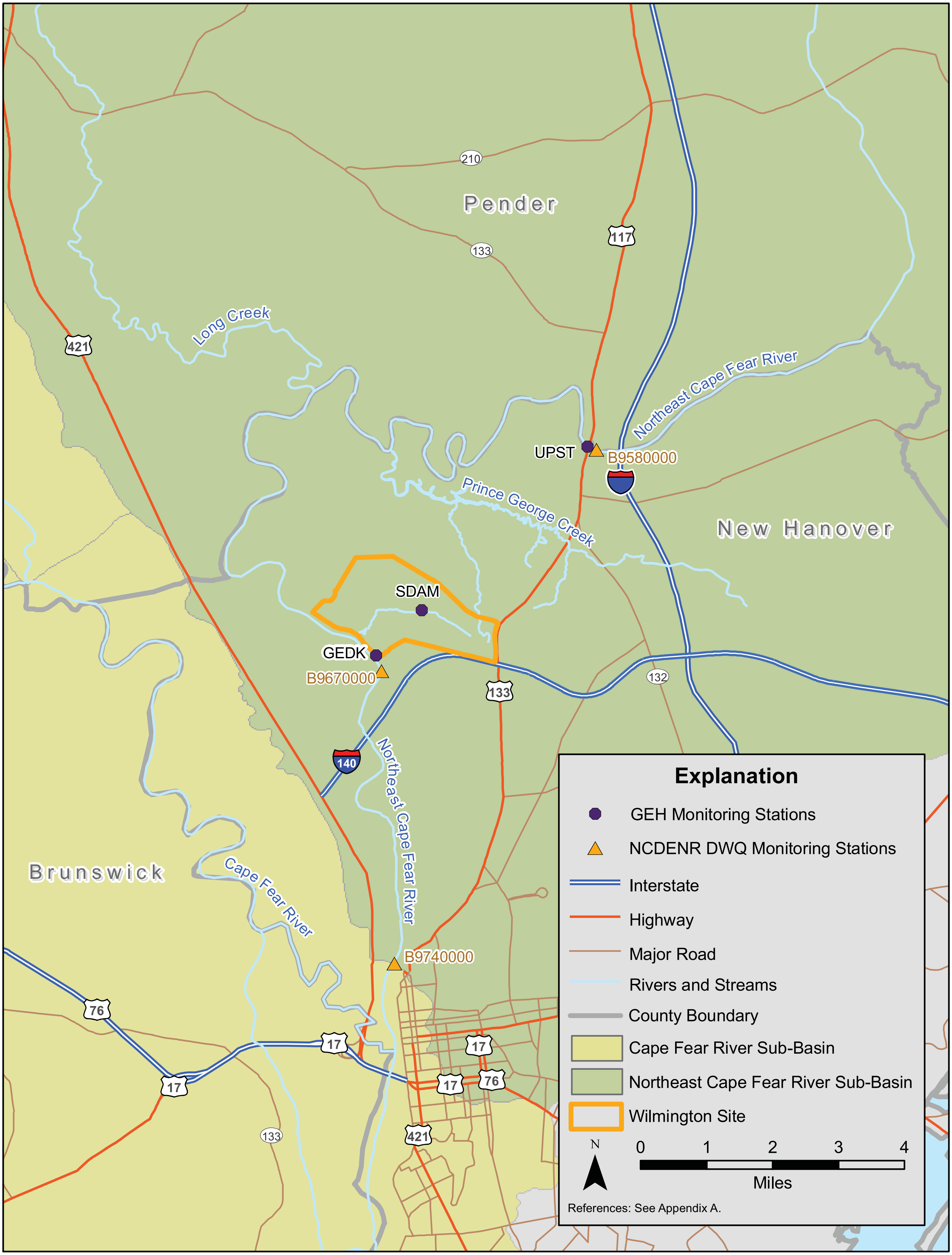


Figure 3.4-20. Water quality monitoring locations.

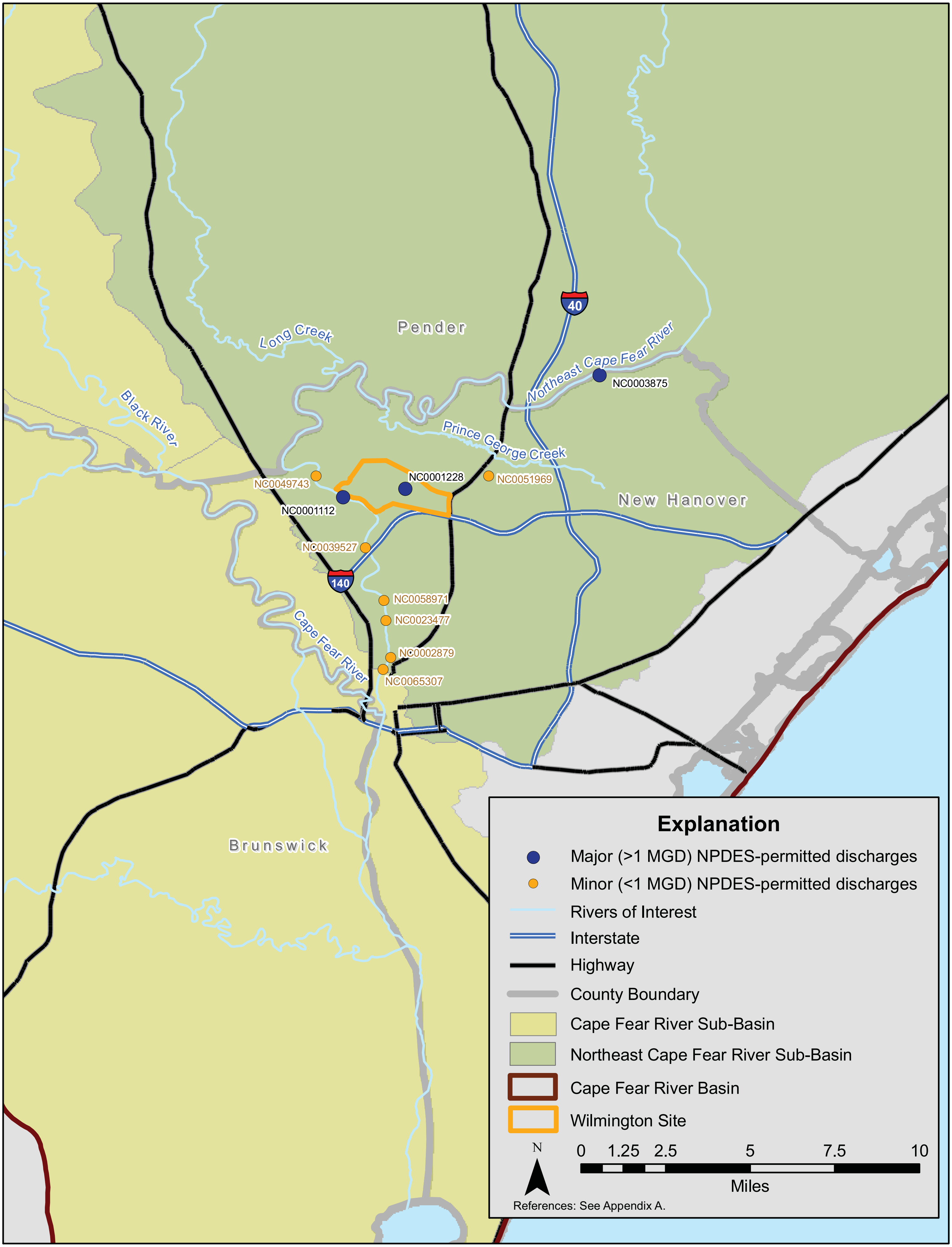


Figure 3.4-21. National Pollutant and Discharge Elimination System (NPDES) permittees on the Northeast Cape Fear River and Prince George Creek in New Hanover County.

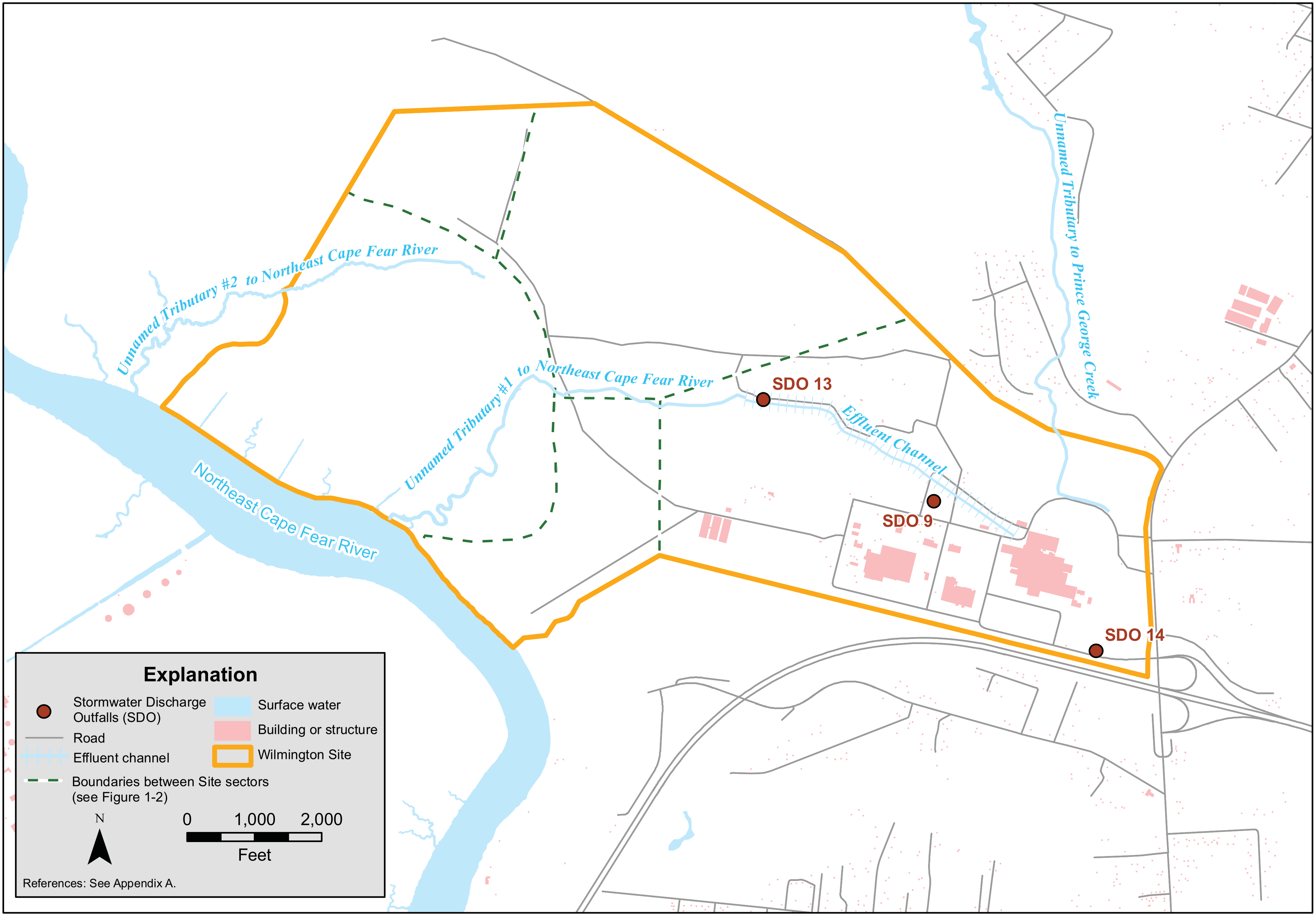


Figure 3.4-22. Wilmington Site stormwater sampling locations.

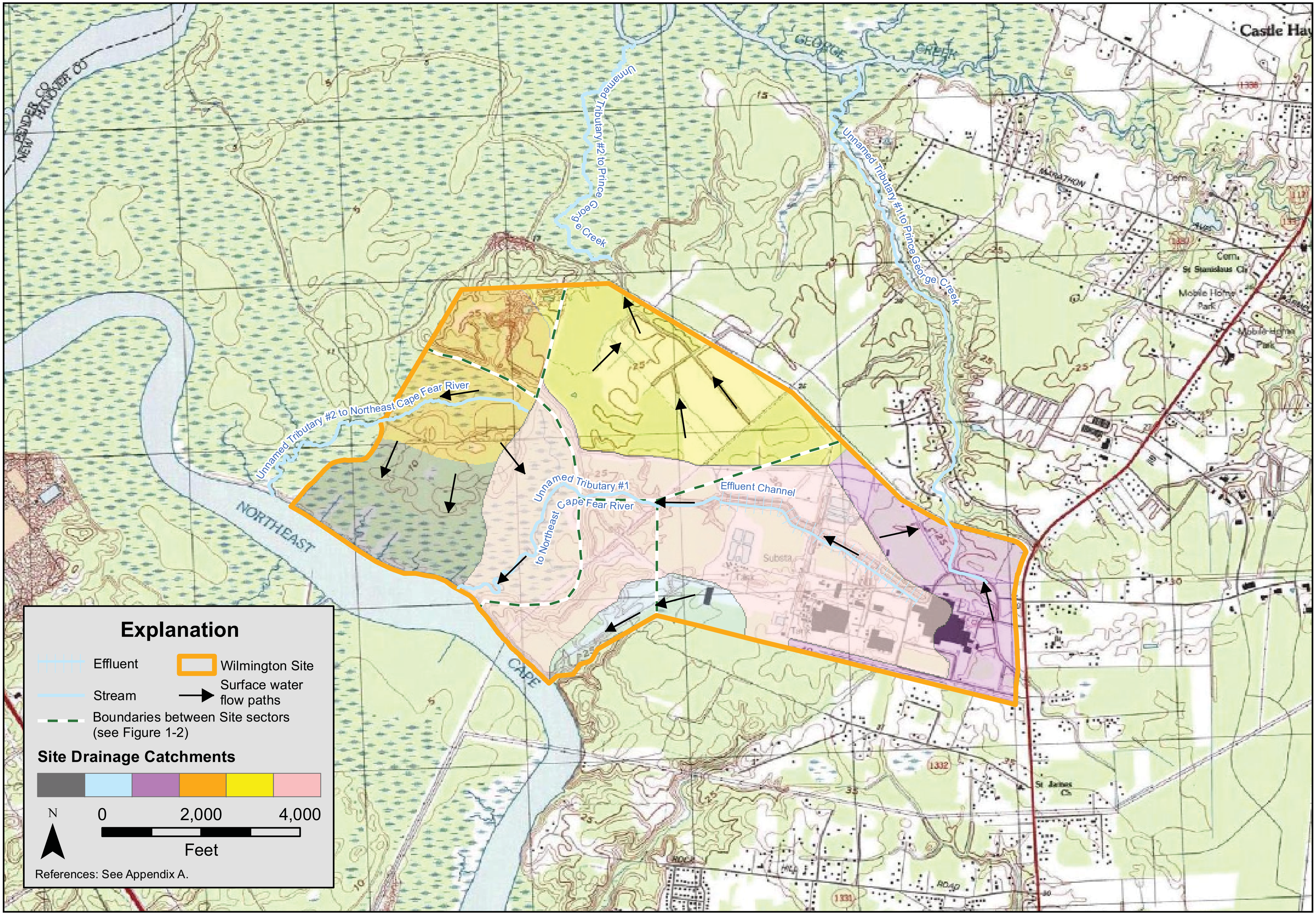


Figure 3.4-23. Current Wilmington Site drainage.

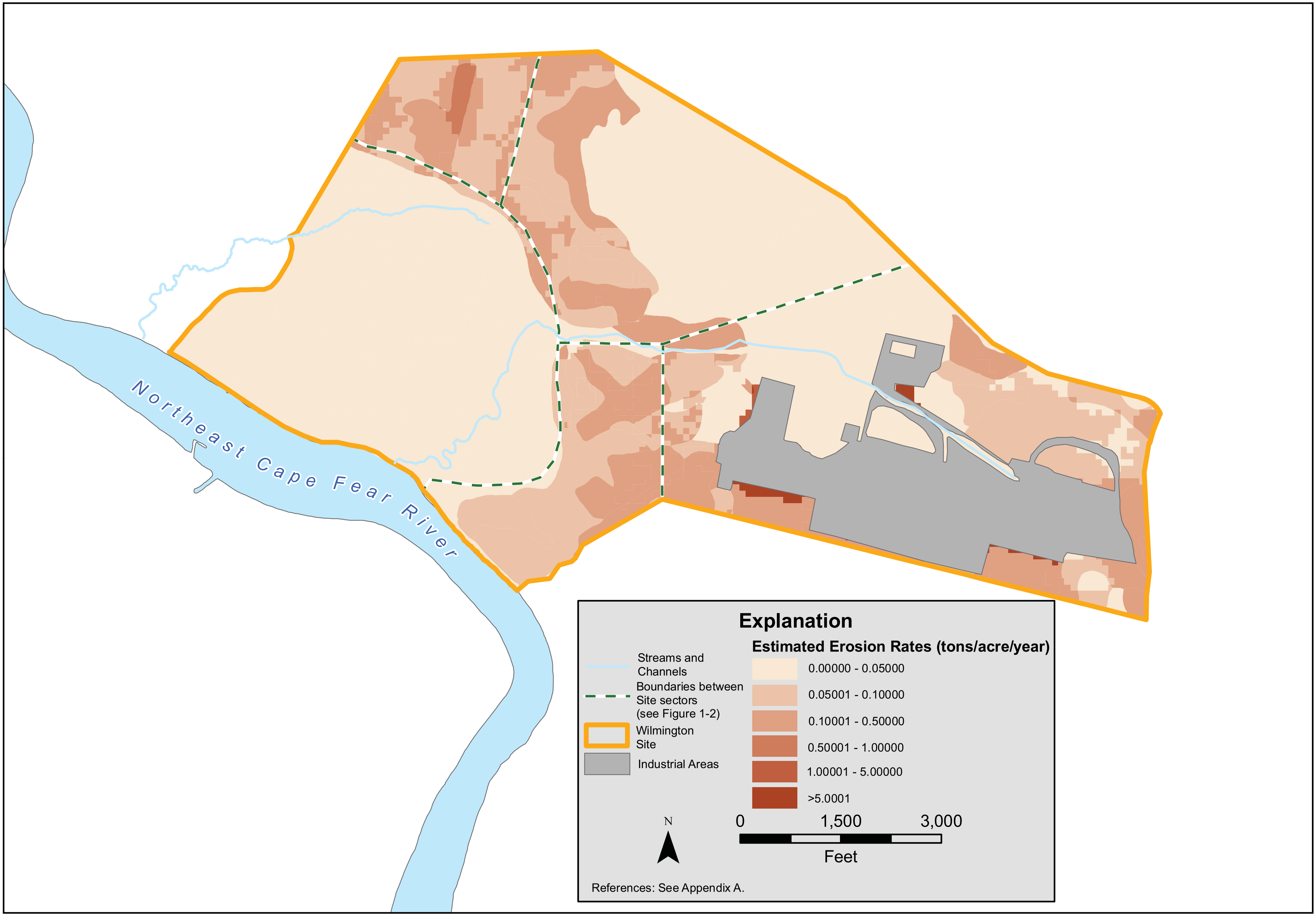


Figure 3.4-24. Estimated erosion rates.

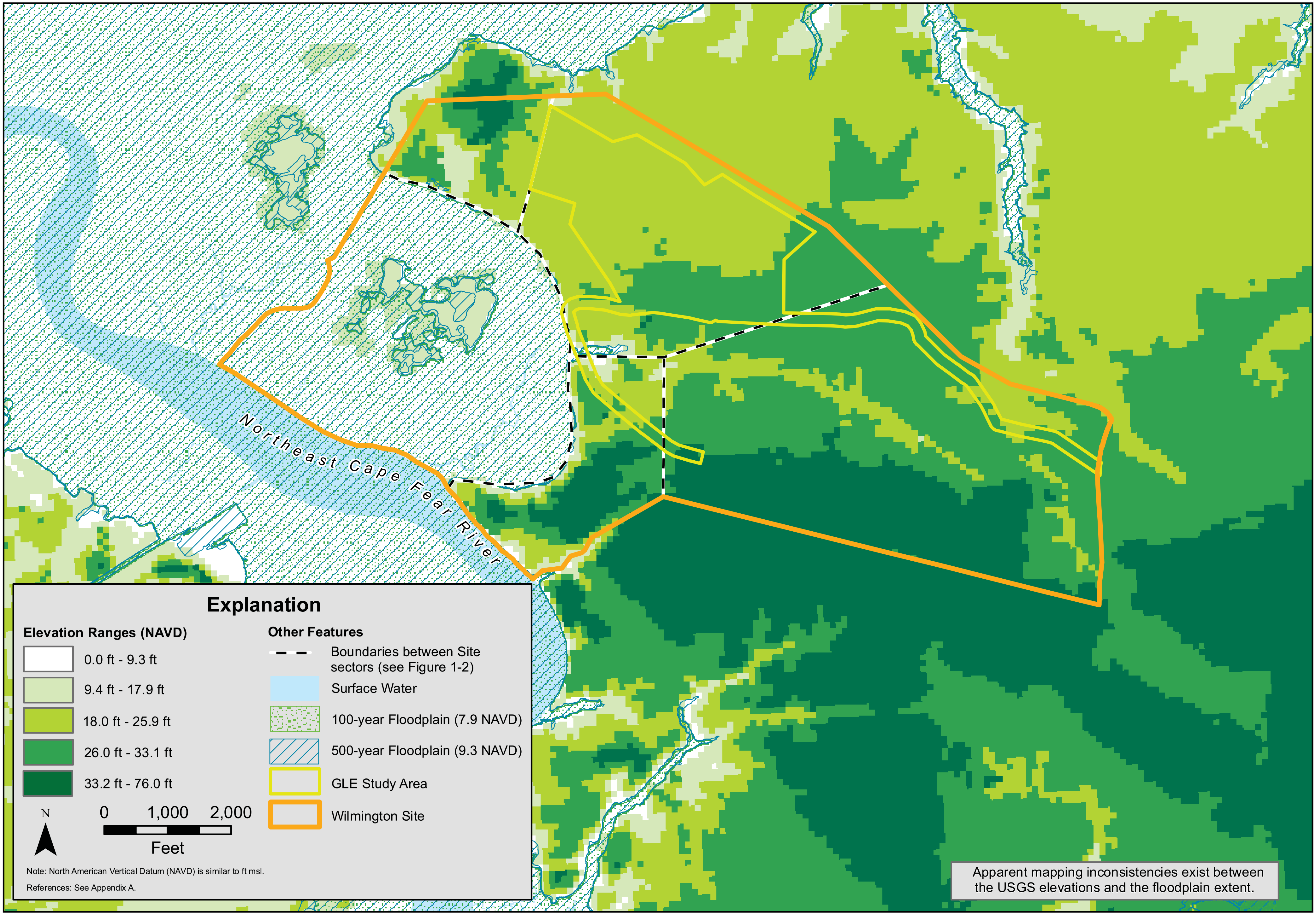


Figure 3.4-25. Floodplain and elevation distribution in the area of the Proposed GLE Facility.

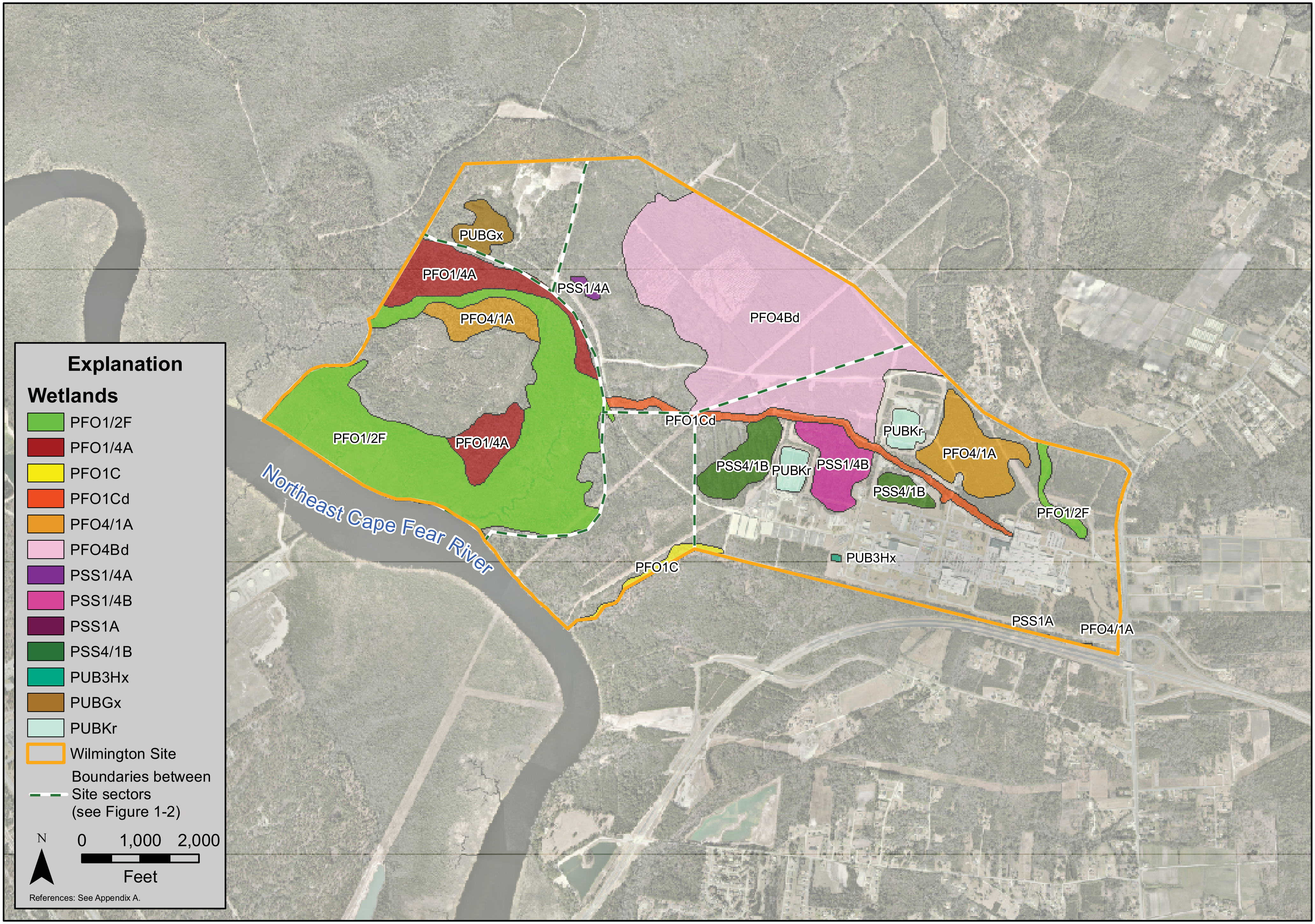


Figure 3.4-26. Wilmington Site wetlands as classified by the National Wetlands Inventory.

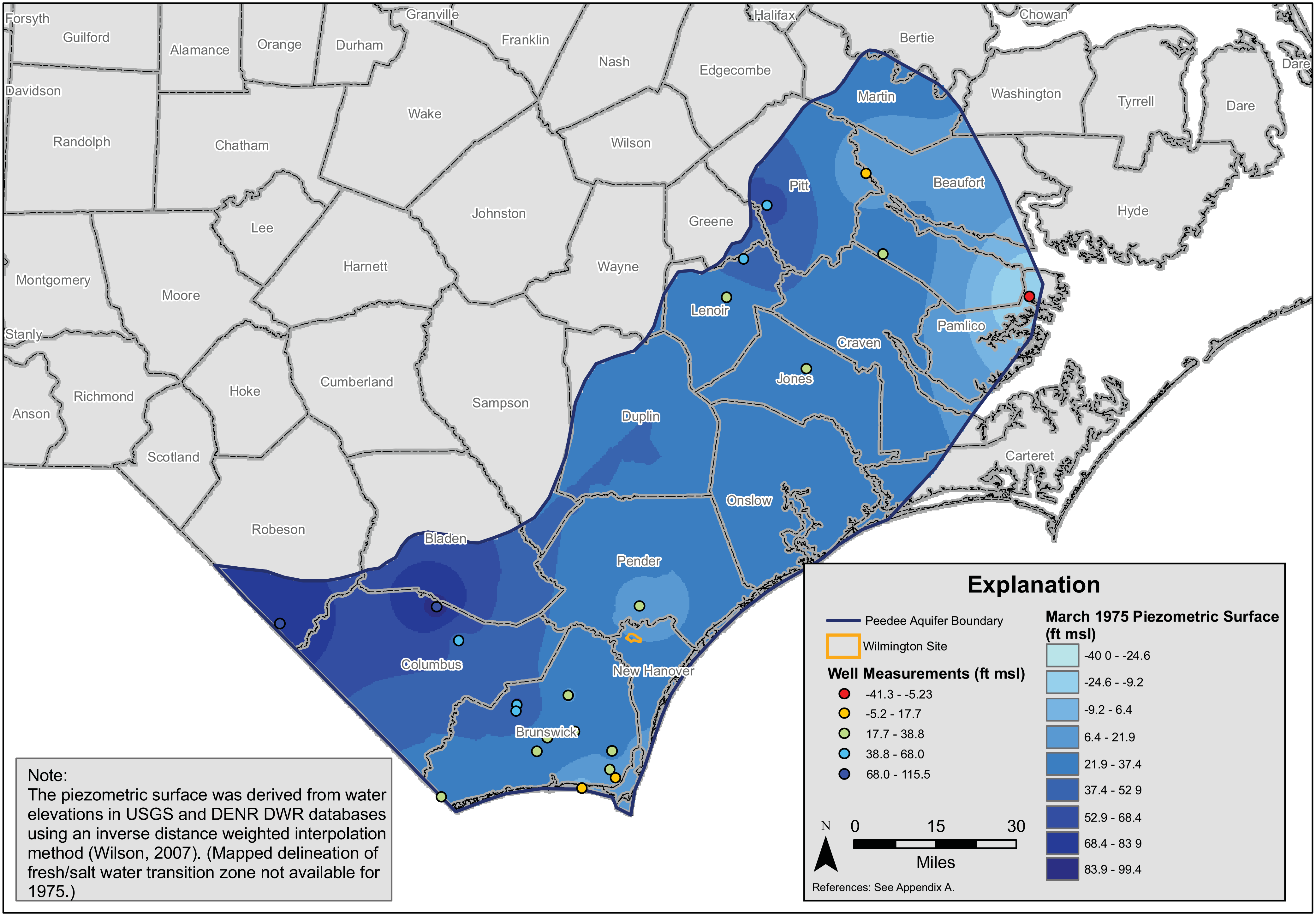


Figure 3.4-27. Peedee Aquifer groundwater elevations, 1975.

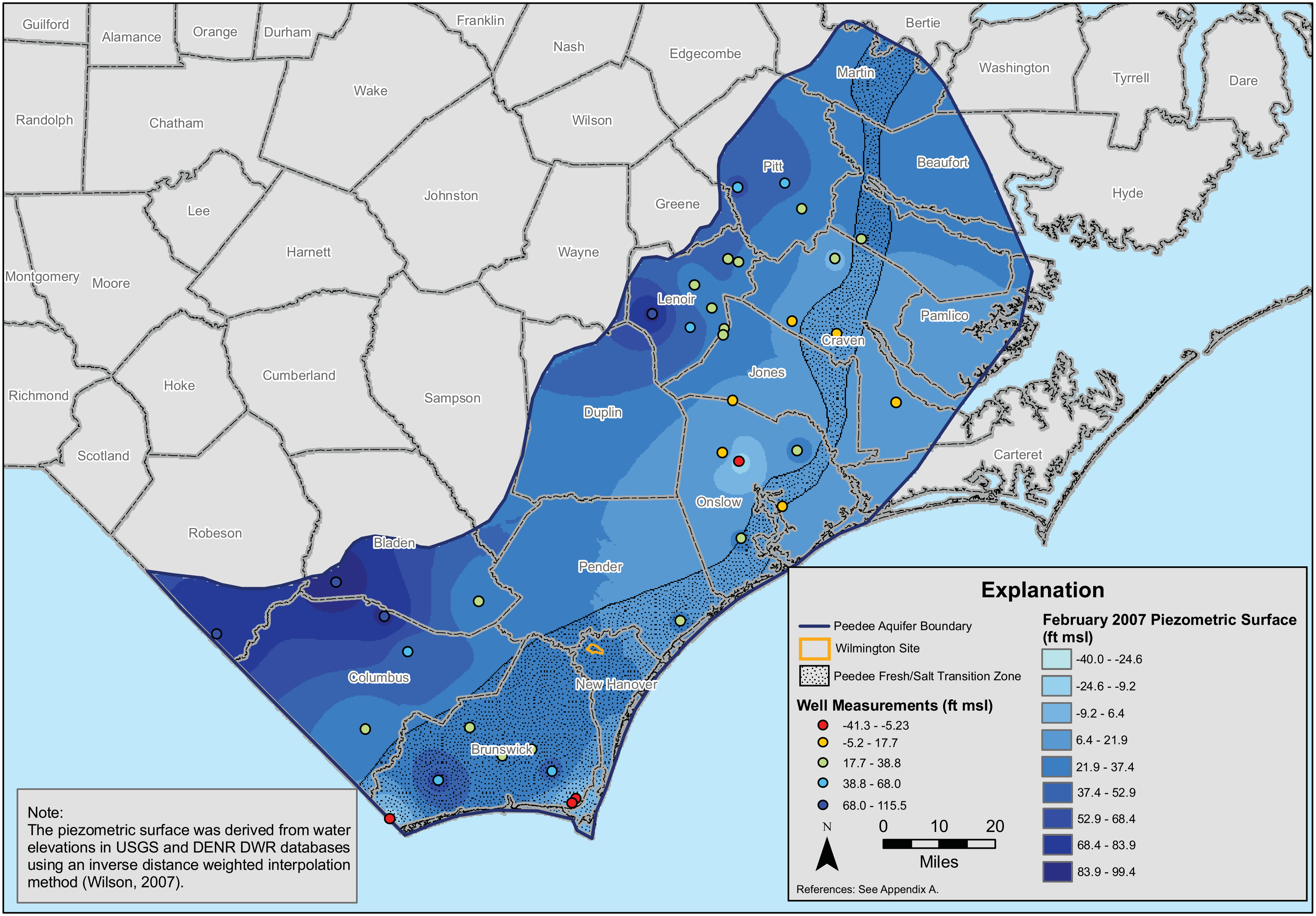


Figure 3.4-28. Peedee Aquifer groundwater elevations, 2007.

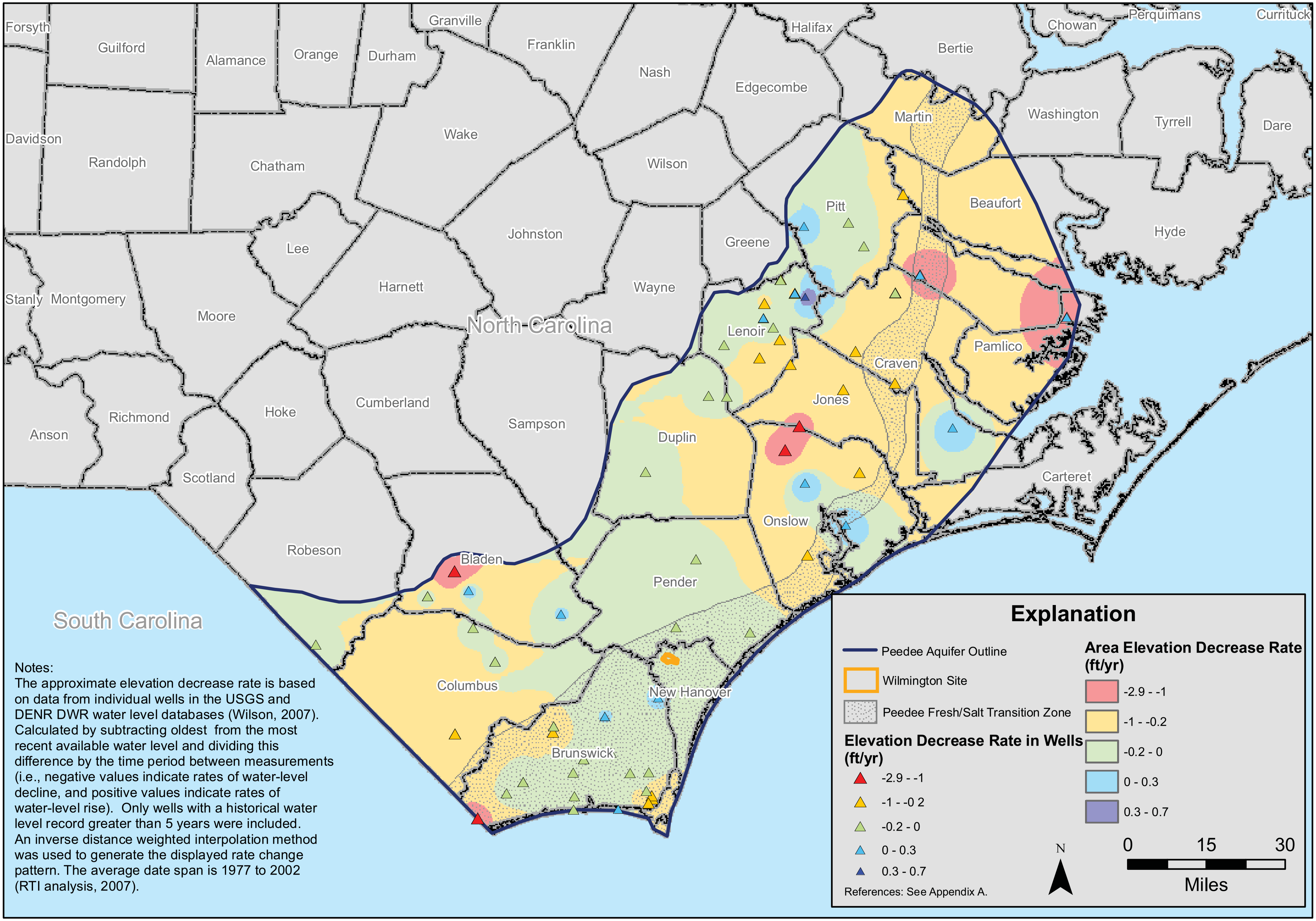
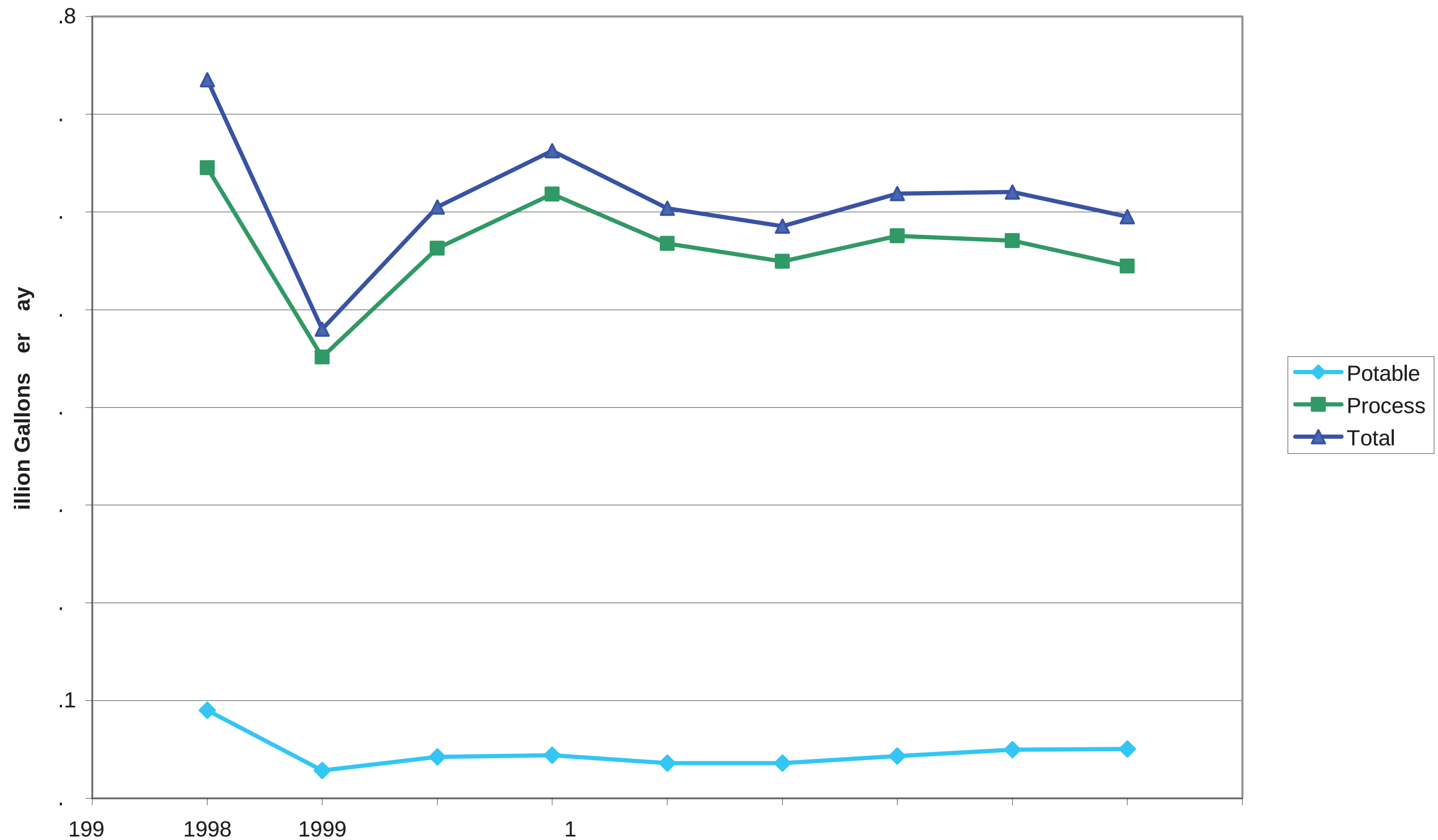


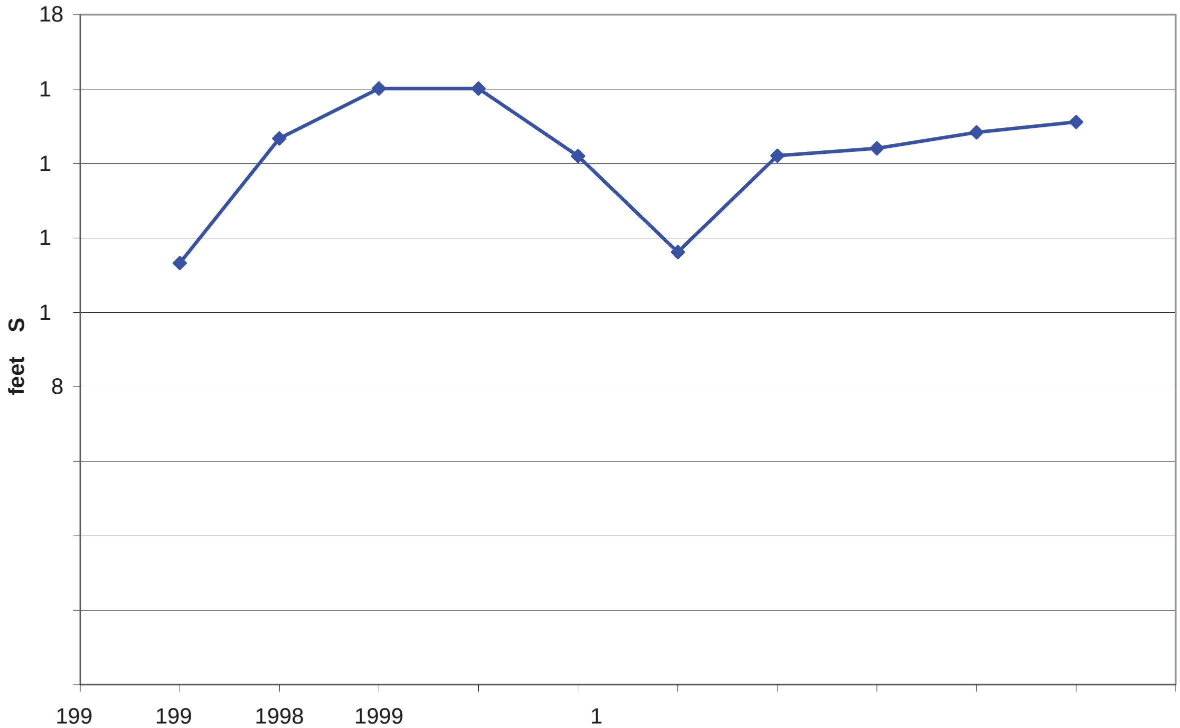
Figure 3.4-29. Approximate rate of groundwater elevation decrease in the Peedee Aquifer.



ote: Site potable ater supply is provided by three ells ust east of the Wilmington Site.

Reference: RT data and analysis, .

Figure 3.4-3 . nnual groundwater withdrawals at the il ington ite.



Reference: RT data and analysis, .

Figure 3.4-31. nnual a erage water le els in onitoring wells installed in the eedee quifer at the il ington ite.

GLE Environmental Report
Section 3.5 – Ecological Resources

Revision 0
December 2008

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3.5 Ecological Resources

This section of this Environmental Report describes the terrestrial and aquatic communities in the region and at the Wilmington Site. This section is intended to provide a baseline characterization of the Site's current ecological condition prior to any environmental disturbances associated with the construction of the Proposed GLE Facility. Prior environmental disturbances (e.g., roads, agricultural, silvicultural, current industrial operations) are considered when describing these baseline conditions. This section begins with a general discussion of the ecoregions of the region and the Wilmington Site , discusses the existing vegetation communities on the Site, identifies the terrestrial and aquatic animals that do or could potentially exist on the Site based on the available habitat, and discusses other ecological conditions that may be stressors to the Site. This section concludes with a summary of species listed as Endangered and Threatened, as well as Federal Species of Concern, relevant to the Site, and a determination if suitable habitat for those species occurs on the Site. The common and scientific names of each species are listed for the first occurrence; subsequent reference to the species is by the common name only.

3.5.1 Regional Ecological Setting

New Hanover County, NC, is located within the Humid Temperate Domain, Subtropical Division, Outer Coastal Plain Mixed Forest Province, and Atlantic Coastal Flatlands of the United States Forest Service (USFS) National Hierarchy (Bailey, 1995). The Humid Temperate Domain (located in the middle latitudes [30–60° north]) is characterized by pronounced seasons with strong annual cycles of temperature and precipitation. The seasonal fluctuation of energy and temperature is greater than the diurnal fluctuation. One of the subcategories of the Humid Temperate Domain is the Subtropical Division. Distinguishable characteristics of the division include a climate marked by high humidity (especially in summer) and the absence of very cold winters. Forests are the typical vegetation throughout most of this division. Much of the sandy Coastal Plain Physiographic Province of the southeastern United States is covered by second-growth forests of longleaf, loblolly, and slash pines. Inland areas have deciduous forest (Bailey, 1995).

The Outer Coastal Plain Mixed Province covers 173,800 mi^2 (447,522 km^2). This province comprises the flat and irregular Atlantic and Gulf Coastal Plains to the ocean. More than 50% of the area is gently sloping. Temperate evergreen (or laurel) forest is typical in the province; however, along the Atlantic Coast, the province is characterized by coastal marshes and interior swamps that are dominated by gum and cypress. Most upland areas are covered by subclimax pine forest, which has an understory of grasses and sedges called savannas. Undrained, shallow depressions in savannas form interior wetlands known as pocosins. Pocosins are formed from the accumulation of organic sediments in these upland depressions and are dominated by evergreen shrubs. Sandy uplands have forests of loblolly pine (*Pinus teada*), longleaf pine (*Pinus palustris*), and slash pine (*Pinus ellioti*), and bald cypress (*Taxodium distichum*) is a dominant tree in swamps (Bailey, 1995).

The predominant vegetation form in the Atlantic Coastal Flatlands Section is needle-leaved evergreen forest with smaller areas of evergreen broad-leaved forest. Forest-cover type is mainly longleaf and loblolly pine in the northern areas. Pond pine (*Pinus serotina*), a fire-maintained species with serotinous cones, is prevalent in coastal North Carolina, where poorly drained organic soils are present and wildfire is common. The oak-gum-cypress forest type is common along floodplains and major rivers; it includes water oak (*Quercus nigra*), laurel oak (*Quercus laurifolia*), swamp tupelo (*Nyssa biflora*), sweetbay (*Magnolia virginiana*), bald cypress, and pond cypress (*Taxodium ascendens*). Localized areas of mostly hardwoods occur and include laurel oak, water oak, sweetbay, sweet gum (*Liquidambar syraciflua*), live oak (*Quercus virginiana*), and red maple (*Acer rubrum*) (Bailey, 1995).

3.5.2 Physical Setting of the Wilmington Site

The Wilmington Site borders the Northeast Cape Fear River, approximately between river miles 6.1 and 6.7 upstream of Wilmington. Elevations on the Site range from 40 ft (12 m) above msl on the eastern portion of the Site to less than 6 ft (2 m) msl at the Northeast Cape Fear River (**Section 3.4.2.1.1**, *Hydrologic Data*). The river and its floodplain dominate the local landscape. In the Western Site Sector, there is evidence of an abandoned river oxbow that has been filled with alluvial deposits in the geologic past (see **Section 3.3.3**, *Site-Specific Geology*, for the geological history) and is now classified as a Swamp Forest (see **Section 3.5.3.2.7**). The ends of the oxbow still connect with the river-dominated tidal swamp on and adjacent to the Site. The center portion of the oxbow is upland dominated by dry, sandy woodlands. The remainder of the Wilmington Site is generally an upland area, with elevations generally ranging between 20 and 40 ft (12 m) msl. Across the upland area, natural topographic variations rarely exceed 5 ft (1.5 m) within localized areas. Pocosins have formed in these minor depressions. The upland area is also bisected with alluvial channels. Anthropogenic alteration and manipulation have influenced and altered these natural conditions to the current conditions described in **Section 3.5.3.3**.

3.5.3 Biotic Communities

Groups of organisms living and interacting within the same habitat are known as biotic communities. Because dominant plant constituents are most obvious, they are generally used as the basis for identifying biotic communities in the field and in mapping. Transitional areas between adjacent biotic communities are termed ecotones or edges. Biotic communities evolve over time in response to changing environmental conditions. For example, a pine forest may not always remain a pine forest. An old field may eventually become a pine forest, which may develop into a hardwood forest.

This section classifies the biotic communities found on the Wilmington Site based on the dominant species in the canopy, sub-canopy or understory, and the groundcover. Interpretations were made using true color orthophotography from 2006 available from New Hanover County. Names for plants species are consistent with *Flora of the Carolinas, Virginia, Georgia and Surrounding Areas* (Weakley, 2007). For this report, these communities have been grouped as naturally occurring communities (**Section 3.5.3.2**) and anthropogenically influenced communities (**Section 3.5.3.3**).

3.5.3.1 Field Surveys on the Wilmington Site

Field surveys were conducted in July (22, 23, 24, 25, 30, 31) and September (4, 5, 6, 7) 2007 to identify the current biotic communities on the Wilmington Site. No attempt was made to list all species that occur on the Site during the field surveys, but rather to generally characterize the natural and anthropogenic communities on the Site. The information provided in this section is a summary of more detailed studies conducted for preparation of this Environmental Report.

Thirteen major biotic communities in varying stages of succession were identified on the Wilmington Site. Eight of the communities are natural: Longleaf Pine/Scrub Forest, Pine Forest, Pine-Hardwood Forest, Hardwood Forest, Alluvial Forest, Pocosin/Bay Forest, Swamp Forest, and Pond. Pine Plantations were observed on the Site and are anthropogenically influenced. These are of various age classes and are managed by prescribed burning to mimic a natural fire regime. The remaining four anthropogenically influenced community types are Field, Operations Area, Power Line Corridor, and Canal Corridor. **Table 3.5-1** summarizes the acreage for each community, and **Figure 3.5-1** illustrates the location of each community on the Wilmington Site. Areas of reference for discussion of the location of biotic communities on the Wilmington Site are illustrated in **Figure 1-2** of this Report.

3.5.3.2 Natural Communities

3.5.3.2.1 Longleaf Pine/Scrub Forest

On the Wilmington Site, two areas of Longleaf Pine/Scrub Forest community are present in the Northwestern Site Sector. This community was once more common across the upland areas of the Site; however, fire protection, agriculture, and pine plantations have diminished this habitat (Schafale and Weakley, 1990). The canopy layer is dominated by longleaf pine. In the subcanopy, turkey oak (*Quercus laevis*) is most prevalent, although American persimmon (*Diospyros virginiana*) and other oak species such as blackjack oak (*Quercus marilandica*) and sand post oak (*Quercus marqarettiae*) are scattered throughout. Small black blueberry (*Vaccinium tenellum*) and dwarf huckleberry (*Gaylussacia dumosa*) are the common shrub species. Frequently observed herbaceous species include pineland scaly-pink (*Stipulicida setacea*), Carolina sandwort (*Minuartia caroliniana*), and tread-softly (*Cnidoscolus stimulosus*).

3.5.3.2.2 Pine Forest

Pine Forest community is present in the North-Central Site Sector and on the upland within the old oxbow in the Western Site Sector, as well as in several small stands intermixed across the property. Depending on the soil, level of modification, and regeneration time, Pine Forest can be represented by up to three dominant pine canopy species: loblolly, longleaf, and pond pines.

Because this biotic community is capable of flourishing in several types of soils and in varying stages of succession, the numbers of species and canopy levels that can occur in the understory are abundant. Subcanopy tree species may occur and generally consist of sweetgum (*Liquidambar styraciflua*), white oak (*Quercus alba*), southern red oak (*Quercus falcata*), red maple (*Acer rubrum*), water oak (*Quercus nigra*), loblolly bay (*Gordonia lasianthus*), flowering dogwood (*Cornus florida*), and tulip tree (*Liriodendron tulipifera*). Coastal white-alder (*Clethra alnifolia*), red bay (*Persea borbonia*), sweetbay magnolia (*Magnolia virginiana*), wax myrtle (*Morella cerifera*), sassafrass (*Sassafrass albidum*), sweetleaf (*Symplocos tinctoria*), sparkleberry (*Vaccinium arboretum*), and southern blueberry (*Vaccinium formosum*) are included in the shrub species. Pine Forest vines are comprised of muscadine (*Vitus rotundifolia*), Virginia creeper (*Parthenocissus quinquefolia*), yellow evening trumpetflower (*Gelsemium sempervirens*), poison ivy (*Toxicodendron radicans*), common greenbrier (*Smilax rotundifolia*), and trumpet creeper (*Campsis radicans*).

The herbaceous species found in Pine Forest are dependent on thickness of the canopy and the disturbance history of the forest; however, slender woodoats (*Chasmanthium laxum*), ebony spleenwort (*Asplenium platyneuron*), cinnamon fern (*Osmunda cinnamomea*), Southern bracken fern (*Pteridium aquilinum* var. *pseudocaudatum*), and narrowleaf silk grass (*Pityopsis graminifolia*) are some of most common species found in the herbaceous layer.

3.5.3.2.3 Pine-Hardwood Forest

Pine-Hardwood Forest communities are similar to Pine Forest, but represent a dominance of hardwood species. Fire protection and level of past modification are the most influential factors on species content. Pine-Hardwood Forest habitat can be found in the North-Central Site Sector and the South-Central Site Sector. The Eastern Site Sector also contains scattered stands of Pine-Hardwood Forest. The species within the Pine-Hardwood Forest mimic those found in the Pine Forest community; however, sweet-gum, tulip tree, water oak, post oak (*Quercus stellata*), white oak, red maple, black tupelo (*Nyssa sylvatica*), and southern red oak (*Quercus falcata*) are gradually replacing many of the loblolly pines over time. The herbaceous and vine species are similar to those found in Pine Forest communities.

3.5.3.2.4 Hardwood Forest

Hardwood Forest communities are mature forest habitats generally present in areas with minimal fire and anthropogenic modification. On the Wilmington Site, only two small communities in the North-Central Site Sector were noted along Unnamed Tributary #1 to Northeast Cape Fear River, downstream of the Operations Area. Canopy species in this community are dominated by sweet-gum, water oak, and Southern red oak. The understory is poorly developed and consists of younger individuals of this canopy species, in addition to scattered horsesugar and black blueberry shrubs. Muscadine vines are common in this community.

3.5.3.2.5 Alluvial Forest

Alluvial Forests are located in floodplains along streams that regularly carry and deposit sediment loads. On the Wilmington Site, the alluvial forest community is located along Unnamed Tributary #1 to Prince George Creek in the Eastern Site Sector and along Unnamed Tributary #1 to Northeast Cape Fear River before it reaches the Swamp Forest Community in the North-Central Site Sector. Red maple and sweet-gum are the major canopy species of this forest community. These are likely to have regenerated following past timber harvest. Loblolly pine is scattered, though most large individuals have been harvested. Swamp chestnut oak (*Quercus michauxii*) is a regular component, as well as water oak and laurel oak (*Quercus laurifolia*). The subcanopy is dominated by switch cane (*Arundinaria tecta*) and red bay with scattered southern bayberry. Herbaceous species are most abundant in open habitats that have been modified by placement of spoil from the stream channel and mowing activities. The most prevalent herbaceous species in the alluvial forest community are Japanese stilt grass (*Microstegium vimineum*), an exotic invasive; smallspike false nettle (*Boehmeria cylindrica*); common rush (*Juncus effusus*); shallow sedge (*Carex lurida*); hop sedge (*Carex lupulina*); dotted smartweed; small skullcap (*Scutellaria parvula*); groundnut (*Apios americana*); and leathery rush (*Juncus coriaceus*). Vines common to this community include poison ivy, common greenbrier, Virginia creeper, and laurel greenbrier (*Smilax laurifolia*).

3.5.3.2.6 Pocosin/Bay Forest

Pocosin/Bay Forest biotic community is associated with the oxbow formation in the Western Site Sector, as well as a small area in the North-Central Site Sector and another two other areas in the Eastern Site Sector. The habitat of this community is grouped together by similar vegetation species, but is separated on the basis of age. Pocosin Forest is represented by dense wetland vegetation on undrained soils composed of a shallow organic layer over sand. Without the presence of a fire regime, the typical Pocosin vegetation gradually develops into Bay Forest.

On the Wilmington Site, both Pocosin and Bay forests exist and are considered as one community for this Report. The canopy consists of loblolly pine and scattered pond pine intermixed with red bay, loblolly bay, swamp tupelo, pond cypress, and laurel oak, with an isolated stand of Atlantic white cedar (*Chamaecyparis thyoides*). Shrub species in the dense understory include fetterbush (*Lyonia lucida*), Southern bayberry, poison sumac (*Toxicodendron vernix*), and large gallberry (*Ilex coriacea*). Due to the dense shrub layer, the herbaceous layer is sparse with prominent species, including Netted chainfern (*Woodwardia areolata*), cinnamon fern, and white arrow arum (*Peltandra sagittifolia*). Groundcover is dominated by sphagnum moss (*Sphagnum* sp.), a bryophyte.

3.5.3.2.7 Swamp Forest

Swamp Forest represents one of the largest communities on the Wilmington Site and is present in two sectors of the Site (**Figure 3.5-1**). The Swamp Forest community in the Western Site Sector is present as a direct result of the Northeast Cape Fear River. Portions of the Swamp Forest closest to the river flood on a regular basis. Occasionally, the estuarine tide will deliver a high amount of ocean-derived salt to

influence plant growth along the Northeast Cape Fear River. Freshwater flow dominates in the spring, with saltwater dominating in the summer and times of drought. Soils in this community consist of organic mucks that formed from accumulation of river sediments and vegetation detritus.

The Swamp Forest Community located in the Eastern Site Sector is a remnant Swamp Forest community in which the vegetation and soil types are consistent with the Swamp Forest biotic community in the Western Site Sector; however, the hydrology under which the vegetation and soil formed has been altered. This area is no longer flooded on a regular basis and will likely gradually evolve into a drier community type, such as Hardwood Forest or Pine-Hardwood Forest.

Vegetation is similar for both areas of Swamp Forest on the Wilmington Site. Pond Cypress (*Taxodium ascendens*), the once dominant tree species, has been reduced to a scattered distribution. Currently, the canopy is dominated by loblolly pine, tulip tree, swamp tupelo, pumpkin ash (*Fraxinus profunda*), red maple, and sweet gum. The understory includes subcanopy species, such as American holly (*Ilex opaca*), and shrubs, such as dwarf palmetto (*Sabal minor*) and swamp loosestrife (*Decodon verticillatus*). Common woody vines include poison ivy, woodvamp (*Decumaria barbara*), and laurel greenbrier. Herbaceous species of a considerable variety can be found through this biotic community. Cinnamon fern and royal fern (*Osmunda regalis* var. *spectabilis*) are found on hummocks between wet soils; lizard's tail is found on the flats between the hummocks; and millet beak sedge (*Rhynchospora miliacea*), cone-cup spike-rush (*Eleocharis tuberculosa*), broadleaf arrowhead (*Sagittaria latifolia*), and marsh seedbox (*Ludwigia palustris*) are found in drier areas of the Swamp Forest.

3.5.3.2.8 Pond

Three natural, ephemeral ponds are present on the Wilmington Site; two within the oxbow of the Western Site Sector, and one located in the North-Central Site Sector within a Pine-Hardwood Forest community (**Figure 3.4-19**). No water was observed in any of the ponds during the field surveys conducted in July (22, 23, 24, 25, 30, 31) and September (4, 5, 6, 7) 2007. The two ponds in the Western Site Sector are depressions of uncertain origins. The western-most pond is adjacent to Pine Forest and Pine Plantation biotic communities. This pond is dominated by shrub species, such as New Jersey blueberry (*Vaccinium caesariense*), swamp titi (*Cyrilla racemiflora*), red bay, and red maple. Virginia chain fern (*Woodwardia virginica*) and Walter's sedge (*Carex striata*) were the most common herbaceous species. A dried, white layer of toothed sphagnum, identified as *Sphagnum cuspidatum,* was evident in the bottom of the pond, indicating the last level of standing water.

The eastern-most pond within the Western Site Sector is also surrounded by Pine Forest and Pine Plantation biotic communities and largely supports the same species as the pond described above. In addition, however, the pond has a few scattered individuals of swamp tupelo, fetterbush, and honeycup (*Zenobia pulverulenta*).

The third pond, located in the North-Central Site Sector, has been modified to the extent that the origin is uncertain. The hydrology of this pond has been altered by installation of ditches and burrow areas that decrease the surface and subsurface input to this pond. This likely occurred when the site roads or nearby barrow areas were created. Currently, this pond may still hold water during non-drought conditions; however, pine seedlings were scattered throughout the bottom. Pondspice (*Litsea aestivalis*), listed by the North Carolina Natural Heritage Program (NCNHP) as rare, was also observed (see **Section 3.5.8.2.3.3** for more discussion of pondspice). Other species scattered along the edges of the pond include red maple, swamp tupelo, blueberry (*Vaccinium* sp.), rosette grass (*Dichanthelium* sp.), and broomsedge (*Andropogon* sp.).

3.5.3.3 Anthropogenically Influenced Communities

3.5.3.3.1 Pine Plantation

Pine Plantation communities on the Wilmington Site are characterized by loblolly or longleaf pine planted in rows. These pine species dominate this community, but other species are also present, depending upon the age of the stand, the pre-existing communities, and the methods used to plant the pine. Canopy species include sweet-gum, red maple, water oak, red bay, loblolly bay, and sweet bay that start in younger communities, but continue to grow in the understory as the pine dominates the canopy. Woody species such as inkberry (*Ilex glabra*), American beauty berry (*Callicarpa americana*), fetterbush, southern bayberry, and switch cane are common in the shrub layer. Herbaceous species include several species of broomsedge, American burnweed (*Erechtites hieraciifolia*), dog-fennel (*Eupatorium capillifolium*), flat-top goldentop (*Euthamia graminifolia*), eastern milk-pea (*Galactia regularis*), panic grasses, and broom sedges.

3.5.3.3.2 Field

There are two very small field communities in the South-Central Site Sector. One of these areas is used for the storage of storm debris, such as downed trees, root balls, and other miscellaneous woody debris. The other area occurs along the property line where the vegetation is regularly mowed along a ditch. Bahia grass (*Paspalum notatum*) is the most-common species in these areas.

3.5.3.3.3 Canal Corridor

In the Eastern Site Sector, there is a biotic community associated with the effluent channel and the other ditches that drain the Operations Area of the Site (see **Section 3.4.2**, *Surface Waters*, for more information on these surface waters). This includes ephemeral stream channels near the South Gate and ditches draining into the effluent channel. This community is referred to in this Report as the Canal Corridor. In general, this community has been created by the re-occurring processes of dredging these channels and ditches. Seeding of the dredge soil with grasses is also common. Some areas of the Canal Corridor also contain loblolly pine plantings (e.g., the upper limits of the effluent channel). Along the upland portions of the Canal Corridor, woody and herbaceous species such as Bahia grass, saw-tooth blackberry (*Rubus argutus*), Chinese bush-clover (*Lespedeza cuneata*), northern dewberrry (*Rubus flagellaris*), winged sumac (*Rhus copillinum*), bluestem (*Andropogon virginicus*), and dog-fennel are common. In areas by the water edges, black willow (*Salix nigra*) and coastal plain willow (*Salix caroliniana*) are frequently observed. Broad-leaf cat-tail (*Typha latifolia*) and common reed (*Phragmites australis*) also grow in the water. The Canal Corridor near the South Gate is regularly mowed. There is some vegetation growing along the water edges and in the water.

3.5.3.3.4 Power Line Corridor

Power line corridors on the Site are linear easements containing electrical transmission lines owned and maintained by Progress Energy. These corridors support a variety of biotic species that occur in adjacent communities crossed by the corridor. However, species that favor or are capable of growing in direct sunlight dominate these areas. Regular mowing and maintenance prevents the growth of tall trees or the establishment of a canopy. Since this community is represented by the plant and animal species that dominate the adjacent biotic communities, no attempt has been made to list all of the species that occur in this community.

3.5.3.3.5 Operations Area

The Operations Areas of the Wilmington Site includes roads; building and parking sites; communications and electrical lines specifically for GE; wells; and mowed lawns. Most of these areas are located within the Eastern Site Sector, but include gravel roads throughout the Site and a borrow area in the

Northwestern Site Sector. Most areas are grassed with Bahia grass and centipede grass (*Eremochloa ophiuroides*) and mowed regularly. Ornamental and planted trees are present within this community type. The Operations Area in the Northwestern Site Sector is dominated by dry, sandy soils and sparse vegetation.

3.5.3.4 Forestry Practices

As listed in **Table 3.5-1**, 19% of the Site is pine plantation. GE is currently in consultation with the North Carolina Forestry Division to develop a Forest Management Plan for the Wilmington Site. Historic forestry practices have included planting pines in disturbed areas, such as those areas used for borrow or old fields. In some areas, mature trees were timbered based on recommendations to create early successional habitat on the Site to create better habitat for wildlife. In total, 312 acres (126 ha) have been cleared and reforested with loblolly or longleaf pine. Often, pine plantations are maintained through manual thinning and prescribed burn treatments to clear the understory. The last prescribed burning or thinning activity on the Wilmington Site occurred in 2003. Loblolly and longleaf pines are native plants, and this habitat can provide food, cover, and space that favor native wildlife.

3.5.4 Terrestrial Wildlife

Terrestrial wildlife use the Wilmington Site for breeding, foraging, and cover. Sightings and signs of wildlife were identified during field surveys conducted in July (22, 23, 24, 25, 30, 31) and September (4, 5, 6, 7) 2007 on the Wilmington Site. Observations were limited by the time of year and weather conditions. Lists of wildlife that have the potential to use the Wilmington Site for habitat are provided in **Tables 3.5-2 through 3.5-5**. Those species that were directly or indirectly (e.g., skat, markings, fur) observed during field surveys in 2007 are marked by an asterisk (*) in the tables and following text.

Several species of terrestrial mammals, such as white-tailed deer* (*Odocoileus virginianus*), black bear* (*Ursus americanus*), bobcat* (*Lynx rufus*), gray fox (*Urocyn cineraeoargenteus*), raccoon* (*Procyon lotor*), eastern cottontail* (*Sylvilagus floridanus*), eastern gray squirrel* (*Sciurus carolinensis*), striped skunk (*Mephitis mephitis*), marsh rabbit (*Sylvilagus palustris*), and many small rodents and shrews are likely to inhabit the Wilmington Site. A list of all of the mammals occurring or potentially occurring on the Wilmington Site is provided in **Table 3.5-2.** White-tailed deer evidence was abundant as many of the biotic communities were heavily browsed. Black bear signs were regularly encountered, and two cubs were observed in the Pine-Hardwood Forest in the north portion of the Eastern Site Sector.

The presence of wild turkey* (*Meleagris gallopavo*), northern Bobwhite* (*Colinus virginianus*), and mourning dove* (*Zenaida macroura*) is widespread. Resident and migratory non-game bird species are numerous, as are species of migratory waterfowl. In flooded areas, ibises, cormorants, herons, egrets, and kingfishers are common. Other common birds include the red-eyed vireo (*Vireo olivaceus*), northern cardinal* (*Cardinalis cardinalis*), tufted titmouse* (*Baeolophus bicolor*), ruby-throated hummingbird (*Archilochus colubris*), eastern towhee* (*Pipilo erythrophthalmus*), wood thrush (*Hylocichla mustelina*), summer tanager* (*Piranga rubra*), blue-gray gnatcatcher* (*Polioptila caerulea*), hooded warbler (*Wilsonia citrine*), and Carolina wren* (*Thryothorus ludovicianus*). See **Table 3.5-3** for a list of birds, their preferred habitat on the Wilmington Site, and the time of year they are likely to be present.

Prevailing drought conditions during the 2007 survey limited the observation of reptiles or amphibians. The following species were observed: eastern box turtle* (*Terrapene carolina carolina*), green anole* (*Anoils carolinensis*), little brown skink* (*Scincella lateralis*), northern black racer* (*Coluber constrictor constrictor*), and eastern six-lined racerunner* (*Cnemidophorus sexlineatus sexlineatus*). A list of reptiles and amphibians likely to occur on the Wilmington Site (**Table 3.5-4**) and their preferred habitat (**Table 3.5-5**) was created based upon species lists from the North Carolina Museum of Natural Sciences. The herpetofauna species include the eastern garter snake (*Thamnophis sirtalis sirtalis*), eastern diamondback

rattlesnake (*Crotalus adamanteus*), timber rattlesnake (*Crotalus horridus*), and American alligator (*Alligator mississippiensis*).

3.5.4.1 Location of Important Travel Corridors for Terrestrial Wildlife

Travel corridors are passageways used by species to access various foraging, nesting, and breeding habitats. Depending upon the species of interest, travel corridor requirements vary widely in size, quality, and biotic community. On the Wilmington Site, wildlife travel corridors are likely a network of individual trails that branch out and reconnect, allowing more mobile animals access to foraging areas, water, cover, and to some extent, breeding areas. These travel corridors change as usage changes due to resource availability and needs. Resource availability is relative to weather, feeding pressure, human use, and season.

Mobile animals on the Site, such as white-tailed deer, black bears, bobcat, foxes, rodents, rabbits, and other terrestrial mammals, collectively create diffuse travel corridors across various biotic communities on the Site and adjacent properties. The longest and most complex trail systems are established by white-tailed deer and black bear. Other species, including humans, may use portions of these regularly traveled trails. Trail systems change, whereas general corridors remain similar from year to year unless blocked or truncated by weather events or changing human use of landscapes.

White-tailed deer, turkey, raccoon, and bobcat tracks were observed across the entire Wilmington Site, indicating that travel corridors are highly variable. These species do not appear to be impacted by the current level of human and industrial activities occurring on the Wilmington Site. The animals take advantage of human-induced corridors, such as ditches, fire-plow lines, road corridors, and utility corridors. Evidence of black bear activity was noted in the woodland areas. This species is highly mobile, and the entire Wilmington Site is considered possible habitat. Where possible, however, black bears utilize stream banks with dense vegetation as travel corridors.

With respect to the reptiles and amphibians, no specific travel corridors were identified on the Wilmington Site. In general, these species are small and have smaller home ranges than mammals. Amphibians and many reptiles live near water and utilize nearby upland habitat. Travel corridors are most likely present between preferred habitat areas, such as ponds and wetlands that are used for breeding, laying eggs, and a food source.

The Wilmington Site provides habitat for different bird species, including resident and migratory birds. Resident bird species use flight corridors for obtaining food, as routes to and from nesting sites, and as escape routes from predators. These corridors are short and are generally defined by a large number of individual flight paths. These flight corridors are easily modified by extreme wind events that blow down trees. Humans also participate in the disruption of flight corridors through various forms of construction.

3.5.5 Aquatic Resources

3.5.5.1 Characterization of the Aquatic Environment

Aquatic communities in the vicinity of the Wilmington Site mainly exist in the Northeast Cape Fear River and its associated tributaries and creeks. The Northeast Cape Fear River is a blackwater river that has lower levels of dissolved oxygen and turbidity than the Cape Fear River (see **Figure 3.4-20; Tables 3.4-6 and 3.4-7**). The Northeast Cape Fear River and its tributaries have a naturally low pH and are classified as swamp water by the NC DWQ. At the Wilmington Site, the river is tidally influenced. Salinity concentrations vary with the rate of freshwater input and the amount of tidal exchange. More information on these surface waters is provided in **Section 3.4.2**, *Surface Waters*.

On the Wilmington Site, there are three streams that provide habitat to aquatic wildlife (**see Figure 3.4-19**). Two of the streams (located in the Swamp Forest community in the Western Site Sector) drain to the Northeast Cape Fear River. The remaining stream is located in the Eastern Site Sector and drains northward to Prince George Creek. Unnamed tributaries #1 and #2 to Northeast Cape Fear are classified as freshwater streams, but their lower reaches are tidally influenced by the river. The third stream, Unnamed Tributary #1 to Prince George Creek, is a freshwater stream and is not tidally influenced within the Wilmington Site. All three streams are capable of accommodating the aquatic species associated with the neighboring Northeast Cape Fear River; however, the tidal variations in dissolved oxygen and salinity may affect the suitability of the habitat for some species. Additional information on the water quality characteristics of the streams present on the Wilmington Site is available in **Section 3.4.2.2**, *Surface Water Quality Characteristics*. Eastern mosquitofish (*Gambusia holbrooki*) were observed in Unnamed Tributary #1 to Northeast Cape Fear River, as were a brown water snake (*Nerodia taxispilota*) and an adult blue crab (*Callinectes sapidus*). These species were observed above the point of tidal influence.

In addition, the three small ephemeral ponds in the Western Site Sector and North-Central Site Sector and wetland areas through out the Site provide habitat and a water source for wildlife found on the Site (see **Sections 3.5.3.2.8 and 3.4.4**, *Wetlands*, respectively).

3.5.5.2 Commercial and Sport Fisheries

The Northeast Cape Fear River and its tributaries contain a variety of freshwater fish, but are also important nursery areas for marine fish. **Table 3.5-6** lists the fish found in the Northeast Cape Fear River near the Wilmington Site and indicates whether those fish use the river for spawning, as juveniles (i.e., as a nursery), or are full-time residents. A mixture of freshwater and saltwater fish are found in the Northeast Cape Fear River, including channel catfish (*Ictalurus punctatus*), hybrid bass (*Morone saxatilis* x *chrysops*), largemouth bass (*Micropterus salmoides*), American shad (*Alosa sapidissima*), Atlantic croaker (*Micropogonias undulatus*), Atlantic stingray (*Dasyatis sabina*), Atlantic sturgeon (*Acipenser oxyrhynchus*), and spotted seatrout (*Cynoscion nebulosus*) (**Table 3.5-6**). The species of fish that occupy the river and its tributaries will vary seasonally and will shift with the salinity of the water. The fish community of the river will be comprised of more estuarine species during drought conditions, when river salinities may be elevated (Barwick, 2007).

Both commercial and recreational fishing occur on the Northeast Cape Fear River. Commercial fishing is more prevalent downstream of the Wilmington Site and in the Cape Fear River Estuary. Commercial and recreational fishing of American shad and striped bass takes place on the Northeast Cape Fear River at the Wilmington Site (NOAA, 2002). In addition to fishing for these anadromous fish, the Northeast Cape Fear River offers freshwater fishing of largemouth bass, catfish, herring, and American and hickory shads. Spring is peak season for largemouth bass and bluegills. Catfish, which are non-game fish, are typically caught in April, May, September, and October.

The spring, summer, and fall seasons generally yield significantly higher commercial landings than the winter season (approximately only 10% of the total seafood mass harvested in 2006 was landed in winter months) (Bianchi, 2007). In 2006, an estimated 1,727,795 pounds (783,800 kg) of commercial fish and shellfish were harvested by commercial fishers in New Hanover County. The reported economic value of commercial fishing landings in the county amounted to $2,347,701 for the 2006 calendar year. Refer to **Table 3.1-7** for additional information on commercial seafood landings (NC DMF, 2007).

The annual economic value of recreational fishing on the Cape Fear River Basin (including the Northeast Cape Fear River sub-basin) was estimated at approximately $1.03 million for the survey period of July 1, 2003, to June 30, 2004 (Ashley and Rachels, 2005). The Cape Fear River offers better fishing opportunities for catfish and sunfish, whereas the Neuse and Chowan rivers in North Carolina are better

for striped bass, white perch, and crappie. Compared with the Neuse and Chowan rivers, the Cape Fear River has a low amount of tournaments for largemouth bass anglers. This low number of bass tournaments on the Cape Fear River lessens the economic value of the recreational fishery compared to others rivers in the state (Ashley and Rachels, 2005).

3.5.5.3 Key Aquatic Indicator Organisms

There are no known key aquatic indicator organisms for the Northeast Cape Fear River and the surface waters on the Wilmington Site or in the Site's vicinity for the purposes of this Environmental Report. The Proposed Action is not expected to have any adverse impacts on aquatic organisms (see **Section 4.5** of this Report, *Ecological Resources Impacts*).

3.5.5.4 Significant Aquatic Habitat

The Northeast Cape Fear River is an important nursery area for many fish and other aquatic organisms such as blue crabs. The use of the river and its tributaries as a nursery is discussed in **Section 3.5.6.1**. The Northeast Cape Fear River and Prince George Creek (downstream of the Wilmington Site) are used by blueback herring for spawning and by American shad and striped bass as nursery grounds. Atlantic and shortnose sturgeon also use the Northeast Cape Fear as a nursery, but they do not ascend into smaller tributaries (NOAA, 2002).

Section 3.5.6.1 of this Report also discusses the importance of the Swamp Forest biotic community and its associated wildlife along the Northeast Cape Fear River. This community in the Western Site Sector is a part of a large, contiguous section of the Northeast Cape Fear River floodplain (25,679 acres [10,390 ha]) that is classified as a site of national significance (NCNHP, 2003). In addition, the Swamp Forest and Pocosin/Bay Forest communities within coastal North Carolina are increasingly being lost to development, and it is recognized that these communities and the habitat they provide for aquatic species need to be preserved.

3.5.6 Environmentally Sensitive Areas

3.5.6.1 Regionally Sensitive Areas

The NCNHP surveys and tracks unique natural communities in the state. In 2002, field surveys conducted by NCNHP in New Hanover County identified 19 standard natural area sites, three macrosites, and one megasite of natural significance at the national, state, or regional level. Four of these sites have been determined to be of national significance. The Northeast Cape Fear River floodplain standard site is one of these sites of national significance that is adjacent to and includes the Swamp Forest biotic community on the Wilmington Site. The Northeast Cape Fear River floodplain natural area contains one of the best examples of the Tidal Cypress-Gum Swamp community in North Carolina (NCNHP, 2003). The Sledge Forest is the property directly adjacent to and north of the Wilmington Site. The forest contains 4,068 acres (1,646 ha) of high-quality woodland lying within the Northeast Cape Fear River floodplain (New Hanover County Local Watershed Planning Group, 2002). The Sledge Forest contains many unique natural communities, including the rare Peatland Atlantic White Cedar Forest and old-growth Non-riverine Swamp Forest. Cypress trees have been dated to more than 350 years of age and loblolly pine to more than 300 years of age. Isolated sandy ridges support three Longleaf Pine communities, with trees aged to over 300 years.

Floodplain habitat is used by many neotropical migratory and breeding birds. Aquatic habitat supports many species of waterbirds, fish, and reptiles. The Northeast Cape Fear River floodplain natural area supports populations of 13 rare plants and 7 rare animals. Among the rare plants are the Federal Species of Concern Venus flytrap (*Dionaea muscipula*) and the State Threatened Carolina grasswort (*Lilaeopsis carolinensis*). The rare animals include the Federal and State Endangered West Indian manatee

(*Trichechus manatus*), the Federal and State Threatened American alligator (*Alligator mississippiensis*), and the Federal Species of Concern southeastern bat (*Myotis austroriparius*). The Sledge Forest portion floodplain consists of land with high-quality (intact) riparian area along one of the North Carolina Coastal Land Trust's high-priority watersheds, the Northeast Cape Fear River. The Sledge Forest is currently enrolled in the North Carolina Forest Service's Forest Stewardship Program.

The North Carolina Marine Fisheries Commission (NCMFC) has established rules to delineate and protect fragile estuarine areas that support juvenile populations of economically important seafood species. These rules set forth permanent nursery areas in all coastal fishing waters, as defined through extensive estuarine survey sampling. The NCMFC regulates estuarine waters, whereas the North Carolina Wildlife Resources Commission regulates inland nursery areas. Nursery areas are classified as primary nursery areas (PNAs), secondary nursery areas, or special secondary nursery areas.

PNAs are located in the upper portions of creeks and bays surrounded by marshes and wetlands and are usually shallow with soft muddy bottoms. Low salinity and the abundance of food in these areas make them ideal for young fish and shellfish. To protect juveniles, many commercial fishing activities are prohibited in these waters, including the use of trawl nets, seine nets, dredges, or any mechanical methods for taking clams or oysters. The Northeast Cape Fear River along the Wilmington Site is designated as a PNA. Prince George Creek and its tributaries are classified as inland waters, and portions downstream from the Wilmington Site are classified as inland nursery areas, which are under jurisdiction of the North Carolina Wildlife Resource Commission (NC DMF, 2006).

3.5.6.2 Wilmington Site Sensitive Areas

The presence and absence of potentially environmental sensitive features and designations were investigated for the Wilmington Site and its vicinity, as illustrated in **Figure 3.5-2**. Those features found on the Wilmington Site include floodplains, wetlands, unstable soils, and steep slopes. Based on digital elevation data, produced in partnership by the State of North Carolina and the USGS, 100-year and 500-year floodplains are present on the Wilmington Site. These floodplains abut the Northeast Cape Fear River and encompass the remnant oxbow present in the Western Site Sector. For more information on the floodplain distribution, refer to **Section 3.4.3**, *Floodplains*. Digital NWI mapping indicates approximately 758.3 acres (306.9 ha) of wetlands within the property boundary, comprising 13 different classes of wetlands. Two of the classes of wetlands that comprise 294.4 acres (120.8 ha) are categorized as being drained or ditched (U.S. FWS, 1990). For more information on Site wetland distribution, refer to **Section 3.4.4**, *Wetlands*.

The location of unstable soils on the Wilmington Site was determined by the presence or absence of NRCS Land Capability Classification *Subclass e* soils. As defined in the NRCS Soils Survey handbook, "*Subclass e* is made up of soils for which the susceptibility to erosion is the dominant problem or hazard affecting their use. Erosion susceptibility and past erosion damage are the major soil factors that affect soils in this subclass" (NRCS, 2007). On the Wilmington Site, unstable soils are found at or in the vicinity of four former borrow pits (**Figure 3.5-2**). The surface area spanned by these soils is approximately 74 acres (30 ha). For more information on Site soils and distribution, refer to **Section 3.3.4**, *Soils*. Based on the average gradients of soils in the vicinity of the Wilmington Site (<6%), slopes over 10% gradient are considered steep slopes. In general, steep slopes are associated with the stream and river features found on the Wilmington Site. The remnant oxbow (marking the path of the Northeast Cape Fear River in the geologic past) and the current stream banks of the Northeast Cape Fear River and effluent channel comprise the majority of the steep slopes. Some steep slopes were also associated with the former borrow pits. For more information on the topography of the Site, refer to **Section 3.3.3.1**, *Topography and Physiography (Site-Specific Geology)*.

The following categories were considered, but are not present on or adjacent to the Wilmington Site: areas that are designated as wilderness areas; barrier islands; wild and scenic rivers; beaches or dunes; and sole-source aquifers. See **Section 3.1.3**, *Special Land Use Classification*, for a discussion of special land-use classifications across Brunswick, New Hanover, and Pender counties.

3.5.6.3 Potential Sources of Ecological Stress

A potential source of ecological stress in the Western Site Sector is the intrusion of saline water into the Swamp Forest community adjacent to the Northeast Cape Fear River. This process is generally controlled by river discharge. The LCFRP is monitoring for this effect on the Northeast Cape Fear River. Results from monitoring year 6 (June 2005 to May 2006) indicate that vegetation in swamp forests at Rat Island (approximately 1.5 miles [2.4 km] downstream of the Wilmington Site) is starting to shift to an oligohaline marsh. Results from Fishing Creek (approximately 0.5 miles [0.9 km] downstream of the Wilmington Site) are beginning to show signs of converting from swamp to oligohaline marsh based on vegetation, but this site remains a tidal swamp (Hackney et al., 2007). If this process continues upstream, this could be a stress to the swamp forest community and tributaries of the Wilmington Site. Changes in 2007 resulting from low freshwater river flows may result in salt water damage to tidally influenced sensitive vegetation along the Northeast Cape Fear River. Additionally, the effects of pollution from point sources of wastewater disposal along the river may be enhanced by the low freshwater flows during 2007.

Gradual sea-level rise is another potential source of ecological stress that could contribute to the intrusion of saline water into swamp forest and other communities adjacent to the Northeast Cape Fear River and its tributaries. Based upon tide data collected at Wilmington from 1935 to 2002, msl has increased at a rate of 0.08 inches/year (2.12 mm/year) (NOAA, 2004). Recent findings by the Intergovernmental Panel on Climate Change (IPCC) project sea level rise to be between 7 and 23 inches (18 and 59 cm) by the 2090 to 2099 time period (IPCC, 2007). Any of these scenarios could alter the existing communities in the vicinity of, and on, the Wilmington Site.

3.5.7 Other Relevant Ecological Studies

The USACE is funding a program to monitor the effects of a potential increased tidal range in the Cape Fear River Ecosystem due to deepening Wilmington Harbor, NC. The University of North Carolina at Wilmington was selected to conduct this study. Dredging of the harbor is expected to increase the tidal amplitude as much as one centimeter in some areas of the river. This project is a 10-year study to examine the effects of dredging the Cape Fear River Harbor on selected physical, chemical, and biological parameters on the Cape Fear and Northeast Cape Fear rivers and their adjacent wetlands. The nearest study sites are located approximately 9.5 river miles (15.2 km) upstream of the Wilmington Site at Prince George Creek and approximately 1.7 river miles (2.7 km) downstream of the Wilmington Site at Rat Island.

The LCFRP is a large-scale water quality and environmental assessment program covering the Cape Fear River Estuary and a large portion of the Cape Fear River Basin, including the Northeast Cape Fear River. This program is administered by the University of North Carolina at Wilmington and is based on a voluntary agreement between the NC DWQ and NPDES permitees, including GEH/GNF-A, in this region. The objective of this program is to understand the fundamental processes shaping and controlling the ecology of the Cape Fear River system. Physical, chemical, and biological measurements are collected at 34 stations throughout the system; 10 of these stations occur within the Northeast Cape Fear River sub-basin.

3.5.8 Rare, Threatened, and Endangered Species

3.5.8.1 Federally Threatened and Endangered Species

Provisions under Section 7 of the Endangered Species Act (ESA), as amended, require that any action likely to adversely affect a species classified as federally protected be subject to review by the FWS. Other species may receive additional protection under separate laws. As of December 20, 2007, the FWS identified four Endangered Species, four Threatened Species, and one species Threatened Due to Similar Appearance as potentially occurring in New Hanover County, NC. **Figure 3.5-3** illustrates the approximate location of known rare, threatened, and endangered species on or within 5 miles (8 km) of the Wilmington Site. An indication of vertebrate animal, invertebrate animal, or vascular plant species is provided in the figure; however, the name of the species observed at each point has been withheld as sensitive information. A detailed list of these federally protected species, their status, and whether a review of NCNHP data of known population of these federally protected species identified populations on or within 5 miles (8 km) of the Wilmington Site are available in **Table 3.5-7**.

Information consultation with the FWS was initiated in November, 2007 by requesting the location of Threatened and Endangered Species within the action area of the Wilmington Site. The FWS provided a list of the current species listed for New Hanover County and specific guidelines for protection of the red-cockaded woodpecker (*Picoides borealis*) (see **Appendix B**, *Regulatory Correspondence*). This section of the Report describes each species, lists the habitat for each species, and assesses whether suitable habitat is available on the Site.

The following species are listed as occurring in New Hanover County, but are not discussed in the text because they are maritime species and would not be affected by the Proposed Action: green sea turtle (*Chelonia mydas*), loggerhead sea turtle (*Caretta caretta*), piping plover (*Charadrius melodus*), and seabeach amaranth (*Amaranthus pumilus*). Descriptions of the remaining species listed by the FWS as Threatened or Endangered Species potentially occurring in New Hanover County are discussed in this section. A discussion of those species that are known to occur or may occur based on available habitat within the GLE Study Area is provided in **Section 4.5.2.2** of this Report (*Impacts to Rare Species, [Ecological Resource Impacts]*). The State status of each species is also listed. In North Carolina, the North Carolina Wildlife Resource Commission has regulatory authority over animals (except insects), and the North Carolina Department of Agriculture has regulatory authority over plants and insects.

3.5.8.1.1 Vertebrate s

3.5.8.1.1.1 Shortnose sturgeon (*Acipenser brevirostrum*)

Federal Status: Endangered.

State Status: Endangered.

The shortnose sturgeon is a fish that is usually less than 3 ft (1 m) long and has dark coloring above and a light underbelly. It has a wide mouth that points downward beneath a short snout. Five rows of sharp, pointed plates along the sides of its body provide protection from predators. The sturgeon inhabits the lower sections of larger rivers and coastal waters along the Atlantic Coast. It may spend most of the year in brackish or salt water and move into fresh water only to spawn. The fish feeds on invertebrates (e.g., shrimp, worms) and stems and leaves of aquatic plants (U.S. FWS, 2003a). This species was recorded within 5 miles (8 km) of the Wilmington Site in the Cape Fear River near Lake Sutton (NCNHP, 2007).

Suitable Habitat: The sturgeon may be present in the Northeast Cape Fear River and lower portions the unnamed tributaries to the Northeast Cape Fear River that occur within the Swamp Forest on the Wilmington Site; therefore, suitable habitat for the shortnose sturgeon is present on the Wilmington Site.

3.5.8.1.1.2 American alligator (*Alligator mississippiensis*)

Federal Status: Threatened (Similar Appearance).

State Status: Threatened (Similar Appearance).

The American alligator is blackish in color and has a broadly rounded snout. Alligators may have a bold yellowish crossband that is a lasting coloration from the juvenile state. The total body length is generally 13 ft (4 m) or less, but has been known to reach lengths up to 19 ft (5.8 m). One distinguishing characteristic of the American alligator is that it does not have any upwardly protruding teeth in its lower jaw.

The American alligator occurs in southeastern North America. They live primarily in freshwater swamps and marshes, but can also be found in rivers, lakes, and smaller bodies of water. There are currently fourteen million acres of alligator habitat, and the species is no longer biologically endangered or threatened. However, the American alligator is listed by FWS as Threatened throughout its entire range due to similarity of appearance to other endangered or threatened crocodilians (NatureServe, 2007; CNHC, 2006). There are several recorded sightings of American alligator within 5 miles (8 km) of the Wilmington Site, including in Prince George Creek at its confluence with Unnamed Tributary #1 of Prince George Creek and in the Northeast Cape Fear River at its confluence with Prince George Creek (see **Figure 3.5-3**). Sightings have also been recorded upstream of the Wilmington Site in Turkey Creek, Morgan Creek, Long Creek, and south of the Site on Ness Creek (NCNHP, 2007).

Suitable Habitat: Breeding habitat is present along the Northeast Cape Fear River and its tributaries within the Site. Additionally, small alligators may move through the streams or in the Swamp Forest surrounding the unnamed tributaries to Northeast Cape Fear River; therefore, suitable habitat is present on the Wilmington Site.

3.5.8.1.1.3 Red-cockaded woodpecker (*Picoides borealis*)

Federal Status: Endangered.

State Status: Endangered.

The red-cockaded woodpecker is 7 to 8 inches (18 to 20 cm) long with a wing span of 13 to 14 inches (35 to 38 cm). It has black and white horizontal stripes on its back, with white on its cheeks and underparts. The cap and stripe on the side of the neck and throat are black. The male has a small red spot on each side of the black cap and red crown patch. The red-cockaded woodpecker's diet is comprised of insects, including ants, beetles, wood-boring insects, and caterpillars, and seasonal wild fruit. Red-cockaded woodpeckers require open stands of mature pine trees (typically over 60 years in age) for nesting and roosting habitat. Longleaf pine is most commonly used. Foraging habitat includes pine-dominated and mixed pine and hardwood stands at least 30 years of age. Typically, a minimum of 80 to 125 acres (30 to 50 ha) of foraging habitat is needed to support a colony. The presence of a red-cockaded woodpecker colony is confirmed by locating a roosting cavity. Cavity trees are live trees ranging in age from 63 to more than 300 years for longleaf pine and 62 to more than 200 years for loblolly and other pines. The aggregate of cavity trees is called a cluster and may include 1 to 20 cavity trees on 3 to 60 acres (1 to 25 ha) (U.S. FWS, 2003b; NatureServe, 2007).

One active colony of red-cockaded woodpeckers is known within a 5-mile (8-km) radius of the Wilmington Site (see **Figure 3.5-3**). This population is located northeast of the Site along NC 117 in Pender County, just north of the Northeast Cape Fear River (NCNHP, 2007).

Suitable Habitat: Longleaf pine/scrub forest, pine forest, pine plantation, and pine-hardwood forest are present on the Wilmington Site and exceed the minimum acreage required for red-cockaded woodpecker foraging needs. No cavity trees were observed on the Wilmington Site; however, individuals may occasionally forage in the Site.

3.5.8.1.1.4 West Indian manatee (*Trichechus manatus*)

Federal Status: Endangered

State Status: Endangered.

The West Indian manatee is a large gray or brown aquatic mammal. Adults average 10 ft (3 m) long and weigh 1,000 pounds (450 kg). They have no hind limbs, and their forelimbs are modified as flippers. Manatee tails are flattened horizontally and rounded. Their body is covered with sparse hairs, and their muzzles with stiff whiskers. Manatees will consume any aquatic vegetation available to them, including shoreline vegetation. Manatees are commonly found in fresh, brackish, or marine water habitats, including shallow coastal bays, lagoons, estuaries, and inland rivers of varying salinity extremes and of sufficient depth (5 to 20 ft [1.5 to 6 m]). Manatees spend much of their time underwater or partly submerged, making them difficult to detect even in shallow water. Although the manatee's principal stronghold in the United States is Florida, the species is considered a seasonal inhabitant of North Carolina, with most occurrences reported from June through October. Manatees are warm-water species and can be found as far north as coastal Virginia, but migrate south when water temperatures drop below 72 degrees Fahrenheit (ºF; 22 degrees Celsius [ºC]) (U.S. FWS, 2003c). Manatee sightings have not been recorded within 5 miles (8 km) of the Wilmington Site (NCNHP, 2007).

Suitable Habitat: Suitable habitat for the West Indian manatee does not exist on the Wilmington Site. Suitable habitat is found in the Northeast Cape Fear River, but the tributaries on the Wilmington Site are not deep enough to support manatees.

3.5.8.1.2 Vascular Plants

3.5.8.1.2.1 Rough-leaved loosestrife (*Lysimachia asperulaefolia*)

Federal Status: Endangered.

State Status: Endangered.

Rough-leaved loosestrife is a perennial herb that grows 12 to 24 inches (30 to 60 cm) tall. Whorls of three to four entire, triangular-shaped leaves encircle the stem. The leaves are smooth and tend to be the widest at the base and have three prominent veins. The yellow flowers are 0.6 inches (1.5 cm) across with yellow-orange anthers. Flowering occurs from mid-May through June, with fruits present from July through October. This species occurs in the ecotones or edges between longleaf pine uplands and pond pine pocosins (i.e., areas of dense shrub and vine growth usually on wet, peaty, poorly drained soil) on moist seasonally saturated sands and on shallow organic soils overlying sands. The grass-shrub ecotone where rough-leaf loosestrife is found is fire-maintained (NCNHP, 2003). This species is not known to occur within 5 miles (8 km) of the Wilmington Site (NCNHP, 2007).

Suitable Habitat: Suitable habitat for this species may have occurred naturally on the Wilmington Site in the past, but the pocosin habitat that could have supported this plant has been drained. In addition, the fire regime necessary for this species is not currently present on the Wilmington Site. However, this plant may be able to survive long periods with the benefit of fire and active hydrology and could be re-established on the Site, so habitat is potentially available on the Site.

3.5.8.2 Federal Species of Concern

There are 31 Federal Species of Concern listed by the FWS for New Hanover County, NC (U.S. FWS, 2007a). These species are not protected under the provisions of Section 7 of the ESA. Federal Species of Concern are defined as species under consideration for listing for which there is insufficient information to support listing as Threatened or Endangered. The federal status of these species may change at any time; therefore they are included in this Report. These species are listed in **Table 3.5-8** along with their federal status, state status, habitat description and availability on the Wilmington Site; and whether a review of NCNHP data of known populations of these species identified populations within a 5-mile (8-km) radius of the Site (see **Figure 3.5-3**).

Based on NUREG-1748, only those species with sightings on the Wilmington Site or within the vicinity are discussed in this section; therefore, this section summarizes the information for the Federal Species of Concern that are known to occur or have occurred historically within a 5-mile (8-km) radius of the Wilmington Site based on review of the NCNHP database accessed on November 28, 2007 (see **Figure 3.5-3**).

3.5.8.2.1 Vertebrate s

3.5.8.2.1.1 American eel (*Anguilla rostrata*)

Federal Status: Federal Species of Concern.

State Status: None.

The American eel has a long, cylindrical body similar to a snake and is olive- to brown-colored on the top, yellowish on the sides, and lighter beneath. It has a single fin running continuously on the top to underneath its body. Females range in length from 24 to 36 inches (60 to 91 cm), whereas the males are smaller. This species has an extensive range, including all accessible rivers and coastal areas from southern Greenland to northern Brazil in the Atlantic Ocean (50 CFR 17, *Endangered and Threatened Wildlife and Plants*). In North Carolina, the American eel is found in coastal areas and streams as far west as the Piedmont (Menhinick, 1991). The American eel matures in fresh or brackish waters and returns to the sea to spawn. Spawning occurs in the fall in the Sargasso Sea, a region in the middle of the Atlantic Ocean. Small eels return to inland waters, where they remain for 4 to 10 years until they are ready to spawn (U.S. FWS, 2007b). In February 2007, the FWS issued a 12-month finding on a petition to list the American eel as Threatened or Endangered (50 CFR 17). The results of this finding are that "listing of the American eel as endangered or threatened in not warranted at this time." This species was recorded in sampling conducted by the LCFRP between 1996 and 2005 in the Northeast Cape Fear River at the Wilmington Site (LCFRP, 2007).

Suitable Habitat: The Northeast Cape Fear River and its tributaries on the Wilmington Site provides suitable habitat for the American eel.

3.5.8.2.1.2 Southern Hognose Snake (*Heterodon simus*)

Federal Status: Federal Species of Concern.

State Status: Special Concern.

The southern hognose snake ranges from 14 to 20 inches (36 to 51 cm) in length and has a stocky body. Its snout has a sharp upturn and is keeled. The snake's belly is either unmarked or mottled with grayish brown, whereas the dorsal scales are keeled. The southern hognose differs from the eastern hognose (*Heterdon platirhinos*) in that the underside of the tale is not significantly paler than the belly, as is the case in the eastern hognose snake. The southern hognose occupies a variety of terrestrial habitats, including grasslands, old fields, savannas, and woodlands (e.g., conifer, hardwood, and mixed). The snake inhabits areas with dry, xeric, sandy soils, such as ridges, coastal dunes, pine flatwoods, mixed oak-pine woodlands and forests, scrub oak woods, and oak hammocks. It spends much of the time buried in the soil (NatureServe, 2007). Two sightings of this species occurred southwest of the Wilmington Site near the intersection of US 421 and I-140 between the Northeast Cape Fear and Cape Fear rivers (NCNHP, 2007).

Suitable Habitat: Within the Wilmington Site, habitat for the Southern hognose snake is available in the pine forest, longleaf pine/scrub forest and hardwoods, and field biotic communities. Additionally, xeric sandy soils that have been mapped in the Northwestern Site Sector in conjunction with the woodlands may potentially be habitat for the southern hognose snake.

3.5.8.2.1.3 Southeastern myotis (*Myotis austroriparius*)

Federal Status: Federal Species of Concern.

State Status: Special Concern.

Southeastern myotis is a small bat with dull, somewhat woolly pelage, gray to orange or russet above, and tan to white below. Its calcar is unkeeled, and its forearm is 1.4 to 1.6 inches (36 to 41 mm) long. This is the only myotis species that usually produces two young rather that one. Young southeastern myotis can fly in 5 to 6 weeks, and adult males join female colonies after maturation of young. These myotis reach sexual maturity within 1 year.

Southeastern myotis are not migratory species. Nesting habitat includes standing snags and hollow trees in both conifer and hardwood forests. Riparian habitat is preferred for foraging for small beetles, moths, mosquitoes, and other aquatic-associated insects. Foraging may also occur in dry areas, such as around live oak trees (NatureServe, 2007). This species is recorded from the floodplain community north of the Wilmington Site near the confluence of the Northeast Cape Fear River and Prince George Creek (NCNHP, 2007).

Suitable Habitat: Riparian habitat and pine and hardwood forest communities are potentially available for foraging and breeding on the Wilmington Site. In addition, the species may potentially forage through some portions of the Operations Area and power corridors.

3.5.8.2.2 Invert ebrates

No known invertebrate Federal Species of Concern are located within 5 miles (8 km) of the Wilmington Site (NCNHP, 2007).

3.5.8.2.3 Vascular Plants

3.5.8.2.3.1 Sandhills milkvetch (*Astragalus michauxii*)

Federal Status: Federal Species of Concern.

State Status: Threatened.

The sandhills milkvetch is a perennial legume with erect or spreading stems. It has alternate, pinnately compound leaflets that occur in pairs of 7 to 15. The flowers can be white, pink, or light green and have a long and narrow structure. Germination of the plant's seeds is limited by the presence of a hard outer coat, a tough inner coat, and possible germination inhibitory substances present in the embryo. This species occurs in longleaf pine/scrub oak woodlands in the Atlantic Coastal Plain (NatureServe, 2007). Due to the germination limitations, the sandhills milkvetch has the most success in highly disturbed or fire-prone areas, such as open understory habitats of xeric to dry-mesic, nutrient-poor soils, thickets, edges of fields, and banks of roads (Weeks, 2004). There is one occurrence of this species within 5 miles (8 km) of the Wilmington Site. This species is recorded southwest of the Site north of the intersection of US 421 and I-140.

Suitable Habitat: The xeric longleaf pine/scrub forest in the Northwestern Site Sector and pine plantation in the North-Central Site Sector may provide suitable habitat for the species; therefore, potential habitat for this species is present on the Site.

3.5.8.2.3.2 Venus Flytrap (*Dionaea muscipula*)

Federal Status: Federal Species of Concern.

State Status: Significantly Rare – Limited

The Venus flytrap is a small, carnivorous, herbaceous wetland plant characterized by its distinctive hinged clamshell-like traps that spring close to catch insects. Near the crease where the two leaf "jaws" join, there is a series of tiny hairs that trigger the lobes to close when an insect walks across the open area. Insects are attracted to the Venus flytrap by nectar that is secreted from glands at the edge of the hinged leaf. Once the insect is trapped, glands on the leaf surface secrete digestive enzymes that help to digest the insect. The Venus flytrap is native to bogs and perennially wet areas. They are often found in areas that lie between longleaf pine savannas and shrub bogs (pocosins) on the coastal plain of the Carolinas (Floridata, 2007). There are five records of these species occurring within 5 miles (8 km) of the Wilmington Site. Four of these records occur in the forested area directly north of the Wilmington Site and bounded by Northeast Cape Fear River, known as the Sledge Forest. The fifth population is documented from along Prince George Creek between NC 117 and I-40 (NCNHP, 2007).

Suitable Habitat: Pocosin and Pine Forest are adjacent biotic communities in the Western Site Sector that are potential habitat for this plant.

3.5.8.2.3.3 Pondspice (*Litsea aestivalis*)

Federal Status: Federal Species of Concern.

State Status: Significantly Rare – Throughout.

Pondspice is a deciduous shrub ranging in height from 3 to 10 ft (1 to 3 m) with zigzag branches. The leaves are alternate, oblong to narrowly elliptic and attached by slender, short, purplish petioles. Male and female flowers are produced on different plants, appearing before the leaves in umbellate clusters at the ends of branchlets. The six outer parts of both male and female flowers are petal-like, yellow, and 0.12 to 0.14 inches (3.0 to 3.5 mm) long. The male flowers are in dense clusters, with 9 to 12 stamens surrounded by a circle of scale-like sterile stamens. In contrast, the female flowers are less conspicuous, with fewer flowers per cluster. The fruit is a globose, red drupe, 0.16 to 0.24 inches (4 to 6 mm) in diameter, with a flowering period from March to April and a fruiting period from May to June. Pondspice is found on margins of swamps, cypress ponds, sandhill depressions, and in hardwood swamps. This species occurs on wet, sandy or peaty, and quite acidic soils. It may form thickets and be abundant locally. The only

known occurrence of this species within 5-miles (8-km) of the Wilmington Site is around the perimeter of an ephemeral pond in the North-Central Site Sector (NCNHP, 2007).

Suitable Habitat: Twelve to fifteen clumps of pondspice have been found on the Wilmington Site at the eastern-most woodland pond located within the North-Central Site Sector (see **Section 3.5.3.2.8** for more information on the pond). However, the hydrological conditions that allowed for this species to become established at this Site have been altered, and current conditions do not appear to support recruitment of additional individuals. During the field survey, the existing plants appeared stressed. Avoiding impacts to this known population was a criterion in the selection of the location of the GLE Study Area and the 100-acre (40-ha) Proposed GLE Facility (see also **Section 2.2.4** of this Report, *Elimination of Facility Location Alternatives at Wilmington Site*).

3.5.8.2.3.4 Spring-flowering goldenrod (*Solidago verna*)

Federal Status: Federal Species of Concern.

State Status: Threatened.

Spring flowering goldenrod is a perennial flower found in the Coastal Plain of the Carolinas. Its stems can reach up to 5 ft (1.5 m) tall, and it flowers from late April to June. When flowering, this goldenrod displays many relatively large, bright yellow heads. The spring-flowering goldenrod can survive in a wide array of habitats, including pine savannas, pocosins, and pine barrens. It has also been found in open woods, fields, dry bogs, and along highly disturbed roadsides (CPC, 2007a). This species is known to occur within 5 miles (8 km) of the Wilmington Site between Sutton Lake and US 421 (NCNHP, 2007).

Suitable Habitat: Favorable habitat is not present on the Wilmington Site; however existing Pocosin/Bay and Pine Forest biotic communities provide limited habitat for this species. Fire or timber harvesting could transform the existing habitat into more favorable conditions for this species.

3.5.8.2.3.5 Coastal goldenrod (*Solidago villosicarpa*)

Federal Status: Federal Species of Concern.

State Status: Endangered.

Coastal goldenrod is endemic to the Coastal Plain of North Carolina. It is a late-flowering species with a large, bright-yellow flower and hairy stems and fruits. It grows to a height of 5 ft (1.5 m). The species is commonly found in the understory of mesic, hardwood forests that have a dense canopy and sparse understories. This species is often found in areas associated with natural or human-caused disturbances (NatureServe, 2007). Several populations were recently located north of the Northeast Cape Fear River in Pender County on dry ridges between Long Creek and Morgans Creek (NCNHP, 2007).

Suitable Habitat: Habitat for this goldenrod is available in the Pine-Hardwood Forest community in the North-Central Site Sector and the South-Central Site Sector.

3.5.8.2.3.6 Pickering's dawnflower (*Stylisma pickeringii* var. *pickeringii*)

Federal Status: Federal Species of Concern.

State Status: Endangered.

Pickering's dawnflower is a spreading, herbaceous, and perennial vine that grows in large mats and clumps. Pickering's, like other members of the morning glory family, is recognizable by its numerous

arching stems that generate from a central point, then trail away from the center to create a circular clump that is usually 3 to 7 ft (1 to 2 m) in diameter. It produces small white and sometimes pink morning glory-like flowers from June through September. Pickering's dawnflower is usually found in dry, barren, deep-sand areas, such as rims of Carolina bays and relict riverine dunes along rivers in the Coastal Plain (Weakley, 2007). It prefers areas that are frequently disturbed, frequently burned, or clear-cut, with little to no competing vegetation (CPC, 2007b). This species was found near the confluence of Turkey Creek and the Northeast Cape Fear River north of the Wilmington Site (NCNHP, 2007).

Suitable Habitat: The Operational Area in the Northwestern Site Sector contains deep sand that is periodically disturbed and may provide suitable habitat for the species.

3.5.8.3 Rare Species on the Wilmington Site

A review of the NCNHP database has identified three rare species occurring on the Wilmington Site and two other species adjacent to the Site. The species reported on and/or observed on the Site are pondspice, white arrow arum (*Peltandra sagittifolia*), and Eastern fox squirrel (*Sciurus niger*). The location of pondspice is discussed in **Section 3.5.8.2.3.3**. White arrow arum is listed by North Carolina as significantly rare–peripheral, meaning that this species is occurring in the periphery of its range in North Carolina, but it is not listed by the federal ESA. White arrow arum was recorded in the NCNHP database, as well as observed during field surveys, as occurring in the swamp forest in the Western Site Sector of the Wilmington Site (NCNHP, 2007). Signs of the Eastern fox squirrel were observed near the ephemeral ponds in the Western Site Sector in 2002. Markings and signs indicative of an Eastern fox squirrel (a longleaf pinecone totally stripped of scales and seeds) were found, but a squirrel was not observed (NCNHP, 2007).

Savanna milkweed (*Asclepias pedicellata*) and Carolina sunrose (*Crocanthemum carolinianum*) are recorded directly west of the Northwestern Site Sector. Both of these species are listed as significantly rare–peripheral by the North Carolina Department of Agriculture (NCDA). Neither of these species is listed as protected by the federal ESA. These plants are found in wiregrass pine flatwoods and dry savannas (NCNHP, 2007).

During field surveys of the Site in 2007, two orchids classified as significantly rare by NCDA were identified in the Swamp Forest in the western portion of the Site. The first, hairy shadow-witch (*Ponthieva racemosa*), is listed as occurring in nearby Pender County, but there is no known record for New Hanover County (NCNHP, 2007). The second orchid, Florida's adder's-mouth orchid (*Malaxis spicata*), is known as occurring Dare, Carteret, Craven, and Chowan counties in the northeastern North Carolina (NCNHP, 2007). These two occurrences are not illustrated on **Figure 3.5-3** because they have not been verified by any regulatory agencies or the NCNHP.

3.5.8.4 Regulatory Framework

The purpose of the ESA of 1973, as amended, is to help preserve our nation's valuable plant and wildlife resources that are imperiled. The ESA provides a means to help preserve these species and their habitats for future generations. Section 7 of the ESA requires that any action likely to adversely affect a species classified as federally protected be subject to review by the FWS. Other species may receive additional protection under separate laws.

The FWS provided a list of known species within the action area (i.e., GLE Study Area and its vicinity) (see **Appendix B** and an evaluation was conducted to determine if the Proposed Action would adversely affect any of these species (see **Section 4.5.2.2** *Impacts to Rare Species [Ecological Resource Impacts]*). If the Proposed Action may affect a listed species, then formal consultation with the FWS would be required.

Tables

Table 3.5-1. Biotic Communities on the Wilmington Site

Biotic Community	Area		Percent of the Site
	Acres	Hectares	
Longleaf Pine/Scrub (LPS)	39	16	2.4%
Pine Forest (PF)	304	123	18.7%
Pine-Hardwood Forest (PH)	231	94	14.3%
Hardwood Forest (HF)	10	4	0.6%
Alluvial Forest (AF)	4	2	0.2%
Pocosin/Bay Forest (PB)	52	21	3.2%
Swamp Forest (SF)	325	131	20.0%
Pond (P)	4	2	0.3%
Pine Plantation (PP)	312	126	19.2%
Field (F)	2	1	0.1%
Canal Corridor (CC)	19	8	1.2%
Power Line Corridor (PC)	16	7	1.0%
Operations Area (OA)	303	122	18.6%
Total	1621	656	100.0%

Reference: Field Surveys by RTI (July and September, 2007).

Table 3.5-2. Mammals Potentially Occurring on the Wilmington Site

Scientific Name	Common Name	Potential Habitat at Site[a]
Blarina brevicauda	Short-Tailed Shrew	PF, PP, PH, HF, AF, PC
Blarina carolinensis	Carolina Short-Tailed Shrew	F, O, CC, LPS, PC, AF
Canis latrans	Coyote	Throughout the Site
Castor canadensis	Beaver	AF
Condylura cristata	Star-Nosed Mole	SF, Stream, AF
Cryptotis parva	Least Shrew	F, O, CC, LPS, PC, AF
Didelphis virginiana	Opossum	Throughout the Site
Eptesicus fuscus	Big Brown Bat	Woodlands,[b] OA, Stream, PC
Glaucomys volans	Southern Flying Squirrel	Woodlands[b]
Lasionycteris noctivagans	Silver-Haired Bat	Woodlands,[b] Stream, PC
Lasiurus borealis	Red Bat	Woodlands,[b] OA, Stream, PC
Lasiurus cinereus	Hoary Bat	Woodlands,[b] OA, Stream, PC
Lasiurus intermedius	Northern Yellow Bat	Woodlands,[b] Stream, PC
Lasiurus seminolus	Seminole Bat	Woodlands,[b] Stream, PC
Lutra canadensis	River Otter	Stream
*Lynx rufus**	Bobcat	Throughout the Site
Microtus pinetorum	Pine Vole	PP, Woodlands[b]
Mus musculus	House Mouse	OA
Mustela frenata	Long-Tailed Weasel	Throughout the Site
Mustela vison	Mink	Wet Woodlands[b]
Myotis austroriparius	Southeastern Bat[c]	Woodlands,[b] OA, Stream, PC
Myotis septentrionalis	Northern Long-Eared Myotis	Woodlands,[b] OA, Stream, PC
Neotoma floridana	Eastern Woodrat	SF
Nycticeius humeralis	Evening Bat	Woodlands,[b] OA, Stream, PC
Ochrotomys nuttalli	Golden Mouse	Woodlands[b]
*Odocoileus virginianus**	White-Tailed Deer	Throughout the Site
Oryzomys palustris	Rice Rat	PC
Peromyscus gossypinus	Cotton Mouse	OA, PC, Field, Woodlands[b]
Pipistrellus subflavus	Eastern Pipistrelle Bat	Woodlands[b]
Plecotus rafinesqueii	Rafinesque's Big-Eared Bat	Woodlands,[b] OA
*Procyon lotor**	Raccoon	Throughout the Site
Puma concolor	Mountain Lion	Woodlands[b]
Rattus norvegicus	Norway Rat	OA
Rattus rattus	Black Rat	Throughout the Site, OA
Reithrodontomys humulis	Eastern Harvest Mouse	OA, PC, Field
*Scalopus aquaticus**	Eastern Mole	Throughout the Site
*Sciurus carolinensis**	Eastern Gray Squirrel	Woodlands[b]
Sciurus niger	Fox Squirrel	LPS
Sigmodon hispidus	Hispid Cotton Rat	OA, PC
Sorex longirostris	Southeastern Shrew	F, OA, CC, LPS, PC
*Sylvilagus floridanus**	Eastern Cottontail	Field, OA, PC, Woodlands[b]
Sylvilagus palustris	Marsh Rabbit	Throughout the Site
Tadarida brasiliensis	Brazilian Free-Tailed Bat	Woodlands,[b] OA
Urocyon cinereoargenteus	Gray Fox	Throughout the Site

(continued)

Table 3.5-2. Mammals Potentially Occurring on the Wilmington Site

Scientific Name	Common Name	Potential Habitat at Site[a]
*Ursus americanus**	Black Bear	Throughout the Site
Vulpes vulpes	Red Fox	Throughout the Site

Reference: ASM, 2007.

[a] Habitat designations used in this list: AF = Alluvial Forest; CC = Canal Corridor; F = Field; HF = Hardwood Forest; LPS = Longleaf Pine/Scrub Forest; OA = Operational Area; P = Pond; PB = Pocosin/Bay Forest; PC = Powerline Corridor; PF = Pine Forest; PH = Pine-Hardwood Forest; PP = Pine Plantation; SF = Swamp Forest.

[b] Woodland habitat designations include: AF; HF; LPS; PB; PF; PP; SF.

[c] Bat information from Webster et al. (1985), Lee et al. (1982), and Legrand et al. (2006).

*Species presence noted from indirect evidence or direct observation by RTI (July and September, 2007).

Table 3.5-3. Birds Potentially Occurring on the Wilmington Site

Scientific Name	Common Name	Potential Habitat at the Site [a]	Residence[b]
Accipiter cooperii	Cooper's Hawk	Woodlands,[c] OA	P
Accipiter gentilis	Northern Goshawk	Variable	T
Accipiter striatus	Sharp-shinned Hawk	Woodlands,[c] OA	W
Actitis macularius	Spotted Sandpiper	CC, OA, Stream, Pond	W-T
Aegolius acadicus	Northern Saw-whet Owl	Woodland[c]	W
Agelaius phoeniceus	Red-winged Blackbird	SF, Field, OA, CC	P
Aimophila aestivalis	Bachman's Sparrow	PF, PP	P
Aix sponsa	Wood Duck	Stream	P
Ammodramus caudacutus	Saltmarsh Sharp-tailed Sparrow	Field, PC, OA	W-T
Ammodramus henslowii	Henslow's Sparrow	Field, PC, OA	T
Ammodramus leconteii	Le Conte's Sparrow	Field, PC, OA	W
Ammodramus maritimus	Seaside Sparrow	Field, PC, OA	P
Ammodramus savannarum	Grasshopper Sparrow	Field, PC, OA	W
Anas acuta	Northern Pintail	Stream	W
Anas clypeata	Northern Shoveler	Stream	T
Anas crecca	Green-winged Teal	Stream	W
Anas discors	Blue-winged Teal	Stream	T
Anas platyrhynchos	Mallard	Stream	W
Anhinga anhinga	Anhinga	SF, Stream	S
Anthus rubescens	American Pipit	OA	W
Archilochus colubris	Ruby-throated Hummingbird	Variable, OA	S
Ardea alba	Great Egret	OA, CC	P
Ardea herodias	Great Blue Heron	SF, PC, CC, OA	P
Asio flammeus	Short-eared Owl	OA	W
Aythya affinis	Lesser Scaup	Stream	W
Aythya americana	Redhead	Stream	W
Aythya collaris	Ring-necked Duck	Stream	W
Aythya marila	Greater Scaup	Stream	T
Aythya valisineria	Canvasback	Stream	W
*Baeolophus bicolor**	Tufted Titmouse	Woodland[c]	P
Bombycilla cedrorum	Cedar Waxwing	OA	W
Botaurus lentiginosus	American Bittern	SF, PC	W (some nesting)
Branta canadensis	Canada Goose	OA	P
Bubo virginianus	Great Horned Owl	Woodland[c]	P
Bubulcus ibis	Cattle Egret	OA	P
Bucephala albeola	Bufflehead	Stream	W
Bucephala clangula	Common Goldeneye	Stream	W
Buteo jamaicensis	Red-tailed Hawk	Woodlands,[c] Variable	P
Buteo lineatus	Red-shouldered Hawk	Woodlands,[c] Variable	P
Buteo platypterus	Broad-winged Hawk	Woodlands,[c] Variable	S
Butorides virescens	Green Heron	SF	S
Calidris alba	Sanderling	CC, OA, Stream, Pond	W-T
Calidris fuscicollis	White-rumped Sandpiper	CC, OA, Stream, Pond	T
Calidris himantopus	Stilt Sandpiper	CC, OA, Stream, Pond	T
Calidris maritima	Purple Sandpiper	CC, OA, Stream, Pond	T
Calidris mauri	Western Sandpiper	CC, OA, Stream, Pond	W-T
Calidris melanotos	Pectoral Sandpiper	CC, OA, Stream, Pond	T
Calidris minutilla	Least Sandpiper	CC, OA, Stream, Pond	W-T
Calidris pusilla	Semipalmated Sandpiper	CC, OA, Stream, Pond	W-T
Caprimulgus carolinensis	Chuck-will's-widow	Woodland[c]	S

(continued)

Table 3.5-3. Birds Potentially Occurring on the Wilmington Site

Scientific Name	Common Name	Potential Habitat at the Site [a]	Residence[b]
Caprimulgus vociferus	Whip-poor-will	Woodland[c]	W
*Cardinalis cardinalis**	Northern Cardinal	Woodland,[c] OA	P
Carduelis pinus	Pine Siskin	PF, Field, PC, OA	W
Carduelis tristis	American Goldfinch	Field, PC, OA	W
Carpodacus mexicanus	House Finch	Field, PC, OA	P
Carpodacus purpureus	Purple Finch	Field, PC, OA	W
Cathartes aura	Turkey Vulture	Variable	P
Catharus fuscescens	Veery	Woodland[c]	T
Catharus guttatus	Hermit Thrush	Woodland[c]	W
Catharus minimus	Gray-cheeked Thrush	Woodland[c]	T
Catharus ustulatus	Swainson's Thrush	Woodland[c]	T
Cathatus bicknellii	Bicknell's Thrush	Woodland[c]	T
Certhia americana	Brown Creeper	Woodland,[c] SF	W
Ceryle alcyon	Belted Kingfisher	Stream	P
Chaetura pelagica	Chimney Swift	Woodland,[c] OA	S
Charadrius vociferus	Killdeer	OA	P
Chondestes grammacus	Lark Sparrow	Field, PC, OA	T
Chordeiles minor	Common Nighthawk	LPS, Woodland[c]	S
Circus cyaneus	Northern Harrier	OA	W
Cistothorus palustris	Marsh Wren	SF, PC	S-T
Cistothorus platensis	Sedge Wren	SF, PC	W-T
Coccothraustes vespertinus	Evening Grosbeak	Field, PC, OA	W
Coccyzus americanus	Yellow-billed Cuckoo	Woodland[c]	S
Coccyzus erythropthalmus	Black-billed Cuckoo	Woodland[c]	T
Colaptes auratus	Northern Flicker	Woodland[c]	P
*Colinus virginianus**	Northern Bobwhite	Woodland,[c] OA	P
Columba livia	Rock Pigeon	OA	P
Contopus virens	Eastern Wood-Pewee	Woodland[c]	S
Coragyps atratus	Black Vulture	Variable	P
Corvus brachyrhynchos	American Crow	Variable	P
Corvus ossifragus	Fish Crow	Variable	P
Coturnicoops noveborecinsis	Yellow Rail	SF	W
Cyanocitta cristata	Blue Jay	Variable	P
Dendroica caerulescens	Black-throated Blue Warbler	Woodland,[c] OA	T
Dendroica castanea	Bay-breasted Warbler	Woodland[c]	T
Dendroica coronata	Yellow-rumped Warbler	Woodland,[c] OA	W
*Dendroica discolor**	Prairie Warbler	PC, OA, Woodland[c]	S
Dendroica dominica	Yellow-throated Warbler	Woodland[c]	S
Dendroica magnolia	Magnolia Warbler	Woodland[c]	T
Dendroica palmarum	Palm Warbler	Woodland[c]	W
Dendroica pensylvanica	Chestnut-sided Warbler	Woodland[c]	T
Dendroica petechia	Yellow Warbler	Woodland[c]	T
Dendroica pinus	Pine Warbler	PF, PH	P
Dendroica striata	Blackpoll Warbler	Woodland[c]	T
Dendroica tigrina	Cape May Warbler	Woodland[c]	T
Dendroica virens	Black-throated Green Warbler	SF, PB	S

(continued)

Table 3.5-3. Birds Potentially Occurring on the Wilmington Site

Scientific Name	Common Name	Potential Habitat at the Site [a]	Residence[b]
Dolichonyx oryzivorus	Bobolink	SF, Field, OA	T
Dryocopus pileatus	Pileated Woodpecker	Woodland[c]	P
Dumetella carolinensis	Gray Catbird	Woodland,[c] OA	P
Egretta caerulea	Little Blue Heron	SF, PC, OA	S
Egretta thula	Snowy Egret	SF, PC, OA	S
Empidonax flaviventris	Yellow-bellied Flycatcher	Woodland[c]	T
Empidonax minimus	Least Flycatcher	Woodland[c]	T
Empidonax traillii	Willow Flycatcher	Woodland[c]	T
Empidonax virescens	Acadian Flycatcher	SF	S
Eudocimus albus	White Ibis	OA	S
*Euphagus carolinus**	Rusty Blackbird	Field, PC, OA	W
Falco columbarius	Merlin	Variable	W
Falco peregrinus	Peregrine Falcon	Fields, OA	W
Falco sparverius	American Kestrel	Fields, Woodlands[c]	P
Fulica americana	American Coot	Stream	W
Gallinago delicata	Wilson's Snipe	OA, CC	W
Gallinula chloropus	Common Moorhen	Stream, SF	S-P
Gavia immer	Common Loon	Stream	W
Gavia stellata	Red-throated Loon	Stream	W
Geothlypis trichas	Common Yellowthroat	Woodland,[c] OA, CC, PC	S
Haliaeetus leucocephalus	Bald Eagle	Woodland,[c] Stream	P
Helmitheros vermivorum	Worm-eating Warbler	Woodland,[c] PF	S
Hirundo rustica	Barn Swallow	OA	S
Hylocichla mustelina	Wood Thrush	Woodland,[c] SF	S
Icteria virens	Yellow-breasted Chat	Woodland,[c] PC, PB	S
Icterus galbula	Baltimore Oriole	OA, CC, PC	T
Icterus spurius	Orchard Oriole	OA, CC, PC	S
Ictinia mississippiensis	Mississippi Kite	Variable, SF	S
Ixobrychus exilis	Least Bittern	SF, PC	S
Junco hyemalis	Dark-eyed Junco	Field, PC, OA	W
Lanius ludovicianus	Loggerhead Shrike	OA	P
Larus atricilla	Laughing Gull	OA	P
Limnodromus griseus	Short-billed Dowitcher	CC, OA, Stream, Pond	W-T
Limnodromus scolopaceus	Long-billed Dowitcher	CC, OA, Stream, Pond	W-T
Limnothlypis swainsonii	Swainson's Warbler	Woodland[c]	S
Lophodytes cucullatus	Hooded Merganser	Stream	W
Megascops asio	Eastern Screech-Owl	Woodland[c]	P
Melanerpes carolinus	Red-bellied Woodpecker	Woodland[c]	P
Melanerpes erythrocephalus	Red-headed Woodpecker	Woodland,[c] SF	P
*Meleagris gallopavo**	Wild Turkey	Woodland,[c] OA	P
Melospiza georgiana	Swamp Sparrow	Field, PC, OA	W
Melospiza melodia	Song Sparrow	Field, PC, OA	W
Mergus serrator	Red-breasted Merganser	Stream	T
*Mimus polyglottos**	Northern Mockingbird	Woodland,[c] OA	P
Mniotilta varia	Black-and-white Warbler	SF	S
Molothrus ater	Brown-headed Cowbird	Throughout the site	P
Mycteria americana	Wood Stork	SF	T
Myiarchus crinitus	Great Crested Flycatcher	Woodland[c]	S

(continued)

Table 3.5-3. Birds Potentially Occurring on the Wilmington Site

Scientific Name	Common Name	Potential Habitat at the Site [a]	Residence [b]
Nyctanassa violacea	Yellow-crowned Night-Heron	SF	S
Oporornis agilis	Connecticut Warbler	Woodland[c]	T
Oporornis formosus	Kentucky Warbler	Woodland[c]	S
Oxyura jamaicensis	Ruddy Duck	Stream	W
Pandion haliaetus	Osprey	Stream, SF	S
*Parula americana**	Northern Parula	Woodland[c]	S
Passer domesticus	House Sparrow	Field, PC, OA	P
Passerculus sandwichensis	Savannah Sparrow	Field, PC, OA	W
Passerella iliaca	Fox Sparrow	Field, PC, OA	W
Passerina caerulea	Blue Grosbeak	Field, PC, OA	S
Passerina ciris	Painted Bunting	Field, PC, OA	S
Passerina cyanea	Indigo Bunting	Field, PC, OA	S
Petrochelidon pyrrhonota	Cliff Swallow	Variable	S
Phalacrocorax auritus	Double-crested Cormorant	Stream	W
Pheucticus ludovicianus	Rose-breasted Grosbeak	Woodland,[c] OA	T
Picoides borealis	Red-cockaded Woodpecker	LPS, Woodland[c]	P
Picoides pubescens	Downy Woodpecker	Woodland[c]	P
Picoides villosus	Hairy Woodpecker	Woodland[c]	P
*Pipilo erythrophthalmus**	Eastern Towhee	Woodland[c]	P
*Piranga olivacea**	Scarlet Tanager	Woodland[c]	S
*Piranga rubra**	Summer Tanager	Woodland[c]	S
Plegadis falcinellus	Glossy Ibis	OA	S
Pluvialis squatarola	Black-bellied Plover	Stream	W-T
Podiceps auritus	Horned Grebe	Stream	W
Podiceps grisegena	Red-necked Grebe	Stream	W
Podilymbus podiceps	Pied-billed Grebe	Stream	P
*Poecile carolinensis**	Carolina Chickadee	Woodland[c]	P
*Polioptila caerulea**	Blue-gray Gnatcatcher	Woodland[c]	P
Pooecetes gramineus	Vesper Sparrow	Field, PC, OA	W
Porphyrio martinica	Purple Gallinule	Stream	T
Progne subis	Purple Martin	OH	S
Protonotaria citrea	Prothonotary Warbler	SF	S
Quiscalus major	Boat-tailed Grackle	Field, PC, OA	P
*Quiscalus quiscula**	Common Grackle	Throughout the site	P
Rallus elegans	King Rail	SF, OA	S
Regulus calendula	Ruby-crowned Kinglet	Woodland[c]	W
Regulus satrapa	Golden-crowned Kinglet	Woodland[c]	W
Riparia riparia	Bank Swallow	Variable	T
Sayornis phoebe	Eastern Phoebe	Woodland[c]	W
Scolopax minor	American Woodcock	SF	P
Seiurus aurocapilla	Ovenbird	Woodland[c]	T
Seiurus motacilla	Louisiana Waterthrush	SF	S
Seiurus noveboracensis	Northern Waterthrush	SF	T
Setophaga ruticilla	American Redstart	Woodland[c]	T
*Sialia sialis**	Eastern Bluebird	Woodland,[c] LPS, OA	P
Sitta canadensis	Red-breasted Nuthatch	Woodland[c]	W
Sitta carolinensis	White-breasted Nuthatch	Woodland[c]	P

(continued)

Table 3.5-3. Birds Potentially Occurring on the Wilmington Site

Scientific Name	Common Name	Potential Habitat at the Site [a]	Residence [b]
*Sitta pusilla**	Brown-headed Nuthatch	LPS, Woodlandc	P
Sphyrapicus varius	Yellow-bellied Sapsucker	Woodland[c]	W
Spiza americana	Dickcissel	Field, PC, OA	W
Spizella passerina	Chipping Sparrow	Woodland,[c] OA, PC	P
Spizella pusilla	Field Sparrow	Woodland, [c] OA, PC	P
Stelgidopteryx serripennis	Northern Rough-winged Swallow	Woodland[c]	S
Sternula antillarum	Least Tern	Stream	S
Strix varia	Barred Owl	SF	P
Sturnella magna	Eastern Meadowlark	SF, Field, OA	P
Sturnus vulgaris	European Starling	OA	P
Tachycineta bicolor	Tree Swallow	Variable	W-T
*Thryothorus ludovicianus**	Carolina Wren	Woodland,[c] OA	P
*Toxostoma rufum**	Brown Thrasher	Woodland,[c] OA	P
Tringa flavipes	Lesser Yellowlegs	CC, OA, Stream, Pond	W
Tringa melanoleuca	Greater Yellowlegs	CC, OA, Stream, Pond	W
Tringa solitaria	Solitary Sandpiper	CC, OA, Stream, Pond	T
Troglodytes aedon	House Wren	Woodland,[c] OA	P
Troglodytes troglodytes	Winter Wren	Woodland,[c] OA	W
Turdus migratorius	American Robin	Woodland,[c] OA	P
Tyrannus tyrannus	Eastern Kingbird	OA	S
Tyrannus verticalis	Western Kingbird	OA	T
Tyto alba	Barn Owl	OA	P
Vermivora celata	Orange-crowned Warbler	Woodland[c]	T
Vermivora peregrina	Tennessee Warbler	Woodland[c]	T
Vermivora pinus	Blue-winged Warbler	Woodland,[c] OA	T
Vermivora ruficapilla	Nashville Warbler	Woodland[c]	T
Vireo flavifrons	Yellow-throated Vireo	PF, PH, HF,SF	S
Vireo gilvus	Warbling Vireo	Woodland[c]	T
Vireo griseus	White-eyed Vireo	PF, PH, HF	S
Vireo olivaceus	Red-eyed Vireo	PH, HF	S
Vireo philadelphicus	Philadelphia Vireo	Woodland[c]	T
Vireo solitarius	Blue-headed Vireo	PF, PH, HF,SF	W
Wilsonia citrina	Hooded Warbler	Woodland,[c] OA, CC, PC	S
Wilsonia pusilla	Wilson's Warbler	Woodland[c]	T
*Zenaida macroura**	Mourning Dove	Woodland[c]	P
Zonotrichia albicollis	White-throated Sparrow	Field, PC, OA	W
Zonotrichia leucophrys	White-crowned Sparrow	Field, PC, OA	T

Reference: Carolina Bird Club, 2006.

[a] Habitat designations used in this list: AF = Alluvial Forest; CC = Canal Corridor; F = Field; HF = Hardwood Forest; LPS = Longleaf Pine/Scrub Forest; OA = Operational Area; P = Pond; PB = Pocosin/Bay Forest; PC = Powerline Corridor; PF = Pine Forest; PH = Pine-Hardwood Forest; PP = Pine Plantation; SF = Swamp Forest.

[b] Residence status is indicated by: P = Permanent Resident; W = Winter Resident; T = Transient; S = Summer.

[c] Woodland habitat designations include: AF; HF; LPS; PB; PF; PP; SF.

* Species observed by RTI (July and September, 2007).

Table 3.5-4. Reptiles Potentially Occurring on the Wilmington Site

Scientific Name	Common Name	Habitat at the Site[a]
Agkistrodon contortrix	Copperhead	Woodland[b]
Agkistrodon piscivorus piscivorus	Eastern Cottonmouth	SF, Stream
Alligator mississippiensis	American Alligator	SF, Stream, OA, CC
*Anolis carolinensis**	Green Anole	Throughout the site
Carphophis amoenus amoenus	Eastern Wormsnake	Woodland[b], OA
Cemophora coccinea copei	Northern Scarletsnake	LPS
Chelydra serpentina serpentina	Eastern Snapping Turtle	SF, Stream, OA, CC
Clemmys guttata	Spotted Turtle [PR]	SF, Stream, OA, CC
*Cnemidophorus sexlineatus sexlineatus**	Eastern Six-lined Racerunner	LPS
*Coluber constrictor constrictor**	Northern Black Racer	Throughout the site
Crotalus adamanteus	Eastern Diamond-backed Rattlesnake	Woodland[b]
Crotalus horridus	Timber Rattlesnake	Woodland[b]
Deirochelys reticularia reticularia	Eastern Chicken Turtle	SF, Stream, OA, CC
Diadophis punctatus punctatus	Southern Ring-necked Snake	Woodland[b]
Elaphe guttata guttata	Corn Snake	Woodland[b]
Elaphe obsoleta quadrivittata	Yellow Ratsnake	Woodland[b], OA
Eumeces fasciatus	Common Five-lined Skink	Throughout the site
Eumeces inexpectatus	Southeastern Five-lined Skink	Woodland[b], OA
Eumeces laticeps	Broad-headed Skink	Woodland[b], OA
Farancia abacura abacura	Eastern Mudsnake	SF, Stream
Farancia erytrogramma erytrogramma	Common Rainbow Snake	SF, Stream
Heterodon platirhinos	Eastern Hog-nosed Snake	Woodland[b], OA
Heterodon simus	Southern Hog-nosed Snake	LPS
Kinosternon baurii	Striped Mud Turtle	SF, Stream, OA, CC
Kinosternon subrubrum subrubrum	Eastern Mud Turtle	SF, Stream, OA, CC
Lampropeltis calligaster rhombomaculata	Mole Kingsnake	Woodland[b]
Lampropeltis getula getula	Eastern Kingsnake	Woodland[b]
Lampropeltis triangulum elapsoides	Scarlet Kingsnake	Woodland[b]
Masticophis flagellum flagellum	Eastern Coachwhip	Woodland[b]
Micrurus fulvius	Harlequin Coralsnake	PB, LPS
Nerodia erythrogaster erythrogaster	Red-bellied Watersnake	SF, Stream
Nerodia fasciata fasciata	Banded Watersnake	SF, Stream
*Nerodia taxispilota**	Brown Watersnake	SF, Stream
Opheodrys aestivus aestivus	Northern Rough Greensnake	Woodland[b]
Ophisaurus attenuatus longicaudus	Eastern Slender Glass Lizard	OA
Ophisaurus mimicus	Mimic Glass Lizard	LPS
Ophisaurus ventralis	Eastern Glass Lizard	Woodland[b], OA
Pituophis melanoleucus melanoleucus	Northern Pinesnake	LPS
Pseudemys concinna floridana	Coastal Plain Cooter	SF, Stream, OA, CC
Regina rigida rigida	Glossy Crayfish Snake	SF,PF
Rhadinaea flavilata	Pine Woods Littersnake	Woodland[b]
Sceloporus undulatus hyacinthinus	Northern Fence Lizard	Dry woodland[b]
*Scincella lateralis**	Little Brown Skink	Woodland[b]
Seminatrix pygaea paludis	Carolina Swampsnake	SF, Stream
Sistrurus miliarius miliarius	Carolina Pygmy Rattlesnake	LPS
Sternotherus odoratus	Stinkpot	SF, Stream, OA, CC
Storeria dekay	DeKay's Brownsnake	LPS, OA

(continued)

Table 3.5-4. Reptiles Potentially Occurring on the Wilmington Site

Scientific Name	Common Name	Habitat at the Site[a]
Storeria o. occipitomaculata	Northern Red-bellied Snake	Woodland[b]
Tantilla coronata	Southeastern Crowned Snake	LPS, OA
*Terrapene carolina carolina**	Eastern Box Turtle	Woodland[b]
Thamnophis sauritus sauritus	Common Ribbonsnake	Woodland[b], OA
Thamnophis sirtalis sirtalis	Eastern Gartersnake	Woodland[b], OA
Trachemys scripta scripta	Yellow-bellied Slider	SF, Stream, OA, CC
Virginia striatula	Rough Earthsnake	Woodland[b]
Virginia valeriae valeriae	Eastern Smooth Earthsnake	Woodland[b]

References: North Carolina Museum of Natural Sciences, 2005; Palmer and Braswell, 1995.

[a] Habitat designations used in this list: AF = Alluvial Forest; CC = Canal Corridor; F = Field; HF = Hardwood Forest; LPS = Longleaf Pine/Scrub Forest; OA = Operational Area; P = Pond; PB = Pocosin/Bay Forest; PC = Powerline Corridor; PF = Pine Forest; PH = Pine-Hardwood Forest; PP = Pine Plantation; SF = Swamp Forest.

[b] Woodland habitat designations include: AF; HF; LPS; PB; PF; PP; SF.

* Species observed by RTI (July and September, 2007).

Table 3.5-5. Amphibians Potentially Occurring on the Wilmington Site

Scientific Name	Common Name	Potential Habitat at the Site[a]
Acris crepitans crepitans	Eastern Cricket Frog	P
Acris gryllus gryllus	Coastal Plain Cricket Frog	P
Ambystoma mabeei	Mabee's Salamander	P
Ambystoma opacum	Marbled Salamander	P
Ambystoma tigrinum tigrinum	Eastern Tiger Salamander	P
Amphiuma means	Two-toed Amphiuma	SF, Stream
Bufo fowleri	Fowler's Toad	Woodland[b], P
Bufo quercicus	Oak Toad	LPS, P
Bufo terrestris	Southern Toad	Woodland[b], P
Desmognathus auriculatus	Southern Dusky Salamander	PB, SF
Eurycea bislineata	Two-lined Salamander	SF, Stream
Eurycea guttolineata	Three-lined Salamander	PB, SF
Gastrophryne carolinensis	Eastern Narrow-mouthed Toad	PB, OA
Hyla chrysoscelis	Cope's Gray Treefrog	P, Woodland[b]
Hyla cinerea	Green Treefrog	P, Woodland[b]
Hyla femoralis	Pine Woods Treefrog	P, Woodland[b]
Hyla gratiosa	Barking Treefrog	PB, SF
Hyla squirella	Squirrel Treefrog	
Hyla versicolor	Gray Treefrog	P, Woodland[b]
Necturus punctatus	Dwarf Waterdog	SF, Stream
Notopthalmus viredescens dorsalis	Broken-striped Newt	P
Plethodon cinereus[c]	Red-backed Salamander	Woodlands[b]
Plethodon glutinosus[c]	Slimy Salamander	Woodlands[b]
Pseudacris brimleyi	Brimley's Chorus Frog	PB, SF
Pseudacris crucifer crucifer	Northern Spring Peeper	PB, SF
Pseudacris nigrita nigrita	Striped Southern Chorus Frog	PB, SF
Pseudacris ocularis	Little Grass Frog	PB, SF
Pseudotriton montanus montanus	Eastern Mud Salamander	PB, SF
Rana capito capito	Carolina Gopher Frog	LPS, P
Rana catesbeiana	American Bullfrog	P, CC
Rana clamitans clamitans	Bronze Frog	CC, P
Rana palustris	Pickerel Frog	PB, SF
Rana sphenocephala utricularia	Southern Leopard Frog	OA, Stream
Rana virgatipes	Carpenter Frog	PB, SF
Scaphiopus holbrookii	Eastern Spadefoot	LPS, P
Siren intermedia intermedia	Eastern Lesser Siren	SF, Stream
Siren lacertina	Greater Siren	SF, Stream
Stereochilus marginatus	Many-lined Salamander	PB, SF

References: North Carolina Museum of Natural Sciences, 2004; Petranka, 1998.

[a] Habitat designations used in this list: AF = Alluvial Forest; CC = Canal Corridor; F = Field; HF = Hardwood Forest; LPS = Longleaf Pine/Scrub Forest; OA = Operational Area; P = Pond; PB = Pocosin/Bay Forest; PC = Powerline Corridor.

[b] Woodland habitat designations include: AF; HF; LPS; PB; PF; PP; SF.

[c] Recent taxonomic segrations of this species are ignored for the purposes of this list.

Table 3.5-6. Fish Species Known to Occur in the Northeast Cape Fear River in the Vicinity of the Wilmington Site

Scientific Name	Common Name	Habitat	Residence[a]	WRC[b]	DCM[b]	LCFRP[b]
				Record of Observation		
Acipenser oxyrhynchus	Atlantic Sturgeon	Marine	N		x	x
Alosa aestivalis	Blue Back Herring	Anadromous fish	S, N		x	x
Alosa mediocris	Hickory Shad	Anadromous fish	S, N		x	
Alosa pseudoharengus	Alewife	Anadromous fish	S, N		x	
Alosa sapidissima	American Shad	Anadromous fish	S, N	x	x	x
Alosa sp.	River herring	Fresh Water	S, N	x		
Ameiurus catus	White Catfish	Fresh Water	R		x	x
Ameiurus natalis	Yellow Bullhead Catfish	Fresh Water	R			x
Ameiurus platycephalus	Flat bullhead	Fresh Water	R	x		
Amia calva	Bowfin	Fresh Water	R	x	x	
Anchoa hepsetus	Striped Anchovy	Marine	R		x	
Anchoa mitchilli	Bay Anchovy	Fresh Water	R		x	
Ancylopsetta quadrocellata	Ocellated Flounder	Marine	N		x	
Anguilla rostrata	American Eel	Fresh Water	N	x	x	x
Aphredoderus sayanus	Pirate Perch	Fresh Water	R	x	x	x
Archosargus probatocephalus	Sheepshead	Marine	N		x	
Bairdiella chrysoura	Silver Perch	Marine	N		x	x
Brevoortia tyrannus	Atlantic Menhaden	Marine	N		x	
Caranx hippos	Crevalle Jack	Marine	N		x	x
Carpiodes velifer	Highfin Carpsucker	Fresh Water	R			x
Centrarchus macropterus	Flier	Fresh Water	R	x	x	
Centropomus undecimalis	Snook	Marine	N		x	
Chaetodipterus faber	Atlantic Spadefish	Marine	N		x	
Chloroscombrus chrysurus	Atlantic Bumper	Marine	N		x	
Chologaster cornuta	Swampfish	Fresh Water	R		x	
Citharichthys spilopterus	Bay Whiff	Marine	R		x	x
Ctenogobius boleosoma	Darter Goby	Marine	R		x	
Ctenogobius shufeldti	Freshwater Goby	Marine	R		x	
Ctenopharyngodon idella	Grass Carp	Fresh Water	R		x	
Cynoscion nebulosus	Spotted Trout	Marine	N		x	x
Cyprinodon variegatus	Sheepshead Minnow	Fresh Water	R		x	
Cyprinus carpio	Common carp	Fresh Water	R	x	x	
Dasyatis sabina	Atlantic Stingray	Marine	R			x
Dormitator maculatus	Fat Sleeper	Fresh Water	R		x	x
Dorosoma cepedianum	Gizzard shad	Fresh Water	R	x	x	
Dorosoma petenense	Threadfin Shad	Fresh Water	R	x	x	
Eleotris amblyopsis	Spinycheek Sleeper	Fresh Water	R		x	
Elops saurus	Lady Fish	Marine	R			x
Enneacanthus gloriosus	Bluespotted sunfish	Fresh Water	R	x	x	
Erimyzon oblongus	Creek chubsucker	Fresh Water	R	x	x	
Erotelis smaragdus	Emerald Sleeper	Marine	R		x	
Esox americanus	Redfin pickerel	Fresh Water	R	x	x	
Esox niger	Chain Pickerel	Fresh Water	R	x	x	x
Etheostoma flabellare	Fantail darter	Fresh Water	R	x		
Etheostoma olmstedi	Tessellated Darter	Fresh Water	R	x		x
Etropus crossotus	Fringed Flounder	Marine	R		x	
Eucinostomus gula	Silver jenny	Marine	N		x	
Evorthodus lyricus	Lyre Goby	Marine	R		x	
Family Gerreidae	Mojarra	Marine	N		x	
Fundulus diaphanus	Banded killifish	Fresh Water	R		x	
Fundulus heteroclitus	Mummichog	Marine	R		x	x
Fundulus luciae	Spotfin Killifish	Fresh Water	R		x	
Gambusia affinis	Mosquitofish	Fresh Water	R			x
*Gambusia holbrooki**	Eastern mosquitofish	Fresh Water	R	x	x	
Gobionellus oceanicus	Highfin Goby	Fresh Water	R		x	
Gobiosoma bosc	Naked Goby	Marine	R		x	
Ictalurus furcatus	Blue catfish	Fresh Water	R	x	x	
Ictalurus punctatus	Channel Catfish	Fresh Water	R	x	x	x
Lagodon rhomboides	Pinfish	Marine	N		x	
Larimus fasciatus	Banded Drum	Marine	N		x	
Leiostomus xanthurus	Spot Fish	Marine	N		x	x
Lepisosteus osseus	Longnose gar	Fresh Water	R	x	x	

(continued)

Table 3.5-6. Fish Species Known to Occur in the Northeast Cape Fear River in the Vicinity of the Wilmington Site

				WRC[b]	DCM[b]	LCFRP[b]
Lepomis auritus	Redbreast sunfish	Fresh Water	R	x	x	
Lepomis gibbosus	Pumpkinseed Fish	Fresh Water	R	x	x	x
Lepomis gulosus	Warmouth	Fresh Water	R	x	x	x
Lepomis macrochirus	Blue Gill	Fresh Water	R	x	x	x
Lepomis microlophus	Redear Sunfish	Fresh Water	R	x	x	x
Lepomis punctatus	Spotted Sunfish	Fresh Water	R	x	x	x
Lepomis sp.	Hybrid sunfish	Fresh Water	R	x		
Lutjanus griseus	Grey Snapper	Marine	N		x	x
Megalops atlanticus	Tarpon	Marine	N	x		
Menidia beryllina	Inland Silverside	Fresh Water	R		x	x
Menidia menidia	Atlantic Silverside	Fresh Water	R		x	
Menticirrhus americanus	Southern kingfish	Marine	N		x	
Microgobius thalassinus	Green Goby	Marine	R		x	
Micropogonias undulatus	Atlantic Croaker	Marine	N		x	x
Micropterus salmoides	Large Mouth Bass	Fresh Water	R	x	x	x
Minytrema melanops	Spotted sucker	Fresh Water	R	x	x	
Morone americana	White Perch	Fresh Water	R		x	
Morone saxatilis	Striped bass	Fresh Water	R	x	x	
Morone saxatilis x *chrysops*	Hybrid Bass	Fresh Water	R		x	x
Moxostoma anisurum	Silver redhorse	Fresh Water	R	x		
Mugil cephalus	Striped Mullet	Marine	R	x	x	x
Mugil curema	White Mullet	Marine	N		x	x
Myrophis punctatus	Speckled Worm Eel	Marine	N		x	
Notemigonus crysoleucas	Golden Shiner	Fresh Water	R	x	x	x
Notropis cummingsae	Dusky shiner	Fresh Water	R	x		
Notropis petersoni	Coastal shiner	Fresh Water	R	x	x	
Notropis procne	Swallowtail shiner	Fresh Water	R	x		
Noturus gyrinus	Tadpole madtom	Fresh Water	R	x		
Opisthonema oglinum	Atlantic thread herring	Marine	S, N		x	
Orthopristis chrysoptera	Pigfish	Marine	N		x	
Paralichthys dentatus	Summer Flounder	Marine	N		x	x
Paralichthys lethostigma	Southern Flounder	Fresh Water	N		x	
Perca flavescens	Yellow perch	Fresh Water	R	x	x	
Pogonias cromis	Black Drum	Marine	N		x	
Pomatomus saltatrix	Blue Fish	Marine	N		x	x
Pomoxis nigromaculatus	Black Crappie	Fresh Water	R	x	x	x
Prionotus tribulus	Bighead Searobin	Marine	N		x	x
Pylodictis olivaris	Flathead catfish	Fresh Water	R	x	x	
Sciaenops ocellatus	Red Drum	Marine	N		x	
Scomberomorus maculatus	Spanish Mackerel	Marine	N		x	x
Strongylura marina	Atlantic needlefish	Fresh Water	R		x	
Symphurus plagiusa	Blackcheek Tounge	Marine	R		x	x
Syngnathus fuscus	Northern Pipefish	Marine	R		x	
Syngnathus louisianae	Chain Pipefish	Marine	R		x	x
Synodus foetens	Inshore Lizardfish	Marine	N		x	
Trinectes maculatus	Hogchoker	Fresh Water	R	x	x	

Reference: LCFRP, 2007.

[a] S= Spawning; N= Nursery; R= Resident. Resident implies that spawning and nursing occur in these waters as well.

[b] WRC= Water Resources Commission; DCM= Division of Coastal Management; LCFRP= Lower Cape Fear River Program

Table 3.5-7. Threatened and Endangered Species Known to Occur in New Hanover County, NC

Scientific Name[a]	Common Name[a]	Federal Status[a,c]	State Status[b,c]	Record Status[a,d]	Possible Habitat[a]	Habitat Present on the Site	Species Identified within 5 Miles of the Site[b]
Vertebrate:							
Acipenser brevirostrum	Shortnose sturgeon	E	E	Current	Marsh, Open Water	Yes	Yes
Alligator mississippiensis	American alligator	T (S/A)	T (S/A)	Current	Swamp, Marsh Open Water	Yes	Yes
Caretta caretta	Loggerhead sea turtle	T	T	Current	Open Water	No	No
Charadrius melodus	Piping plover	T	T	Current	Sandhills	No	No
Chelonia mydas	Green sea turtle	T	T	Current	Open Water	No	No
Picoides borealis	Red-cockaded woodpecker	E	E	Current	Longleaf Pine, Shrub, Grass, Savannah	Yes	Yes
Trichechus manatus	West Indian manatee	E	E	Current	Open Water	No	No
Vascular Plant:							
Amaranthus pumilus	Seabeach amaranth	T	T	Current	Barrier Island Beaches	No	No
Lysimachia asperulaefolia	Rough-leaved loosestrife	E	E	Current	Wet, poorly drained soils	Yes	No

[a] U.S. FWS, 2007a.

[b] NCNHP, 2007.

[c] E = Endangered; T = Threatened; FSC = Federal Species of Concern; SR-L = Significantly Rare – Limited; SR-T = Significantly Rare – Throughout.

[d] Current = the species has been observed in the county within the last 50 years; Historic = the species was last observed in the county more than 50 years ago; Obscure = the date and/or location of observation is uncertain.

Table 3.5-8. Federal Species of Concern Known to Occur in New Hanover County, NC

Scientific Name[a]	Common Name[a]	Federal Status[a,c]	State Status[b,c]	Record Status[a,d]	Possible Habitat[a,b]	Habitat Present on the Site	Species Identified Within 5 Miles of the Site[b]
Vertebrate:							
Anguilla rostrata	American eel	FSC	None	Current	open water, freshwater and brakish rivers	Yes	Yes
Corynorhinus rafinesquii	Rafinesque's big-eared bat	FSC	T	Current	riparian woodlands, hardwood forests	Yes	No
Heterodon simus	Southern hognose snake	FSC	SC	Current	sandhills, pine and turkey oak woodlands	Yes	Yes
Myotis austroriparius	Southeastern myotis	FSC	SC	Current	Riparian woodlands, hardwood and pine forests	Yes	Yes
Ophisaurus mimicus	Mimic glass lizard	FSC	SC	Historic	sandhills, pine and turkey oak woodlands	Yes	No
Passerina ciris ciris	Eastern painted bunting	FSC	SR	Current	woodlands	Yes	No
Pituophis melanoleucus melanoleucus	Northern pine snake	FSC	SC	Historic	woodlands	Yes	No
Rana capito capito	Carolina crawfish frog	FSC	T	Historic	sandhills, pine and turkey oak woodlands; breeds in wetlands and temporary pools	Yes	No
Invertebrate:							
Agrotis buchholzi	Buchholz's dart moth	FSC	None	Current	pine plains	No	No
Atrytone arogos arogos	Eastern beard grass skipper	FSC	SR	Obscure	post-burn wetlands, xeric or dry-mesic grasslands	Yes	No
Atrytonopsis loammi	Loammi skipper	FSC	SR	Obscure	Barrier islands	No	No
Helisoma eucosmium	Greenfield rams-horn	FSC	E	Historic	Shallow creekbed, marsh, swamp	Yes	No
Planorbella magnifica	Magnificent rams-horn	FSC	E	Historic	ponds	No	No
Problema bulenta	Rare skipper	FSC	SR	Current	brackish river marshes, abandoned rice paddies	Yes	No
Triodopsis soelneri	Cape Fear threetooth	FSC	T	Current	savannah, flatwoods, swamp	Yes	No
Vascular Plant:							
Amorpha georgiana var. *confusa*	Carolina lead-plant	FSC	T	Historic	dry savannah, riverbank	No	No
Astragalus michauxii	Sandhills milkvetch	FSC	T	Historic	xeric to dry mesic pine forest	Yes	Yes
Dionaea muscipula	Venus flytrap	FSC	SR-L	Current	bogs and perrenially wet areas	Yes	Yes
Hypericum adpressum	Bog St. John's-wort	FSC	None	Historic	shores, shallow water of freshwater ponds	No	No
Litsea aestivalis	Pondspice	FSC	SR-T	Current	margins of swamps and ponds; depressions	Yes	Yes
Ludwigia ravenii	Raven's boxseed	FSC	SR-T	Historic	swamps, bogs, ponds	Yes	No
Pteroglossaspis ecristata	False coco	FSC	E	Historic	pine savannah, scrub oak	No	No
Ptilimnium ahlesii	Carolina bishopweed	FSC	SR-L	Historic	tidal freshwater marsh	Yes	No

(continued)

Table 3.5-8. Federal Species of Concern Known to Occur in New Hanover County, NC

Scientific Name[a]	Common Name[a]	Federal Status[a,c]	State Status[b,c]	Record Status[a,d]	Possible Habitat[a,b]	Habitat Present on the Site	Species Identified Within 5 Miles of the Site[b]
Rhynchospora pleiantha	Coastal beaksedge	FSC	T	Current	sands and peats of pond shores, moist pine savannahs	No	No
Sagittaria weatherbiana	Grassleaf arrowhead	FSC	SR-T	Current	swamp	Yes	No
Sideroxylon tenax	Tough bumelia	FSC	SR-P	Historic	dry sandy soil	No	No
Solidago verna	Spring-flowering goldenrod	FSC	T	Historic	savannahs, pocosins, fields, roadsides	Yes	Yes
Solidago villosicarpa	Coastal goldenrod	FSC	E	Historic	mesic hardwood forests	Yes	Yes
Stylisma pickeringii var. *pickeringii*	Pickering's dawnflower	FSC	E	Current	dry, deep sand	Yes	Yes
Thalictrum macrostylum	Small-leaved meadow-rue	FSC	SR-L	Current	variable	Yes	No
Trichostema sp. *1*	Dune blue curls	FSC	SR-L	Current	Maritime grasslands behind foredune, maritime scrub	No	No

[a] U.S. FWS, 2007a.

[b] NCNHP, 2007.

[c] E = Endangered; T = Threatened; FSC = Federal Species of Concern; SR-L = Significantly Rare – Limited; SR-T = Significantly Rare – Throughout.

[d] Current = the species has been observed in the county within the last 50 years; Historic = the species was last observed in the county more than 50 years ago; Obscure = the date and/or location of observation is uncertain.

Figures

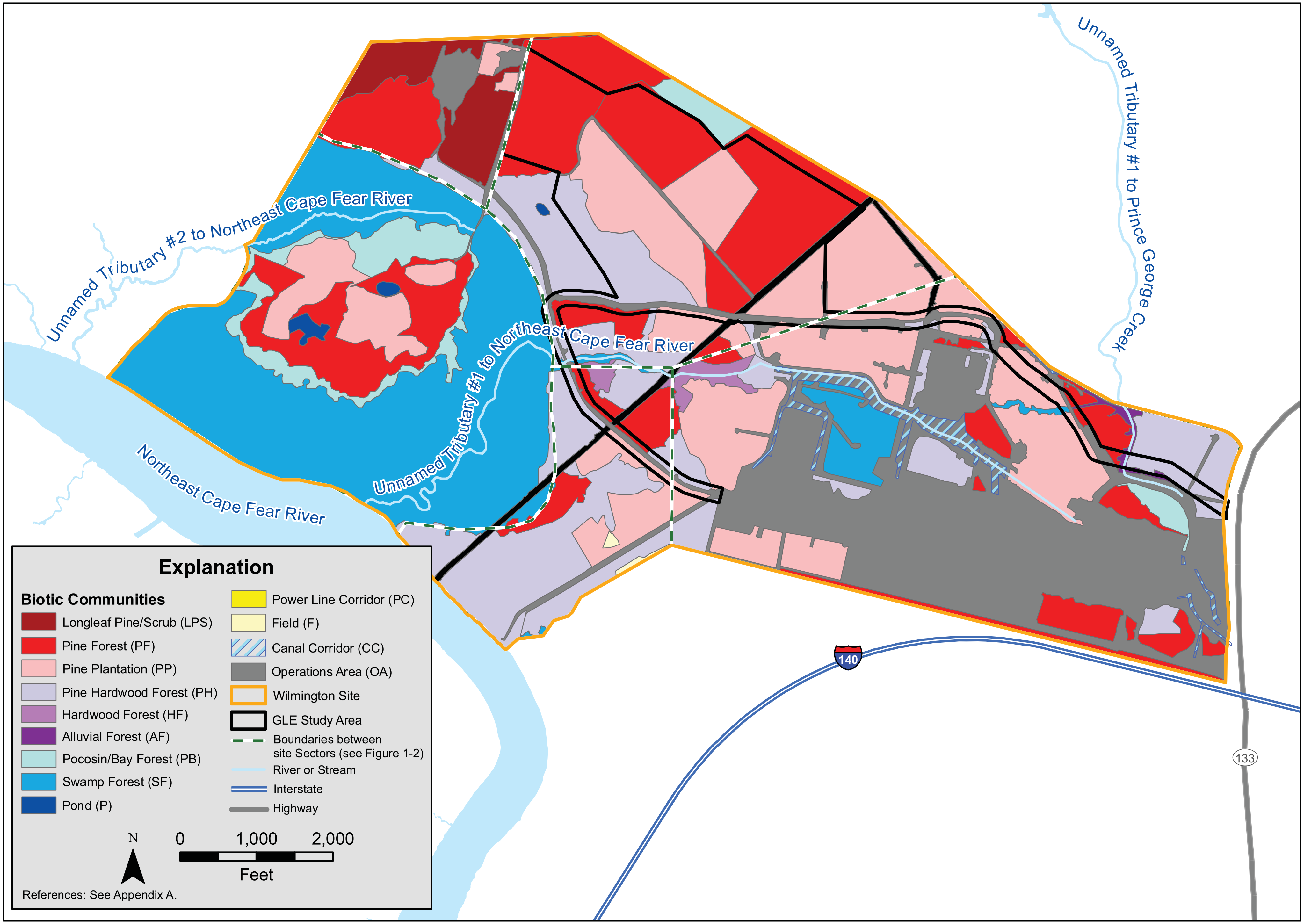

Figure 3.5-1. Biotic communities at the Wilmington Site.

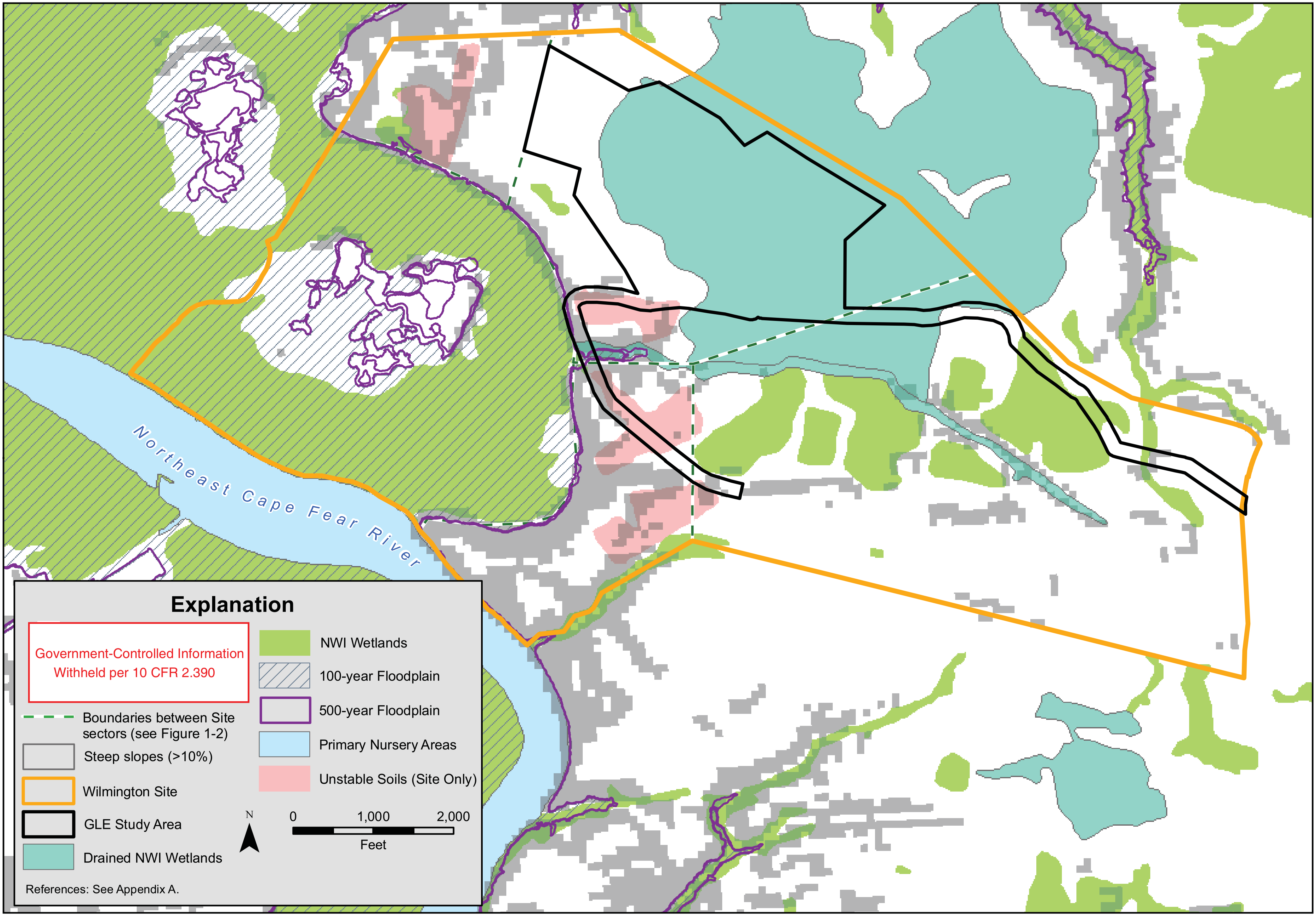

Figure 3.5-2. Location of environmental sensitive areas in the vicinity of the Wilmington Site.

Government-Controlled Information
Withheld per 10 CFR 2.390

Figure 3.5-3. Approximate location of known rare, threatened, and endangered species within 5 miles (8 km) of the Wilmington Site.

GLE Environmental Report

Section 3.6 – Meteorology, Climatology, and Air Quality

Revision 0

December 2008

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3.6 Meteorology, Climatology, and Air Quality

3.6.1 Meteorology

3.6.1.1 Sources of Meteorological Data

Meteorological data collected at Wilmington International Airport (latitude 34.271 North; longitude 77.903 West) were used to assess the meteorological conditions at the Wilmington Site. The airport is located approximately 4 miles (6.4 km) southeast of the Wilmington Site, and information collected at this location is considered accurate for characterizing weather conditions at the Proposed GLE Facility. The elevation of the airport is 32 ft (9.75 m) msl. Weather data at Wilmington International Airport are collected and reported by the National Weather Service using a standard Automated Surface Observing System (ASOS). The monitored parameters include temperature, relative humidity, wind direction and speed, pressure, visibility, and precipitation (State Climate Office of North Carolina, 2007). Wind speed is measured by an anemometer height of 32 feet, 10 inches (10 m) above ground level (agl). Some of these meteorological data also are collected by GEH at the Wilmington Site, but the data from the airport were chosen for evaluation in this Environmental Report due to the longer duration, comprehensiveness, measurement-technique consistency, and comparability of the National Weather Service's Wilmington International Airport dataset to other regional datasets.

3.6.1.2 Major Seasonal Synoptic Weather Pattern

The weather in North Carolina is primarily influenced by the position of the jet stream and its associated polar front, which is usually positioned to the north of the state, and a large subtropical area of high pressure called the Bermuda high. The Bermuda high is considered a semi-permanent atmospheric feature that is centered over Bermuda in the summer months and recedes eastward during the winter months.

During the summer, the jet stream is situated well to the north of the Carolinas near the United States–Canada border, and the polar front, which separates tropical from polar air, is situated in the northern United States. The Bermuda high is most often centered over Bermuda and, on occasion, asserts a more direct influence in North Carolina by moving westward into the Coastal Plain of the Carolinas. During the winter, the jet stream usually dips down well into the east-central United States, bringing the polar front into a position to directly influence weather in the Carolinas (Robinson, 2005). The Bermuda high recedes eastward during the winter, thus exerting a weaker influence on the weather in North Carolina.

Summers in North Carolina are usually hot and humid due to dominant southwest winds, which bring warm, moist maritime tropical (mT) air to the area. This predominant wind direction is strongly influenced by the Bermuda high. Cumulus clouds and eventual afternoon thunderstorms are common during the summer months; however, during summers when the Bermuda high has moved westward, drought becomes a problem. Under such conditions, drought occurs because high pressure sitting over North Carolina stabilizes the atmosphere and stifles convective activity. In addition, the position of the Bermuda high blocks occasional, weak low-pressure systems that have the potential to cause rain as they travel along under the influence of the predominant westerly wind flow (Robinson, 2005).

Winter in North Carolina is also dominated by mT air, which favors warm and moist conditions. This mT regime is commonly punctuated by invasions of Continental Polar (cP) outbreaks, which move down from the Canadian Arctic as the polar front migrates southward. These cP air masses arrive very quickly, with strong, gusty winds that bring cold, dry air and sunny weather to North Carolina. Most of the low-temperature records in North Carolina have occurred under the influence of a cP air mass (Robinson, 2005).

The Gulf Stream and the Labrador Current also exert a strong influence on the weather of coastal North Carolina. Usually, the Gulf Stream approximately parallels the coast of the Carolinas to about Cape Hatteras before diverging into the Atlantic. The warm waters of the Gulf Stream often cause cloudy conditions along the coast, especially during winter, when there is a greater temperature contrast between these waters and the air. In contrast, the Labrador Current may sometimes reach as far south as Cape Hatteras, bringing colder water to the coast and decreasing cloudiness (Robinson, 2005).

The proximity of New Hanover County, NC, to the Gulf Stream also increases this area's potential for hurricane development. Because hurricanes feed on warm ocean water, hurricanes approaching the southeastern North Carolina coast have a good chance of intensification while crossing the warm waters of the Gulf Stream. As a result, New Hanover County, NC, is at particular risk of major storm events.

The Wilmington Site and the nearby Wilmington International Airport are only 9.5 miles (15.3 km) from the ocean; therefore, the climate in the vicinity of the Site is strongly moderated by the ocean. Summers will usually be somewhat cooler than locations further inland, and winters will be somewhat warmer. As Robinson (2005) describes in *North Carolina Weather and Climate*, during the summer months, the warming of the land causes the air to circulate. The warm land heats the air, causing the air to rise as denser, cooler air from the ocean advances inland behind a sea breeze front. The advance of the cooler air further lifts the warm air, often causing convection, showers, and thunderstorms. In some cases, a sea breeze front may travel inland around 50 miles (80 km); however, the prevailing westerly winds in North Carolina usually cause the inland advance of the ocean's effects to be small.

3.6.2 Climate

3.6.2.1 Temperature and Dewpoint

Figures 3.6-1 and 3.6-2 show mean annual average temperatures and mean annual maximum and minimum temperatures, respectively, for North Carolina. Temperatures in the vicinity of the Proposed GLE Facility near Castle Hayne, NC, are moderated due to the proximity of the Atlantic Ocean, which is located approximately 9.5 miles (15.3 km) to the southeast. Based on measurements at the nearby Wilmington International Airport, the mean annual temperature is 17.7°C (63.8°F), with mean annual maximum and minimum temperatures of 23.3°C (74.0°F) and 11.9°C (53.5°F), respectively. On average, temperatures are coldest during January, at 7.8°C (46.1°F), and warmest during July, at 27.3° C (81.1°F) (NOAA, 2004a). **Figure 3.6-3** shows the variation in mean monthly temperature experienced at the Wilmington Site. **Table 3.6-1** provides a complete listing of mean annual and monthly maximum and minimum temperatures at Wilmington International Airport.

Dewpoint is a measure of the temperature to which air must be cooled at constant pressure for condensation to occur. A dewpoint equal to the air temperature would mean that the relative humidity is 100% or that the atmosphere has reached saturation. According to NOAA (1996), the mean annual dewpoint temperature at Wilmington International Airport is 12.2°C (54.0°F). The lowest mean monthly dewpoint of 2.2°C (36.0°F) occurs in January, whereas the highest mean monthly dewpoint of 22.2°C (72.0°F) occurs in July. The National Climatic Data Center's Climate Maps of the United States (NOAA, 2002) show that the mean annual maximum dewpoint at Wilmington International Airport is approximately 13.3°C (56.0°F) and the mean annual minimum dewpoint is approximately 7.2°C (45.0°F). NOAA (2002) also approximates that the lowest mean monthly maximum dewpoint of 3.9°C (39.0°F) and the lowest mean monthly minimum dewpoint (frostpoint) of -3.9°C (25.0°F) occur in January. The highest mean monthly maximum dewpoint of 22.8°C (73.0°F) and the highest mean monthly minimum dewpoint of 18.9°C (66.0°F) occur in July.

3.6.2.2 Precipitation

The mean annual precipitation in eastern North Carolina is heaviest in the southeast corner of the state and steadily decreases toward the north and west. The higher precipitation amounts are due to higher levels of moisture provided by the Atlantic Ocean. The area along the North Carolina coast will often experience afternoon showers and thunderstorms during the summer months. These storms form along a sea breeze front as it moves inland from the coast. The mean annual precipitation for the area around the Proposed GLE Facility is approximately 55.0 inches/year (1,397 mm/year) according to the 1948 to 1995 dataset (NOAA, 1996) and 57.1 inches/year (1,449.6 mm/year) according to the 1971 to 2000 dataset (NOAA, 2004a). **Figure 3.6-4** shows the mean annual precipitation for North Carolina, and **Figure 3.6-5** shows the monthly precipitation for Wilmington International Airport. **Figure 3.6-4** presents the mean annual precipitation based on the older 1948 to 1995 data due to the availability of comparable statewide data. The average annual and monthly precipitation for the airport is provided in **Table 3.6-2.**

During the 5-year period from 1992 through 1996, Wilmington International Airport recorded precipitation for 2,576 hourly observations, which translates to an average of 515.2 hourly measurements per year. **Figure 3.6-6** shows the frequency of precipitation at the airport from 1992 through 1996 for each hour of the day. The highest frequency of precipitation, 127 hours for the time period, occurred at about 16:00 hours Greenwich Mean Time (GMT; GMT is 5 hours ahead of Eastern Standard Time and 4 hours ahead of Eastern Daylight Time), whereas the lowest frequency of precipitation, 86 hours for the time period, occurred at about 08:00 hours GMT. **Figure 3.6-7** shows the distribution of average hourly precipitation rates at Wilmington International Airport from 1992 through 1996. The maximum average hourly precipitation rate of 0.16 inches/hour (4.1 mm/hour) occurred at 00:00 hours GMT. The minimum average hourly precipitation rate of 0.09 inches/hour (2.2 mm/hour) occurred at about 21:00 hours GMT. **Figure 3.6-8** shows the distribution of maximum hourly precipitation rates at Wilmington International Airport from 1992 through 1996. The highest maximum hourly precipitation rate of 2.39 inches/hour (60.7 mm/hour) occurred at 19:00 hours GMT, whereas the lowest maximum hourly precipitation rate of 0.77 inches/hour (19.6 mm/hour) occurred at 22:00 hours GMT (NOAA, 2005b). Overall, these statistics indicate that higher precipitation events occur in the mid-afternoon to early evening periods of the day for the Wilmington area.

Due to the moderate climate, Wilmington receives very little snowfall, except on rare occasions. On average, only about 2.1 inches (53.3 mm) of snowfall occurs annually. December and January are expected to receive the most average snowfall, at 0.6 inches (15.2 mm) (NOAA, 2004a).

Wilmington also receives only a small amount of sleet. The mean recurrence interval for measurable sleet in Wilmington, NC, is approximately 4.6 years, or an annual probability about 22%. Sleet greater than 0.25 inches has a mean recurrence interval of only once every 46.0 years, or an annual probability of about 2% (Fuhrmann and Konrad, 2007).

Freezing rain usually poses a higher risk to power systems and trees than does sleet. According to Fuhrmann and Konrad (2007), freezing rain does not occur often in Wilmington, although it occurs more often than sleet. Measurable accumulations occur in Wilmington with a mean recurrence interval of about 1.5 years, or an annual probability of 67%. More significant accumulations of >0.25 inches occur with a mean recurrence interval of 7.7 years, or an annual probability of 13%. Accumulations of >0.5 inches, which are very likely to affect power lines and trees, are expected to occur in Wilmington at a mean recurrence interval of 46 years, or an annual probability of 2%.

3.6.2.3 Winds

On an annual basis, the wind direction (direction from where the wind is blowing) at Wilmington International Airport is predominantly southwesterly (NOAA, 1996), thus reflecting the general synoptic-

scale wind pattern. In contrast, the predominant wind direction during the fall and winter is often northerly, due largely to the influence of invading polar air masses and changes in global circulation (NOAA, 1996; Robinson, 2005). **Figure 3.6-9** shows the overall wind rose for Wilmington International Airport, whereas **Figures 3.6-10 through 3.6-21** show the monthly wind roses for the airport. **Table 3.6-3** shows the wind frequency distribution for Wilmington International Airport. The annual prevailing wind speed at the airport is 9 knots (kts) (4.6 m/s) (NOAA, 1996).

3.6.2.4 Atmospheric Stability

The stability of the atmosphere is important because a more stable atmosphere suppresses the dispersion of potential contaminants that might be released into the atmosphere during the construction phase or an operational emergency of the Proposed GLE Facility. Stability is normally classified by the Pasquill-Gifford Stability Class, which has values of A through F (**Table 3.6-4**). The most-stable conditions are classified as Stability Class F, and in these conditions, an airborne plume would remain narrow and stay close to the ground. The least-stable atmospheric conditions, which would be classified as Stability Class A, would cause a potential plume to be dispersed more quickly, thus lowering concentrations of the airborne potential contaminants that were released. Stability Class D is considered to represent an atmosphere with neutral stability. The worst-case scenario for the release of a potential contaminant is normally considered the combination of Stability Class F conditions and low wind speed.

Five years of data (1988 through 1992) (WebMET.com, 2002) from Wilmington International Airport were used to generate joint frequency distributions of wind speed and direction with respect to stability class. These data are available in Met144 format and were transformed to CD144 format using EPA's MET144.exe. CD144 format is the only compatible format for use with the EPA Stability Array (STAR) program, which generates the joint frequency distributions. Met144-format data more recent than 1992 were not available for use with the STAR program.

The results from the STAR program show that conditions at Wilmington International Airport met the following stability class criteria (A through F) for the following percentages of hourly observations: A, 0.8%; B, 6.7%; C, 13.7%; D, 40.9%; E, 13.8%; and F, 24.0%; therefore, Wilmington has the most stable conditions (Class F) almost 25% of the time. Calms, winds of 4–7 miles per hour (mph) (1.8–3.1 m/s), and winds of only 1–3 mph (0.4–1.3 m/s) co-occur with Stability Class F conditions about 8.7%, 5.6%, and 9.8% of the total time in the Wilmington area, respectively. The highest co-occurrence of winds of ≤3 mph (1.3 m/s) and Stability Class F occurs when the wind is blowing from the north, a combination that occurs 0.7% of the total time. Considering all wind speeds observed during Class F conditions, which are always observed with speeds ≤7 mph (3.1 m/s), the wind blows from the north most often (7.4% of the time in Class F), followed by the west-southwest (5.9%) and southwest (5.7%). **Table 3.6-5** shows the number of hours certain wind directions and speeds were observed at Wilmington International Airport. **Tables 3.6-6 through 3.6-11** correlate these directions and speeds with different classes of atmospheric stability conditions.

Based on the frequency of Stability Classes E and F, inversions occur rather frequently, or 37.8% of the time, in the Wilmington area. The data available from Wilmington International Airport are insufficient to make an accurate determination about the duration of inversion conditions; however, conditions conducive to stagnation, which are usually caused by persistent high-pressure systems, can last several days for areas along the coast (Wang and Angell, 1999). Nocturnal inversions are generally prone to break up on the time scale of hours due to the sun's heating.

3.6.2.5 Mixing Heights

The mixing height is the height above the surface of the earth through which relatively vigorous vertical mixing occurs (Holzworth, 1972). The mixing height is an important parameter in forecasting the

dispersion of pollutants because it is used to determine the vertical plume spread for non-dense gases. As presented in Holzworth's mixing height document (1972), mean annual morning and afternoon mixing heights were developed. The Holzworth document was used because site-specific mixing height data are not available for Wilmington International Airport. Consequently, seasonal values were substituted for monthly values.

The mean annual morning mixing height for the Wilmington Site is approximately 1,804 ft (550 m). Due to the moderating effect of the ocean, mean morning mixing heights generally increase toward the coast and over the ocean (Holzworth, 1972). **Figure 3.6-22** shows the mean annual morning mixing heights for the United States, whereas **Figures 3.6-23 through 3.6-26** show the seasonal mean morning mixing heights. The mean annual afternoon mixing height for the Wilmington Site, as taken from Holzworth (1972), is approximately 3,839 ft (1,170 m). As opposed to the mean morning mixing height, the afternoon mixing height decreases toward the ocean due to its moderating effects. Mean annual afternoon mixing heights for the United States are shown in **Figure 3.6-27**, whereas seasonal mean afternoon mixing heights are shown in **Figures 3.6-28 through 3.6-31**. Holzworth (1972) is regarded as the most-current available comprehensive document about mixing heights and is considered valid guidance on the subject matter.

3.6.2.6 Extreme Conditions

3.6.2.6.1 Extreme Temperature

The highest recorded temperature at Wilmington International Airport for the period of record is 40.0°C (104.0°F), which occurred during June 1952 (NOAA, 2004a). The lowest recorded temperature of -17.8°C (0.0°F) occurred in December 1989 (NOAA, 2004a). This shows that the possible temperature range at the Proposed GLE Facility is about 57.8°C (104.0°F). **Table 3.6-12** provides the extreme monthly maximum and minimum temperatures for the airport.

3.6.2.6.2 Extreme Precipitation

Tropical storms and hurricanes occur in and around the southeastern United States, making Wilmington prone to high amounts rainfall over a short time period. The highest recorded 24-hour rainfall amount of 13.38 inches (339.85 mm) at Wilmington International Airport occurred during September 1999 due to the effects of Hurricane Floyd making landfall on the North Carolina coast (NOAA, 2004a).

Considering the expected precipitation intensity, Wilmington International Airport has a 1 in 50 annual exceedance probability (AEP) of receiving precipitation at a rate of 11.86 inches/hour (301.24 mm/hour) for a duration lasting 5 minutes. The AEP for precipitation with a rate of 16.05 inches/hour (407.67 mm/hour) occurring for 5 minutes is about 1 in 1,000. Generally, the intensity of rainfall that could occur for a given AEP decreases as the duration of the precipitation event increases (NOAA, 2004b). **Table 3.6-13** provides the extreme monthly maximum and minimum precipitation for the airport.

On rare occasions, Wilmington can receive large snowfall amounts. During a storm event in late December 1989, the area received 9.6 inches (243.8 mm) of snow in a 24-hour period (NOAA, 1996, 2004a). This December 1989 storm also matched a previous record snow depth of 13 inches (330.2 mm). Assuming that the water content of wet, heavy snow is about 33% and that 1 inch of water weighs 5.2 pounds/ft^2 (25.4 kg/m^2) (VanDevender and Petty, 2006), this maximum snow depth may weigh up to 22.3 pounds/ft^2 (108.9 kg/m^2).

3.6.2.6.3 Extreme Winds

Extreme winds may occur at Wilmington International Airport due to localized events, such as thunderstorm downdrafts, microbursts, or tornadoes. In addition, the airport lies in a particularly

vulnerable location for hurricane-force winds. As of 1995, the highest wind gust measured at the airport was 68 kts (35.0 m/s) (NOAA, 1996); however, since that time, Wilmington has experienced Hurricanes Fran (1996), Floyd (1999), and Charley (2004). According to Mayfield (1996), Hurricane Fran had a peak gust of 75 kts (38.6 m/s) measured at Wilmington International Airport. Hurricane Floyd similarly caused a wind gust of 75 kts (38.6 m/s) at the airport (Pasch et al., 1999). Hurricane Charley had somewhat lower wind gusts of 64 kts (32.9 m/s) at the airport (Pasch et al., 2005).

3.6.2.7 Storms

3.6.2.7.1 Thunderstorms

Rainfall in the region during the summer months comes primarily from thunderstorms. These storms occur on approximately 33% of all days during June through August in the vicinity of the Site and are scattered and uneven in coverage (NOAA, 1996). Although summer thunderstorms are often caused by the inland advance of the sea breeze front, other primary causes of thunderstorms in the Wilmington area are tropical storms or hurricanes approaching from the south and southeast and large-scale synoptic fronts approaching from the north and west. The latter two causes of thunderstorms also increase the chance of severe weather (e.g., wind gusts ≥50 kts [26 m/s], tornadoes, ≥3/4 inch [1.9 cm] hail). For example, hail is observed in the Wilmington area on an average of about once per year (NOAA, 1996) and is most likely to be associated with synoptic frontal thunderstorms.

Severe thunderstorms may produce damaging straight-line winds greater than 50 kts (26 m/s). According to the National Severe Storms Laboratory (NSSL, 2003), the area surrounding the Wilmington Site will experiences about 4 days per year of damaging thunderstorm winds or winds ≥50 kts (26 m/s) due to a thunderstorm.

Another hazard of thunderstorms is lightning, which can strike miles from a thunderstorm and often occurs without warning. Besides the obvious danger to personnel working outside, lightning can disrupt electrical circuits and cause fires. In general, the Wilmington area has a high risk of lightning strikes. The region surrounding the Wilmington Site has experienced a lightning flash density ranging from 4 to 16 flashes/km^2/year over the period from 1989 through 1999. **Figure 3.6-32** shows the approximate density of lightning flashes throughout the continental United States.

3.6.2.7.2 Tornadoes

Fifteen tornadoes are known to have touched down in New Hanover County, NC, between 1950 and 2004, including waterspouts in the sound and on the Atlantic Ocean. The strongest of these 15 tornadoes occurred on June 13, 1962, in the western part of the county and measured F2 on the Fujita scale, which means that it was capable of producing considerable damage. This particular tornado produced between $5,000 and $49,999 in damage (NOAA, 2005c). Wind speeds associated with an F2 tornado are between 113 mph; 182 km/hour) and 157 mph (253 km/hour). **Figure 3.6-33** shows the number of tornado touchdowns per county in southeastern North Carolina.

Six of the 15 tornadoes that occurred in New Hanover County occurred during a 2-year period (1998–1999). The four tornadoes in 1998 were all F1 tornadoes and produced between $0.04 million and $0.18 million in damage. The two tornadoes in 1999 were both F0 tornadoes, for which the amount of damage was not known (NOAA, 2005c). F0 tornadoes produce winds between 40 mph (64 km/hour) and 72 mph (116 km/hour), which are below hurricane force.

Based on evaluation of data from the NSSL (2003), a tornado would be expected to occur within 25 miles (40 km) of the Wilmington Site on 0.4 to 0.6 days per year. The ocean covers a significant portion of the area within 25 miles (40 km) of the Wilmington Site; therefore, some of these tornadoes could occur as

waterspouts. Tornado design-basis guidance indicates that tornadoes in the Wilmington area would be expected to have 200-mph (322-km/hour) maximum, winds with an exceedance probability of 10^{-7}per year. Immediately west of the Wilmington Site, tornadoes would be expected to be more intense, with 230-mph (370-km/hour) maximum winds at an exceedance probability of 10^{-7} per year (NRC, 2007). In reality, this change in expected intensity would not be abrupt, but due to the coarse nature of the grid cells used in *Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants, Regulatory Guide 1.76* (NRC, 2007) to calculate the intensity regions, there is a sharp demarcation between regions.

3.6.2.7.3 Tropical Storms and Hurricanes

New Hanover County is particularly susceptible to tropical storms and hurricanes. These storms often bring damaging winds, flooding from heavy rains, and high storm surges to this section of the state, and the interactions between these storms and the land surface are also highly likely to spawn tornadoes. The area of New Hanover County could expect the following return periods for each category of hurricane passing within 75 nautical miles (86 miles, 139 km): Category 1, 6 to 10 years; Category 2, 23 to 30 years; Category 3, 33 to 44 years; Category 4, 79 to 120 years; and Category 5, 191 to 250 years (Neumann, 1999).

Because winds are stronger on the right side of the storm's eye, causing more wind damage and higher storm surges, the greatest meteorological threat to New Hanover County comes from hurricanes that strike land in the approximate area between the South Carolina border and the outlet of the Cape Fear River. In addition, the strongest bands of rain occur in front of a hurricane as it approaches, resulting in a great deal of heavy, flooding rain in New Hanover County when a storm approaches this area of coastline. Between 1954 and 2004, three hurricanes that ranged from Category 1 through Category 3 made landfall in this area of the coast. Two of these, Hurricanes Hazel (1954) and Fran (1996), were Category 3 storms that made landfall with winds between 111 mph (170 km/hour) and 130 mph (209 km/hour). During this same time frame, a significant number of storms have threatened the coastal counties of southeastern North Carolina, but these storms have stayed offshore or made landfall farther to the north (NOAA, 2005a). **Figure 3.6-34** summarizes the storm tracks of major hurricanes that have made landfall in and around the Carolinas and surrounding states. For the purpose of this figure, major hurricanes include those that have made landfall (i.e., crossed the coast or came close to the coast) with an intensity of Category 3 or higher, sometimes at other locations on the U.S. coastline, before weakening and affecting the Carolinas as a weaker hurricane or tropical storm. For instance, Hurricane Floyd (1999) is not included in the figure because it was a Category 2 hurricane upon making landfall, and was not close to the U.S. coast as a Category 3 or greater hurricane; and Hurricane Charlie (2004) is included in the figure because it approached Florida as a Category 4 hurricane, although it crossed the coast at Category 1 and passed through North Carolina as a tropical storm (thin green line on **Figure 3.6-34**).

Storm surges result when a hurricane's strong winds push water onto the shore prior to the landfall of the storm's eye wall. A storm surge in the Wilmington area is likely to travel up through the mouth of the Cape Fear River and has the potential to travel some distance upstream (**Figure 3.6-35**). According to the examination of NOAA (1999) storm surge data, most portions of the Wilmington Site, including the North-Central Site Sector (containing the Main Portion of the GLE Study Area) will not be directly affected by the highest storm surge; however, much of the low-lying Western Site Sector along the river would be inundated by storm surge from a Category 3, 4, or 5 hurricane.

3.6.2.7.4 River Floodplains

The GLE Study Area does not fall within 100-year or 500-year floodplains (FEMA and State of North Carolina, 2006a, 2006b); however, some of the low-lying Western Site Sector contains Swamp Forest habitat that borders the Northeast Cape Fear River. Much of this Swamp Forest is in the floodplain and

may flood during extreme rain events upstream. Floodplains are discussed further in **Section 3.4.3**, *Floodplains*.

3.6.2.8 Atmospheric Stagnation Episodes

An air stagnation event is basically a meteorological situation that is favorable to an air pollution episode. During these regional events, air pollution can accumulate, causing poor air quality. Air stagnation is often due to the occurrence of persistent light or calm winds and the presence of an inversion. The Wilmington area has a mean of 15 to 17 air stagnation days per year, which equates to a mean of about three air stagnation cases per year. These cases last for a mean duration of between 5 and 6 days per event. Wilmington is most prone to air stagnation in the month of September, which has a mean of about 4 to 5 air stagnation days and the highest mean number of cases at above 0.75 cases for the month. The number of air stagnation days in the Wilmington area is increasing by approximately 0.5 days per decade (Wang and Angell, 1999).

3.6.2.9 Topography

The topography around the Proposed GLE Facility near Wilmington does not have sufficient relief to exhibit any appreciable influence on weather patterns. Locally, the terrain is fairly flat, with minimal relief of only a few feet, except where the Northeast Cape Fear River is incised to about 20 ft below the level of the Proposed GLE Facility.

3.6.3 Air Quality

3.6.3.1 Applicable Air Quality Standards and Regulations

3.6.3.1.1 Federal Standards and Regulations

The EPA, pursuant to the Clean Air Act (CAA), is the responsible federal agency for developing, implementing, and enforcing national air pollution control programs. The CAA directs EPA to establish National Ambient Air Quality Standards (NAAQS), which consist of two levels of standards. Primary NAAQS set limits to protect public health, including the health of “sensitive” populations, such as people with asthma and other respiratory conditions, children, and the elderly. Secondary NAAQS set limits to protect public welfare, prevent visibility impairment, and prevent damage to animals, crops, vegetation, and buildings. The EPA has set NAAQS for the following principal air pollutants, which are called criteria air pollutants (U.S. EPA, 2007a):

- Carbon monoxide (CO)
- Lead (Pb)
- Ozone (O_3)
- Nitrogen dioxide (NO_2)
- Particulate matter (PM)
- Sulfur dioxide (SO_2).

Table 3.6-14 presents the primary and secondary NAAQS for each of the criteria air pollutants. PM in the air is a mixture of solids and liquid droplets that vary in size. The NAAQS address two size categories of PM: PM less than 10 micrometers in diameter (PM_{10}), and very small PM with diameters less than 2.5 micrometers ($PM_{2.5}$). $PM_{2.5}$ are called fine particles and are produced by many types of combustion sources, including motor vehicles, power plants, residential wood burning, forest fires, and agricultural burning, as well as some industrial processes. $PM_{2.5}$ pose the greatest public health concern because they can pass through the nose and throat and penetrate deep into the lungs.

Air toxics are those air pollutants that are known or suspected to cause cancer or other serious health effects (e.g., reproductive effects or birth defects) or adverse environmental effects. The CAA Amendments of 1990 established a list of specific hazardous air pollutants (HAPs) and directed EPA to regulate the emissions of these HAPs from stationary industrial sources. National ambient concentration standards for HAPs analogous to the criteria air pollutant NAAQS have not been established. Instead, EPA develops and promulgates national air emission standards to limit the amount of HAP emissions released into the atmosphere from specific categories of stationary sources. These standards are called the National Emission Standards for Hazardous Air Pollutants (NESHAP) and are based on implementing selected air pollutant control technologies or work practices. Uranium enrichment operations are not a source category subject to a NESHAP.

3.6.3.1.2 State of North Carolina Standards and Regulations

The NC DAQ (under NCDENR) is the responsible agency for implementing and enforcing state and federal air pollution control programs. In North Carolina, the State General Assembly enacts state air pollution laws, and the North Carolina Environmental Management Commission (NC EMC) adopts most air quality regulations. In addition, EPA has designated the NC DAQ as the lead agency for enforcing federal air pollution regulations in the state.

The NC DAQ does not regulate the air emissions of radionuclides from sources. The State agency responsibility for regulation of the possession, use, transfer, transportation, and disposal of radioactive materials within North Carolina is assigned to the NCDENR's Radiation Protection Section (RPS). Ambient air radionuclide monitoring at the Wilmington Site and surrounding area conducted under the supervision of the RPS is discussed in **Section 3.11**, *Public and Occupational Health*.

Table 3.6-15 presents the State of North Carolina's ambient air quality standards for each of the criteria air pollutants (15A NCAC 02D .0400). The North Carolina ambient air quality standards directly adopted all of the NAAQS for CO, Pb, O_3, NO_2, and SO_2. As shown in **Table 3.6-15**, there are differences between the PM NAAQS and the North Carolina ambient air quality standards for PM; the State's ambient air quality standards include several additional PM standards that are not NAAQS. For PM, the North Carolina ambient air quality standards include individual standards for total suspended particulates (TSP) and currently retain the annual average PM_{10} standard that EPA revoked from the NAAQS.

The State of North Carolina's air toxic regulation is a site-specific, public health risk-based program established to protect public health by limiting emissions of toxic air pollutants (TAPs) from man-made sources. This North Carolina program was created independent of the federal HAP program. As a result, although the State's list of regulated TAPs includes many of the federal HAPs, it also includes additional substances not on the HAP list. For individual TAPs, the NC DAQ establishes a specific ambient concentration level, referred to as the acceptable ambient level (AAL), above which the substance may be considered to have an adverse effect on human health. The NC DAQ has developed AALs for 97 TAPs. These AALs are used by the DAQ for air permitting of a new or modified facility on a case-by-case basis to set maximum emissions limits for specific TAPs from sources at a facility so that the applicable AALs are not exceeded at the facility property boundary (i.e., fenceline).

3.6.3.2 Regional Ambient Air Quality Monitoring Data

3.6.3.2.1 Criteria Air Pollutants

The NC DAQ and several county air quality regulatory agencies operate and maintain air monitors to measure ambient air concentrations of criteria air pollutants at more than 70 locations around the state (NC DAQ, 2007a). Two types of monitors are used for criteria air pollutant emissions: those that continuously measure and record pollutant concentration data and those with filters that must be collected

manually for analysis. The final data recorded for each monitoring station are reported to EPA's Air Quality System database (U.S. EPA, 2007b), which compiles and summarizes nationwide ambient air monitoring data.

There are two ambient air monitoring stations currently operating in the vicinity of the Wilmington Site that measure criteria pollutants, and these stations are referred to as the Castle Hayne station and the New Hanover County station (**Table 3.6-16**). Both of these monitoring stations are operated by the NC DAQ and are located in New Hanover County; no monitoring stations are operated in adjacent Brunswick or Pender counties. **Figure 3.6-36** shows the locations of the currently operating NC DAQ monitoring stations in relation to the Wilmington Site. Not all of the criteria air pollutants are measured at each of the monitoring stations. Ozone, $PM_{2.5}$, and SO_2 are measured at the Castle Hayne monitoring station located northeast of the Wilmington Site, whereas only SO_2 is measured at the New Hanover County monitoring station located south of the Site (**Figure 3.6-36**). The NC DAQ does not monitor NO_2 or Pb at any of its stations in the statewide compliance monitoring network, where the applicable NAAQS have been demonstrated, and these parameters are not measured in the vicinity of the Wilmington Site. A CO air monitoring station was operated at a third location in Wilmington (the Oleander and College monitoring station located southeast of the Wilmington Site), but this station was shut down in 2005 because of the low CO levels consistently measured at that location.

A comparison of the federal and state ambient criteria air pollutant standards to ambient air monitoring measurements in the vicinity of the Wilmington Site is presented in **Table 3.6-17**. For the 5-year period from 2002 through 2006, ambient concentrations of CO, O_3, $PM_{2.5}$, and SO_2 measured at the monitoring stations in New Hanover County did not exceed the applicable NAAQS and State standard levels (i.e., the measured ambient concentration levels were less than the NAAQS levels).

3.6.3.2.2 Hazardous/Toxic Air Pollutants

The NC DAQ operates and maintains monitoring stations to measure ambient air concentrations of certain HAPs/TAPs at six urban community locations around the state (NC DAQ, 2007c). One of these ambient HAP/TAP monitoring stations is in New Hanover County, and no air toxic monitoring stations are operated in adjacent Brunswick or Pender counties. The TAP monitoring station in New Hanover County is next to the USS North Carolina Battleship Memorial, across the Cape Fear River from downtown Wilmington, and is referred to by the NC DAQ as the Battleship monitoring station; **Table 3.6-16** identifies the specific monitoring station location. At this location, EPA methods are used to sample and analyze the ambient air concentrations of individual VOCs, carbonyls, and semi-volatile organic compounds on EPA's HAP and the NC DAQ TAP lists. Sampling at the Battleship monitoring station began in 2004. **Table 3.6-18** summarizes the ambient HAP/TAP monitoring results measured at the Battleship monitoring station for 2004 and 2005 (NC DAQ, 2006).

3.6.3.3 Regional NAAQS Attainment Status

As defined in the CAA, EPA issues a legal status designation about whether an area violates NAAQS or contributes to an NAAQS violation in a neighboring area using the terms "attainment" or "non-attainment." An attainment area is defined as a geographic area that meets the NAAQS. EPA designates an area as a non-attainment area if air quality monitoring shows that the area exceeds any NAAQS for a given criteria pollutant. An area may be a non-attainment area for one criteria pollutant and an attainment area for the other criteria air pollutants. A non-attainment area can be redesignated as an attainment area if the area can maintain the applicable standard for at least 10 years. These areas are called maintenance areas. The EPA's current listings of U.S. counties that have been designated as non-attainment or maintenance areas by each criteria air pollutant are available in EPA's *Green Book* (U.S. EPA, 2007c).

Brunswick, New Hanover, and Pender counties are NAAQS attainment areas for all of the criteria air pollutants. Certain counties in North Carolina and South Carolina outside the region comprised by Brunswick, New Hanover, and Pender counties have been designated non-attainment areas for either O_3 or $PM_{2.5}$. The location of these designated non-attainment areas in relation to the Wilmington Site are shown in **Figures 3.6-37 and 3.6-38** for O_3 and $PM_{2.5}$, respectively. In addition, certain counties in North Carolina outside the Brunswick, New Hanover, and Pender county region have been designated as maintenance areas for CO. The location of these designated CO maintenance areas in relation to the Wilmington Site are shown in **Figure 3.6-39**.

3.6.3.4 Regional Emissions Inventory

The NC DAQ maintains an online statewide emissions inventory database system for stationary sources (NC DAQ, 2007b). Owners and operators of individual facilities prepare emissions estimates for their facility and submit their estimates to the NC DAQ. Staff at the NC DAQ review and must accept the facility's estimates before the estimates are posted in the online database. A facility that has the potential to emit 100 tons or more per year for one or more criteria air pollutants is considered to be a major source for air permitting purposes. Major source threshold values for air toxics (i.e., HAPs) are 10 tons/year (9 metric tons [mt]/year) or more for a single HAP or 25 tons/year (23 mt/year) or more for any combination of HAPs. In North Carolina, major source facilities are required to submit certified emissions reports to the NC DAQ annually. Individual sources with an air permit classification as "small" or "synthetic minor" are inventoried as part of their permit-renewal process (every 5 years), or more often if applying for a permit modification. The NC DAQ emissions inventory database includes emissions estimates for both criteria air pollutants and air toxics. The most recent calendar year for which data are available from the NC DAQ emissions inventory database is 2005.

3.6.3.4.1 Criteria Air Pollutants

The annual criteria pollutant emissions for 2005 are available from the NC DAQ emissions inventory database on a countywide total basis, as well as a specific facility basis. The inventory includes estimates of VOCs, which are the photochemically reactive compounds involved in O_3 formation in the atmosphere. **Table 3.6-19** summarizes the total countywide annual criteria pollutant emissions for Brunswick, New Hanover, and Pender counties. The annual emissions from individual facilities in these three counties that emit more than 100 tons/year (91 mt/year) of at least one criteria pollutant are listed in **Table 3.6-20**.

3.6.3.4.2 Hazardous/Toxic Air Pollutants

The annual HAP/TAP emissions for calendar year 2005 are also available from the NC DAQ emissions inventory database on a countywide total basis and a facility-specific basis. **Table 3.6-21** summarizes the total countywide annual air hazardous/toxic emissions for stationary sources in Brunswick, New Hanover, and Pender counties.

3.6.3.5 Wilmington Site Existing Air Emission Sources and Controls

3.6.3.5.1 Wilmington Site Existing Air Quality Permits

Air permits are legally enforceable documents that specify requirements based on applicable federal and state regulations, which facility owners and operators must meet to control air pollutant emissions from sources operating at their facilities. The NC DAQ issues individual air quality permits to facility owners and operators for the construction and operation of air emissions sources in North Carolina. There are two active air quality permits for the air emissions sources currently operating at the Wilmington Site.

Permit No. 1161R19 is issued to the GE to operate air emissions sources associated with the Aircraft Engine (AE) operations and one air emissions source related to the Services Components Operation

(SCO) (NC DAQ, 2004a). The specific permitted air emissions sources and air emissions controls associated with these operations are listed in **Table 3.6-22**. The operations are designated as a "synthetic minor" source, which means that the operations are subject to federally enforceable conditions that limit the maximum air pollutant emissions levels from the associated operation emissions sources to below the major source threshold levels.

Permit No. 1756R17 is issued to GNF-A to operate air emission sources associated with the FMO facility and the associated Fuel Components Operation (FCO) (NC DAQ, 2004b). The specific permitted air emissions sources and air emissions controls associated with these operations are listed in **Table 3.6-23**. These operations are also designated as a "synthetic minor" source.

3.6.3.5.2 Wilmington Site Air Emissions Inventory

The NC DAQ emissions inventory database includes the most recent criteria air pollutants and HAP/TAP emissions estimates for the existing sources at the Wilmington Site (NC DAQ, 2007b). The criteria air pollutant emissions inventory for all existing stationary sources at the Wilmington Site is presented in **Table 3.6-24**. The HAP/TAP emissions inventory for the existing stationary sources at the Wilmington Site is presented in **Table 3.6-25**.

Tables

Table 3.6-1. Mean Annual and Monthly Temperatures for Wilmington International Airport

Wilmington International Airport — Latitude: 34.271 N
Period of Record: 1971–2000 — Longitude: 77.903 W

Month	Mean Average °C (°F)	Mean Maximum °C (°F)	Mean Minimum °C (°F)
January	7.8 (46.1)	13.5 (56.3)	2.1 (35.8)
February	9.2 (48.5)	15.3 (59.5)	3.1 (37.5)
March	12.8 (55.0)	19.0 (66.2)	6.5 (43.7)
April	17.1 (62.7)	23.4 (74.1)	10.7 (51.2)
May	21.2 (70.2)	27.0 (80.6)	15.4 (59.8)
June	25.0 (77.0)	30.2 (86.4)	19.8 (67.6)
July	27.3 (81.1)	32.2 (89.9)	22.4 (72.3)
August	26.5 (79.7)	31.3 (88.3)	21.7 (71.0)
September	23.9 (75.0)	28.9 (84.1)	18.8 (65.9)
October	18.2 (64.8)	24.2 (75.6)	12.2 (53.9)
November	13.6 (56.5)	19.9 (67.8)	7.3 (45.1)
December	9.4 (48.9)	15.3 (59.6)	3.4 (38.1)
Annual	17.7 (63.8)	23.3 (74.0)	11.9 (53.5)

Reference: NOAA, 2004a.

Table 3.6-2. Mean Annual and Monthly Precipitation for Wilmington International Airport

Wilmington International Airport — Latitude: 34.271 N
Period of Record: 1971–2000 — Longitude: 77.903 W

Month	Mean Precipitation mm (in)	Mean Snowfall mm (in)
January	114.81 (4.52)	15.2 (0.6)
February	92.96 (3.66)	12.7 (0.5)
March	107.19 (4.22)	10.2 (0.4)
April	74.68 (2.94)	Trace
May	111.76 (4.40)	0.0 (0.0)
June	136.14 (5.36)	0.0 (0.0)
July	193.55 (7.62)	0.0 (0.0)
August	185.67 (7.31)	0.0 (0.0)
September	172.47 (6.79)	0.0 (0.0)
October	81.53 (3.21)	0.0 (0.0)
November	82.80 (3.26)	Trace
December	96.01 (3.78)	15.2 (0.6)
Annual	1449.58 (57.07)	53.3 (2.1)

Reference: NOAA, 2004a.

Table 3.6-3. Wind Frequency Distribution for Wilmington International Airport

Wilmington International Airport Latitude: 34.271 N
Period of Record: 1990–2006 Longitude: 77.903 W

Direction (From)	Number of Occurrences	Frequency %
North	15,374	10.3
North-Northeast	13,847	9.3
Northeast	10,189	6.8
East-Northeast	6,313	4.2
East	7,805	5.2
East-Southeast	5,159	3.5
Southeast	5,351	3.6
South-Southeast	6,253	4.2
South	12,206	8.2
South-Southwest	14,197	9.5
Southwest	13,833	9.3
West-Southwest	10,050	6.7
West	10,138	6.8
West-Northwest	5,555	3.7
Northwest	6,611	4.4
North-Northwest	6,691	4.5
Calm	24,230	16.2
Missing	6,112	4.1
Total	149,303	100.0

References: Lakes Environmental, 2006; NOAA, 2005b.

Table 3.6-4. Pasquill-Gifford Stability Classes

Surface (10 m) Wind Speed (m/second)	Daytime			Nighttime	
	Incoming Solar Radiation			Thin Overcast or ≥ 4/8 Low Cloud	≤ 3/8 Cloud Cover
	Strong	Moderate	Slight		
< 2	A	A-B	B	F[a]	F[a]
2-3	A-B	B	C	E	F
3-5	B	B-C	C	D	E
5-6	C	C-D	D	D	D
>6	C	D	D	D	D

Note: Class A is most unstable, Class D is Neutral, Class F is most stable.
[a] Class F for wind speed of <2 m/s occurs in rural areas only.
Reference: Turner, 1970.

Table 3.6-5. Wind Direction and Speed Frequency Distribution in Hours for All Stability Classes

Wilmington International Airport 5-Year Annual Joint Frequency Distribution
All Stability Classes Combined
Units are hours of measurement occurrences from Jan. 1, 1988 – Dec. 31, 1992
Calm Wind Occurrences: 4493 hours

	Wind Speed m/s (mph)						
Direction	**0.4-1.3 (1-3)**	**1.8-3.1 (4-7)**	**3.6-5.4 (8-12)**	**5.8-8.0 (13-18)**	**8.5-10.7 (19-24)**	**> 10.7 (24)**	**Total**
North	442	1,435	1,278	491	24	0	3,670
North-Northeast	157	1,025	1,321	592	21	1	3,117
Northeast	197	1,004	1,188	353	6	2	2,750
East-Northeast	205	807	665	195	2	2	1,876
East	320	681	742	391	12	9	2,155
East-Southeast	198	442	591	151	0	1	1,383
Southeast	203	558	663	189	10	1	1,624
South-Southeast	181	591	754	259	9	4	1,798
South	275	1,093	1,024	511	20	1	2,924
South-Southwest	211	851	1,240	872	69	5	3,248
Southwest	234	1,132	1,641	883	82	5	3,977
West-Southwest	212	1,263	1,265	335	16	1	3,092
West	207	1,151	1,073	422	35	4	2,892
West-Northwest	121	528	556	287	13	0	1,505
Northwest	134	535	651	313	17	1	1,651
North-Northwest	189	598	568	320	15	1	1,691
TOTAL	3,486	13,694	15,220	6,564	351	38	39,353

Reference: WebMET.com, 2002.

Table 3.6-6. Wind Direction and Speed Frequency Distribution in Hours for Stability Class A

Wilmington International Airport 5-Year Annual Joint Frequency Distribution
Stability Class A
Units are hours of measurement occurrences from Jan. 1, 1988 – Dec. 31, 1992
Calm Wind Occurrences: 35 hours

Direction	Wind Speed m/s (mph)						Total
	0.4-1.3 (1-3)	1.8-3.1 (4-7)	3.6-5.4 (8-12)	5.8-8.0 (13-18)	8.5-10.7 (19-24)	> 10.7 (24)	
North	6	24	0	0	0	0	30
North-Northeast	2	18	0	0	0	0	20
Northeast	2	6	0	0	0	0	8
East-Northeast	2	15	0	0	0	0	17
East	3	11	0	0	0	0	14
East-Southeast	2	9	0	0	0	0	11
Southeast	4	7	0	0	0	0	11
South-Southeast	6	5	0	0	0	0	11
South	3	17	0	0	0	0	20
South-Southwest	4	25	0	0	0	0	29
Southwest	3	29	0	0	0	0	32
West-Southwest	2	31	0	0	0	0	33
West	3	29	0	0	0	0	32
West-Northwest	3	18	0	0	0	0	21
Northwest	3	14	0	0	0	0	17
North-Northwest	4	13	0	0	0	0	17
TOTAL	52	271	0	0	0	0	323

Reference: WebMET.com, 2002.

Table 3.6-7. Wind Direction and Speed Frequency Distribution in Hours for Stability Class B

Wilmington International Airport 5-Year Annual Joint Frequency Distribution
Stability Class B
Units are hours of measurement occurrences from Jan. 1, 1988 – Dec. 31, 1992
Calm Wind Occurrences: 224 hours

Direction	Wind Speed m/s (mph)						Total
	0.4-1.3 (1-3)	1.8-3.1 (4-7)	3.6-5.4 (8-12)	5.8-8.0 (13-18)	8.5-10.7 (19-24)	> 10.7 (24)	
North	53	101	67	0	0	0	221
North-Northeast	20	65	52	0	0	0	137
Northeast	28	59	45	0	0	0	132
East-Northeast	22	43	32	0	0	0	97
East	36	67	68	0	0	0	171
East-Southeast	17	35	86	0	0	0	138
Southeast	16	54	79	0	0	0	149
South-Southeast	18	43	67	0	0	0	128
South	23	61	59	0	0	0	143
South-Southwest	17	49	61	0	0	0	127
Southwest	32	88	104	0	0	0	224
West-Southwest	29	126	142	0	0	0	297
West	30	123	145	0	0	0	298
West-Northwest	24	74	78	0	0	0	176
Northwest	24	77	44	0	0	0	145
North-Northwest	22	62	47	0	0	0	131
TOTAL	411	1,127	1,176	0	0	0	2,714

Reference: WebMET.com, 2002.

Table 3.6-8. Wind Direction and Speed Frequency Distribution in Hours for Stability Class C

Wilmington International Airport 5-Year Annual Joint Frequency Distribution
Stability Class C
Units are hours of measurement occurrences from Jan. 1, 1988 – Dec. 31, 1992
Calm Wind Occurrences: 161 hours

Direction	Wind Speed m/s (mph)						Total
	0.4-1.3 (1-3)	1.8-3.1 (4-7)	3.6-5.4 (8-12)	5.8-8.0 (13-18)	8.5-10.7 (19-24)	> 10.7 (24)	
North	16	143	262	31	0	0	452
North-Northeast	5	104	198	31	0	0	338
Northeast	16	85	215	24	0	0	340
East-Northeast	14	78	155	20	0	0	267
East	14	67	195	61	1	0	338
East-Southeast	9	59	226	38	0	0	332
Southeast	13	63	292	40	0	0	408
South-Southeast	13	63	291	46	0	0	413
South	14	71	249	54	0	0	388
South-Southwest	7	53	195	62	2	0	319
Southwest	15	79	288	82	4	0	468
West-Southwest	10	148	345	53	0	0	556
West	15	144	327	64	0	0	550
West-Northwest	10	79	140	25	0	0	254
Northwest	5	64	111	23	0	0	203
North-Northwest	7	85	124	19	0	0	235
TOTAL	183	1,385	3,613	673	7	0	5,861

Reference: WebMET.com, 2002.

Table 3.6-9. Wind Direction and Speed Frequency Distribution in Hours for Stability Class D

Wilmington International Airport 5-Year Annual Joint Frequency Distribution
Stability Class D
Units are hours of measurement occurrences from Jan. 1, 1988 – Dec. 31, 1992
Calm Wind Occurrences: 272 hours

Direction	Wind Speed m/s (mph)						Total
	0.4-1.3 (1-3)	1.8-3.1 (4-7)	3.6-5.4 (8-12)	5.8-8.0 (13-18)	8.5-10.7 (19-24)	> 10.7 (24)	
North	55	457	731	460	24	0	1,727
North-Northeast	29	281	805	561	21	1	1,698
Northeast	26	298	710	329	6	2	1,371
East-Northeast	24	233	408	175	2	2	844
East	42	205	394	330	11	9	991
East-Southeast	20	144	252	113	0	1	530
Southeast	18	170	256	149	10	1	604
South-Southeast	20	149	344	213	9	4	739
South	34	241	597	457	20	1	1,350
South-Southwest	15	156	693	810	67	5	1,746
Southwest	16	172	766	801	78	5	1,838
West-Southwest	24	190	472	282	16	1	985
West	18	227	401	358	35	4	1,043
West-Northwest	16	142	211	262	13	0	644
Northwest	20	133	289	290	17	1	750
North-Northwest	26	183	274	301	15	1	800
TOTAL	403	3,381	7,603	5,891	344	38	17,660

Reference: WebMET.com, 2002.

Table 3.6-10. Wind Direction and Speed Frequency Distribution in Hours for Stability Class E

Wilmington International Airport 5-Year Annual Joint Frequency Distribution
Stability Class E
Units are hours of measurement occurrences from Jan. 1, 1988 – Dec. 31, 1992
Calm Wind Occurrences: 0 hours

	Wind Speed m/s (mph)						
Direction	**0.4-1.3 (1-3)**	**1.8-3.1 (4-7)**	**3.6-5.4 (8-12)**	**5.8-8.0 (13-18)**	**8.5-10.7 (19-24)**	**> 10.7 (24)**	**Total**
North	0	246	218	0	0	0	464
North-Northeast	0	211	266	0	0	0	477
Northeast	0	214	218	0	0	0	432
East-Northeast	0	188	70	0	0	0	258
East	0	183	85	0	0	0	268
East-Southeast	0	118	27	0	0	0	145
Southeast	0	163	36	0	0	0	199
South-Southeast	0	189	52	0	0	0	241
South	0	384	119	0	0	0	503
South-Southwest	0	298	291	0	0	0	589
Southwest	0	335	483	0	0	0	818
West-Southwest	0	291	306	0	0	0	597
West	0	198	200	0	0	0	398
West-Northwest	0	76	127	0	0	0	203
Northwest	0	77	207	0	0	0	284
North-Northwest	0	72	123	0	0	0	195
TOTAL	0	3,243	2,828	0	0	0	6,071

Reference: WebMET.com, 2002.

Table 3.6-11. Wind Direction and Speed Frequency Distribution in Hours for Stability Class F

Wilmington International Airport 5-Year Annual Joint Frequency Distribution
Stability Class F
Units are hours of measurement occurrences from Jan. 1, 1988 – Dec. 31, 1992
Calm Wind Occurrences: 3801 hours

Direction	Wind Speed m/s (mph)						Total
	0.4-1.3 (1-3)	1.8-3.1 (4-7)	3.6-5.4 (8-12)	5.8-8.0 (13-18)	8.5-10.7 (19-24)	> 10.7 (24)	
North	312	464	0	0	0	0	776
North-Northeast	101	346	0	0	0	0	447
Northeast	125	342	0	0	0	0	467
East-Northeast	143	250	0	0	0	0	393
East	225	148	0	0	0	0	373
East-Southeast	150	77	0	0	0	0	227
Southeast	152	101	0	0	0	0	253
South-Southeast	124	142	0	0	0	0	266
South	201	319	0	0	0	0	520
South-Southwest	168	270	0	0	0	0	438
Southwest	168	429	0	0	0	0	597
West-Southwest	147	477	0	0	0	0	624
West	141	430	0	0	0	0	571
West-Northwest	68	139	0	0	0	0	207
Northwest	82	170	0	0	0	0	252
North-Northwest	130	183	0	0	0	0	313
TOTAL	2,437	4,287	0	0	0	0	6,724

Reference: WebMET.com, 2002.

Table 3.6-12. Extreme Annual and Monthly Temperatures for Wilmington International Airport

Wilmington International Airport Latitude: 34.271 N
Period of Record: 1971–2000 Longitude: 77.903 W

Month	Extreme Maximum °C (°F)	Extreme Minimum °C (°F)
January	27.8 (82)	-15.0 (5)
February	29.4 (85)	-12.2 (10)
March	31.7 (89)	-12.8 (9)
April	35.0 (95)	-1.1 (30)
May	36.7 (98)	1.7 (35)
June	40.0 (104)	8.9 (48)
July	38.9 (102)	12.8 (55)
August	39.4 (103)	12.8 (55)
September	36.7 (98)	6.7 (44)
October	35.0 (95)	-2.8 (27)
November	30.6 (87)	-8.9 (16)
December	27.8 (82)	-17.8 (0)
Annual	40.0 (104)	-17.8 (0)

Reference: NOAA, 2004a.

Table 3.6-13. Extreme Annual and Monthly Precipitation for Wilmington International Airport

Wilmington International Airport | Latitude: 34.271 N
Period of Record: 1971–2000 | Longitude: 77.903 W

Month	Maximum Precipitation mm (in)	Minimum Precipitation mm (in)	24 Hour Maximum Precipitation mm (in)
January	259.59 (10.22)	27.69 (1.09)	76.96 (3.03)
February	284.99 (11.22)	25.65 (1.01)	85.60 (3.37)
March	210.06 (8.27)	42.16 (1.66)	130.05 (5.12)
April	193.04 (7.60)	4.06 (0.16)	88.90 (3.50)
May	207.26 (8.16)	24.13 (0.95)	127.51 (5.02)
June	323.60 (12.74)	22.61 (0.89)	195.33 (7.69)
July	368.05 (14.49)	71.63 (2.82)	164.85 (6.49)
August	357.12 (14.06)	62.99 (2.48)	171.96 (6.77)
September	594.61 (23.41)	17.78 (0.70)	339.85 (13.38)
October	236.47 (9.31)	9.65 (0.38)	139.70 (5.50)
November	199.90 (7.87)	12.45 (0.49)	103.12 (4.06)
December	179.32 (7.06)	14.99 (0.59)	101.35 (3.99)
Annual	1691.6 (66.6)[a]	937.3 (36.9)[a]	339.85 (13.38)

Reference: NOAA, 2004a.

[a] NOAA, 1996 (period of record 1948–1995).

Table 3.6-14. National Ambient Air Quality Standards (NAAQS)

Criteria Air Pollutant		National Ambient Air Quality Standards		
		Averaging Time	**Primary Standard**	**Secondary Standard**
Carbon monoxide (CO)		8-hour [a]	9 ppm (10 mg/m^3)	None
		1-hour [a]	35 ppm (40 mg/m^3)	None
Lead (Pb)		Quarterly average (3-month)	1.5 µg/m^3	Same as primary
Nitrogen dioxide (NO_2)		Annual average (arithmetic mean)	0.053 ppm (100 µg/m^3)	Same as primary
Particulate matter (PM)	PM_{10} [b]	24-hour [c]	150 µg/m^3	Same as primary
	$PM_{2\ 5}$	Annual [d] (arithmetic mean)	15.0 µg/m^3	Same as primary
		24-hour [e]	35 µg/m^3	Same as primary
Ozone (O_3)		8-hour [f]	0.08 ppm	Same as primary
		1-hour [g] (applies only Early Action Compact [EAC] in areas) [h]	0.12 ppm	Same as primary
Sulfur dioxide (SO_2)		Annual (arithmetic mean)	0.03 ppm	-------
		24-hour [a]	0.14 ppm	-------
		3-hour [a]	-------	0.5 ppm (1,300 µg/m^3)

Reference: U.S. Environmental Protection Agency (2007b).

Notes:

[a] Not to be exceeded more than once per year.

[b] Annual PM_{10} NAAQS revoked in 2006 because of a lack of evidence linking health problems to long-term exposure to coarse particle pollution.

[c] Not to be exceeded more than once per year on average over 3 years.

[d] To attain this standard, the 3-year average of the weighted annual average $PM_{2\ 5}$ concentrations from single or multiple community-oriented monitors must not exceed 15 µg/m^3.

[e] To attain this standard, the 3-year average of the 98th percentile of 24-hour average $PM_{2\ 5}$ concentrations at each population-oriented monitor within an area must not exceed 35 µg/m^3.

[f] To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.

[g] To attain this standard, the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm must be ≤1 ppm as determined by the EPA-specified method.

[h] One-hour ozone NAAQS revoked in all areas except for 8-hour ozone nonattainment EAC areas.

Table 3.6-15. State of North Carolina Ambient Air Quality Standards (NAAQS)

Criteria Air Pollutant		Ambient Air Quality Standards	
		Averaging Time	Standard
Carbon monoxide (CO)		8-hour	Same as primary NAAQS (see **Table 3.6-14**)
		1-hour	Same as primary NAAQS (see **Table 3.6-14**)
Lead (Pb)		Quarterly	Same as primary NAAQS (see **Table 3.6-14**)
Nitrogen dioxide (NO_2)		Annual	Same as primary NAAQS (see **Table 3.6-14**)
Particulate matter (PM)	TSP	Annual (geometric mean)	75 µg/m^3
		24-hour [a]	150 µg/m^3
	PM_{10}	Annual (arithmetic mean)	50 µg/m^3
		24-hour [b]	Same level as primary NAAQS (150 µg/m^3) but attainment determination basis is different under North Carolina regulations [b]
	$PM_{2.5}$	Annual	Same as primary NAAQS (see **Table 3.6-14**)
		24-hour [c]	65 µg/m^3
Ozone (O_3)		8-hour	Same as primary NAAQS (see **Table 3.6-14**)
		1-hour [d]	Same as primary NAAQS (see **Table 3.6-14**)
Sulfur dioxide (SO_2)		Annual	Same as primary NAAQS (see **Table 3.6-14**)
		24-hour	Same as primary NAAQS (see **Table 3.6-14**)
		3-hour	Same as secondary NAAQS (see **Table 3.6-14**)

Reference: 15A NCAC 02D .0400.

[a] Not to be exceeded more than once per year.

[b] To attain this standard, 99th percentile 24-hour concentration must be less than or equal to 150 µg/m^3.

[c] To attain this standard, the 3-year average of the 98th percentile of 24-hour average $PM_{2.5}$ concentrations at each population-oriented monitor within an area must not exceed 65 µg/m^3.

[d] Applies only to the following NC counties: Alamance, Alexander, Burke (part), Caswell, Caldwell (part), Catawba, Cumberland, Davidson, Davie, Forsyth, Guilford, Randolph, and Rockingham.

Table 3.6-16. NC DAQ Ambient Air Quality Monitoring Stations Located in New Hanover County, NC

Ambient Air Quality Monitoring Station			Pollutants Monitored	Years of Data Collection
NC DAQ Station Name[a]	Address	Location		
Castle Hayne	6028 Holly Shelter Road Castle Hayne, NC	Lat. 34.364167 Long. -77.838611	$PM_{2.5}$ O_3 SO_2 [b]	1979–Present
New Hanover County [a, c]	2400 U.S. Highway 421 N Wilmington, NC	Lat 34.268403 Long. -77.956529	SO_2	1991–Present
Oleander & College [d]	Intersection of Oleander Drive and College Road Wilmington, NC	Lat. 34.210473 Long. -77.886096	CO	1997–2004
Battleship [e]	No. 1 Battleship Drive Wilmington, NC	Lat. 34.235556 Long. -77.955833	individual organic compounds[f]	2004–Present

Reference: NC DAQ (2007a, 2007c).

[a] Name commonly used in NC DAQ documents to refer to site location. Note that while one of the stations is referred to as the New Hanover County station, all of the monitoring stations listed in the table are in New Hanover County.

[b] Special purpose SO_2 monitor is operated at the Castle Hayne station January 1 to through December 31 every third year. This monitor was last operated at the Castle Hayne station in 2005 and is scheduled to operate next at the site in 2008.

[c] Monitoring station is located next to a sulfuric acid manufacturing facility in a unincorporated area of New Hanover County.

[d] Monitoring station shut down after 2004.

[e] Monitoring station is near the *USS North Carolina* memorial near the City of Wilmington downtown district.

[f] NC DAQ monitors for selected organic compounds from the EPA hazardous air pollutant (HAP) and NC DAQ toxic air pollutant (TAP) lists. HAPs and TAPs are not criteria air pollutants with ambient air quality standards and, therefore, are not listed on **Tables 3.6-14 and 3.6-15**.

Table 3.6-17. Comparison of Ambient Criteria Air Pollutant Monitoring Data Measured in New Hanover County, NC, to Ambient Air Quality Standards

Criteria Air Pollutant [a]	Ambient Air Quality Standard	Measurements at NC DAQ Monitoring Stations [b]					
		Data Format	Year 2002	Year 2003	Year 2004	Year 2005	Year 2006
Carbon monoxide (CO)	35 ppm (1-hr average)	2nd maximum 1-hr average	4.0 ppm	4.6 ppm	3.3 ppm	c	c
	9 ppm (8-hr average)	2nd maximum 8-hr average	2.7 ppm	2.9 ppm	2.3 ppm	c	c
Ozone (O_3)	0.12 ppm (1-hr average)	2nd maximum 1-hr average	0.091 ppm	0.086 ppm	0.081 ppm	0.088 ppm	0.085 ppm
	0.08 ppm (8-hr average)	4th maximum 8-hr. average	0.080 ppm	0.076 ppm	0.070 ppm	0.075 ppm	0.070 ppm
Particulate matter $PM_{2.5}$	35 $\mu g/m^3$ (NAAQS 24-hr average)	98th percentile 24-hr average	25 $\mu g/m^3$	18 $\mu g/m^3$	23 $\mu g/m^3$	25 $\mu g/m^3$	26 $\mu g/m^3$
	15.0 $\mu g/m^3$ (annual average)	Annual average	10.5 $\mu g/m^3$	9.2 $\mu g/m^3$	10.5 $\mu g/m^3$	10.3 $\mu g/m^3$	9.8 $\mu g/m^3$
Sulfur Dioxide (SO_2)[d]	0.14 ppm (24-hr average)	2nd maximum 24-hr average	0.040 ppm	0.046 ppm	0.022 ppm	0.022 ppm	0.030 ppm
	0.030 ppm (annual average)	Annual average	0.007 ppm	0.005 ppm	0.005 ppm	0.003 ppm	0.005 ppm

Reference: U.S. Environmental Protection Agency Air Quality System (AQS) database (U.S. EPA, 2007a).

[a] The NC DAQ does not monitor for NO_2 or lead at any of its sites in North Carolina because statewide attainment with applicable ambient air quality standards has been demonstrated.

[b] Measurements at the NC DAQ monitoring station(s) listed in **Table 3.6-16** and shown in **Figure 3.6-36,** with applicable pollutant monitors operating in the calendar year.

[c] Ambient CO monitoring discontinued after 2004.

[d] Measurement performed at the NC DAQ New Hanover County monitoring station.

Table 3.6-18. Ambient Hazardous/Toxic Air Pollutant Monitoring Data for the Battleship Monitoring Station, New Hanover County, NC

Hazardous/Toxic Air Pollutant with Detectable Results	Battleship Monitoring Station Measurements					
	Year 2004			Year 2005		
	4 samples			42 samples		
	Average (ppbv)	Standard Deviation	Percent Detects	Average (ppbv)	Standard Deviation	Percent Detects
Freon 12	0.582	0.059	100%	0.569	0.090	100%
Methyl chloride	Not analyzed			0.388	0.338	60%
1,3-Butadiene	1.142	1.945	50%	0.069	0.065	12%
Chloroethane	Not analyzed			0.318	0.350	45%
Ethanol	Not analyzed			4.727	6.372	50%
Freon 11	0.253	0.072	100%	0.417	0.031	95%
Acetone	Not analyzed			3.668	3.398	90%
Isopropyl alcohol	Not analyzed			0.126	0.489	2%
Methylene chloride	0.108	0.084	50%	0.110	0.070	71%
Freon 113	0.071	0.041	50%	0.082	0.036	90%
Carbon disulfide	0.051	0.002	25%	0.176	0.375	69%
Methyl ethyl ketone	Not analyzed			0.111	0.201	12%
Hexane	0.384	0.440	100%	0.129	0.190	50%
Ethyl acetate	Not analyzed			0.108	0.166	14%
Benzene	0.434	0.273	100%	0.240	0.115	100%
Carbon tetrachloride	0.068	0.031	50%	0.089	0.044	93%
Trichloroethylene	0.125	0.091	50%	0.140	0.107	71%
Heptane	0.100	0.099	25%	0.052	0.021	7%
Toluene	0.719	0.663	100%	0.328	0.329	100%
Ethylbenzene	0.107	0.067	50%	0.125	0.199	43%
m- and p-Xylene	1.201	0.884	100%	0.289	0.687	55%
Styrene	Not analyzed			0.158	0.134	48%
o-Xylene	0.166	0.134	50%	0.056	0.045	26%
1-ethyl-4-methylbenzene	0.070	0.034	25%	0.600	0.038	21%
1,3,5-Trimethylbenzene	Not analyzed			0.052	0.021	14%
1,2,4-Trimethylbenzene	Not analyzed			0.082	0.111	21%
Benzyl chloride	Not analyzed			0.079	0.105	7%
1,2,4-Trichlorobenzene	Not analyzed			0.050	---	ND

ND = not determined.

Reference: NC DAQ, 2006.

Table 3.6-19. Criteria Air Pollutant Stationary Source Emission Inventory for Brunswick, New Hanover, and Pender Counties

Criteria Air Pollutant	Total Reported 2005 Annual Emissions (ton/yr)			
	Brunswick County	New Hanover County	Pender County	Total for 3 Counties
CO	5,718	13,790	0	19,508
NO_x	2,581	10,005	0	12,586
PM (TSP)	246	2,057	11	2,314
PM_{10}	130	1,459	5	1,594
$PM_{2.5}$	64	722	1	787
SO_2	6,911	27,278	0	34,189
VOC	1,328	2,101	49	3,478

Reference: NC DAQ, 2005.

Table 3.6-20. Emission Inventory of Existing Major Stationary Sources in Brunswick, New Hanover, and Pender Counties Emitting ≥100 Ton/Year of One or More Criteria Air Pollutants

Major Source Facility [a]				Reported 2005 Annual Emissions	
Name	**Address**	**County**	**Type**	**Pollutant**	**Tons/yr**
Progress Energy Carolina	801 Sutton Steam Plant Road Wilmington, NC 28401	New Hanover	Coal-fired electric utility power plant	SO_2	21,146
				NOx	8,282
				PM_{TSP}	1,320
				PM_{10}	884
				$PM_{2.5}$	382
				CO	348
Invista S.A.R.L.	4600 U.S. Highway 421 N Wilmington, NC 28401	New Hanover	Industrial organic chemical manufacturer (dimethyl terephthalate and terephthalic acid)	CO	13,329
				SO_2	4,562
				VOC	976
				NOx	901
				PM_{TSP}	357
				PM_{10}	312
				$PM_{2.5}$	214.9
DAK Americas LLC	3500 Daniels Road NE Leland, NC 28451	Brunswick	Organic fiber manufacturer	CO	5,507
				SO_2	2,649
				NOx	1,186
				VOC	884
Primary Energy of North Carolina LLC	1281 Power House Drive SE Southport, NC 28461	Brunswick	Coal-fired combined heat and power facility	SO_2	4,216
				NOx	1,337
				CO	159
Southern States Chemical	2600 U.S. Highway 421 N Wilmington, NC 28402	New Hanover	Sulfuric acid manufacturer	SO_2	820
Oracle Packaging of Wilmington	2221 J.R. Kennedy Drive Wilmington, NC 28405	New Hanover	Paperboard box manufacturer	VOC	650
Elementis Chromium	5408 Holly Shelter Road Castle Hayne, NC 28429	New Hanover	Sodium dichromate and chromic acid manufacturer	SO_2	546
				NOx	420
				PM_{TSP}	141
				PM_{10}	103
Technical Coating International, Inc.	150 Backhoe Road Leland, NC 28451	Brunswick	Plastic container, coated packaging paper manufacturer	VOC	249
Corning Inc.	310 North College Road Wilmington, NC 28405	New Hanover	Optical fiber manufacturer	NOx	164
New Hanover County WASTEC	3002 U.S. Highway 421 N Wilmington, NC 28401	New Hanover	Refuse-fired combined heat and power facility	NOx	118

Reference: NC DAQ, 2005.

[a] The Wilmington Site is not classified as a major source of criteria air pollutants.

Table 3.6-21. Hazardous/Toxic Air Pollutant Stationary Source Emission Inventory for Brunswick, New Hanover, and Pender Counties

Hazardous/Toxic Air Pollutant	Total Reported 2005 Annual Emissions (lb/yr)			
	Brunswick County	New Hanover County	Pender County	Total for 3 Counties
Acetaldehyde	46,417	3,876	0	50,293
Acetic acid	751,674	399,487	0	1,151,161
Acetophenone	2	0	0	2
Acrolein	193	794	0	987
Allyl chloride	0	310	0	310
Ammonia (as NH_3)	5,974	47,946	0	53,919
Ammonium chromate VI (component of total SolCR6)	0	10	0	10
Antimony and compounds (SBC)	24	231	0	255
Antimony metal (component of total SBC)	0	99	0	99
Antimony unlisted compounds (component of total SBC)	24	132	0	156
Arsenic and compounds (ASC)	28	642	0	670
Arsenic compounds—arsine gas (component of total ASC)	0	35	0	35
Arsenic metal, elemental unreacted (component of total ASC)	13	3	0	16
Arsenic unlisted compounds (component of total ASC)	15	604	0	619
Benzene	15,533	9,230	0	24,763
Benzo(a)pyrene (Component total POM Title V)	0	0	0	0
Benzyl chloride	233	0	0	233
Beryllium and compounds (BEC)	4	40	0	44
Beryllium compound, unlisted (component of total BEC)	3	39	0	41
Beryllium metal (unreacted) (component of total BEC)	1	1	0	2
Biphenyl (component of total POM Title V)	1,044	2	0	1,047
Bromine	8,966	0	0	8,966
Bromoform	4	54	0	58
Butadiene, 1,3-	3	16	0	19
Butyl carbitol acetate (component of GLYET)	93	0	0	93
Cadmium and compounds (CDC)	9	100	0	109

(continued)

Table 3.6-21. Hazardous/Toxic Air Pollutant Stationary Source Emission Inventory for Brunswick, New Hanover, and Pender Counties (continued)

Hazardous/Toxic Air Pollutant	Total Reported 2005 Annual Emissions (lb/yr)			
	Brunswick County	New Hanover County	Pender County	Total for 3 Counties
Cadmium metal (elemental unreacted, component of total CDC)	7	32	0	38
Cadmium unlisted compounds (component of total CDC)	2	67	0	70
Cadmium acetate (component of total CDC)	0	0	0	0
Carbon disulfide	44	75	0	119
Chlorine	5	79,332	0	79,337
Chloroacetophenone, 2-	2	10	0	12
Chlorobenzene	2	0	0	2
Chloroform	6	0	0	6
Chromium and compounds (CRC)	38	20,259	1	20,298
Chromate VI bioavailable pigments (BioCR6) (component of and total CRC)	0	2	0	2
Chromic acid VI (component of SolCR6 and total CRC)	6	1	0	7
Chromium VI soluble chromate compounds (SolCR6)(component of total CRC)	6	7,878	0	7,883
Chromium VI non-specific compounds, (component of total CRC)	2	13	0	15
Chromium unlisted Compounds (component of total CRC)	30	12,366	1	12,397
Cobalt compounds	52	406	4	462
Cresol, p-	0	44	0	44
Cumene	1	0	0	1
Cyanide compounds (see also hydrogen cyanide)	834	3,445	0	4,279
Di(2-ethylhexyl)phthalate (DEHP)	17	123	0	140
Dibutylphthalate	5,449	16	0	5,65
Dichlorobenzene(p), 1,4-	0	10,303	0	10,303
Dichloropropene, 1,3-	0	2,321	0	2,321
Diethanolamine	72	0	0	72
Dimethyl phthalate	0	1,492	1	1,493
Dimethyl sulfate	16	66	0	82
Dinitrotoluene, 2,4-	0	7	0	7
Dioxane, 1,4-	8,396	3,279	0	11,675
Ethyl acetate	413,960	12,247	0	426,206
Ethyl benzene	442	628	0	1,070

(continued)

Table 3.6-21. Hazardous/Toxic Air Pollutant Stationary Source Emission Inventory for Brunswick, New Hanover, and Pender Counties (continued)

Hazardous/Toxic Air Pollutant	Total Reported 2005 Annual Emissions (lb/yr)			
	Brunswick County	New Hanover County	Pender County	Total for 3 Counties
Ethyl chloride (chloroethane)	4	18	0	22
Ethylene dibromide	0	89	0	89
Ethylene dichloride (1,2-dichloroethane)	13	0	0	13
Ethylene glycol	49,948	3,143	0	53,091
Ethylene glycol monoethyl ether (component of total GLYET)	27	0	0	27
Fluorides (sum of all fluoride compounds)	17,645	909	0	18,555
Formaldehyde	1,167	77,674	0	78,841
Furans—dibenzofurans (component total POM Title V)		20	0	20
Glycol ethers (GLYET) (total all individual glycol ethers)	3,888	1,698	0	5,586
Glycol ethers, unlisted (component of total GLYET)	3,768	1,698	0	5,466
Hexamethylene-1,6-diisocyanate	183	0	0	183
Hexane, n-	218	6,757	0	6,975
Hydrogen chloride (hydrochloric acid)	439,269	2,683,206	0	3,122,475
Hydrogen fluoride (hydrofluoric acid as mass of HF - component of total fluorides)	51,768	206,707	0	258,475
Hydrogen selenide	88	0	0	88
Isophorone	193	41	0	234
Lead and lead compounds (PBC)	24	660	0	684
Lead unlisted compounds (component of total PBC)	24	659	0	683
Manganese and compounds (MNC)	243	1,600	0	1,843
Manganese unlisted compounds (component of total MNC)	243	1,598	0	1,841
Mercury and compounds (HGC) (including mercury vapor)	62	211	0	273
Mercury unlisted compounds (component of total HGC)	62	210	0	272
Mercury, vapor (component of total HGC)	0	1	0	1
Methanol	107,405	958,850	0	1,066,254
Methyl bromide	133,416	1,310	5	134,731
Methyl chloride	177	38	0	214
Methyl chloroform	0	<1	0	<1

(continued)

Table 3.6-21. Hazardous/Toxic Air Pollutant Stationary Source Emission Inventory for Brunswick, New Hanover, and Pender Counties (continued)

Hazardous/Toxic Air Pollutant	Total Reported 2005 Annual Emissions (lb/yr)			
	Brunswick County	New Hanover County	Pender County	Total for 3 Counties
Methyl ethyl ketone	37,298	15,998	0	53,296
Methyl hydrazine	57	234	0	291
Methyl iodide	0	68	0	68
Methyl isobutyl ketone	827	1,900	0	2,727
Methyl methacrylate	31,000	0	1	31,001
Methyl tertiary butyl ether (MTBE)	3	7,607	0	7,610
Methylene chloride	74	175	0	249
Naphthalene (component of POM Title V)	154	338	0	492
Nickel and compounds (NIC)	425	6,015	19	6,459
Nickel unlisted compounds (component of total NIC)	424	5,922	0	6,347
Nickel metal (component of total NIC)	1	71	19	91
Nitric acid	0	620	0	620
Phenol	3	3,404	0	3,406
Phosphorus metal, yellow or white	47	26	0	72
Polycyclic organic matter (total includes PAH, dioxins, and regulatory agency historical compounds)	201	2,014	0	2,215
Polycyclic organic matter (POM Title V) (specific compounds listed by U.S. EPA for determination of title V major source status)	1,198	361	0	1,559
Potassium chromate VI (component of total CRC and SolCR6)	0	9	0	9
Potassium dichromate VI (component of total CRC and SolCR6)	0	<1	0	<1
Propionaldehyde	145	61	0	206
Selenium compounds	322	4,336	0	4,658
Sodium chromate (component of total CRC and SolCR6)		4,628	0	4,628
Sodium dichromate VI (component of total CRC and SolCR6)	0	3,230	0	3,230
Strontium chromate VI (component of total CRC and BioCR6)	0	<1	0	<1
Styrene	156,264	616	12,679	169,559
Sulfur trioxide	0	1,318	0	1,318
Sulfuric acid	90,955	75,291	0	166,247

(continued)

Table 3.6-21. Hazardous/Toxic Air Pollutant Stationary Source Emission Inventory for Brunswick, New Hanover, and Pender Counties (continued)

Hazardous/Toxic Air Pollutant	Total Reported 2005 Annual Emissions (lb/yr)			
	Brunswick County	New Hanover County	Pender County	Total for 3 Counties
Tetrachlorodibenzo-p-dioxin, 2,3,7,8- (component total POM Title V)	0	1	0	1
Toluene	14,774	53,609	0	68,384
Toluene diisocyanate, 2,4-	1	0	0	1
Vinyl acetate	1	298	0	299
Vinyl chloride	0	28	0	28
Xylene	4,564	2,064	1	6,629
Xylene, m-	4	0	0	4
Xylene, o-	2,586	70	0	2,656
Xylene, p-	80,394	344,683	0	425,077
Zinc chromate VI (component of BioCR6 and CRC)	0	1	0	1

Reference: NC DAQ, 2005.

Table 3.6-22. Existing Permitted Air Emission Sources for GE Aircraft Engine Components Manufacturing Operations at the Wilmington Site

Emission Source		Emission Control Device	
Permit ID	**Description**	**Permit ID**	**Description**
ES-1	Surface coating operation metal cleaning (ID No. SCO4)	CD-1	Packed-bed, cross flow-type, wet scrubber and mist eliminator (250 gal/min nominal liquid injection rate)
ES-2	Large parts cleaning system (ID No. AE1)	CD-2	Cross-flow wet scrubber (37.8 gal/min of water nominal injection rate)
ES-3	Large parts cleaning system (ID No. AE2)	CD-3	Cross-flow wet scrubber (37.8 gal/min of water nominal injection rate)
ES-4	Lubricant application booth (ID No. AE3) and curing oven (ID No. AE4)	N/A	N/A
ES-7	Coolant return fume hood (ID No. AE7)	CD-4	Mist eliminator system consisting of a centrifugal mist separator, a metal mesh coalescing filter (4.0 ft^2 of filter area nominal)
			Fabric filter (110 ft^2 of filter area nominal)
ES-8	Automated parts washer (ID No. AE8)	CD-5	Packed-tower wet scrubber (49.2 gal/min of water nominal injection rate)
N/A	VOC-containing material not in use (including waste material); spills; wipe rags; sponges, fabric, wood, paper products, and other absorbent materials; solvents used to clean supply lines and other coating equipment; mixing, blending, and manufacturing vats and containers; and spent cleaning solvent	N/A	Work practices

N/A = Not applicable.

Reference: NC DAQ, 2004a.

Table 3.6-23. Existing Permitted Air Emission Sources for GNF-A Nuclear Fuel Operations at the Wilmington Site

Emission Source		Emission Control Device	
Permit ID No.	**Description**	**Permit ID No.**	**Description**
ES-S13	Natural gas-fired multiple chambered incinerator ▪ Primary burner, 1.5 million Btu/hr minimum heat input ▪ Secondary burner, 2.5 million Btu/hr minimum heat input)	CD-S0004572	Flue gas quencher
		CD-S0004570	Venturi scrubber (100 gal/min water nominal injection rate)
		CD-S0004573	Countercurrent packed-bed scrubber (162 gal/min water nominal injection rate)
		CD-S0004605	Fabric filter (1,696 ft^2 of filter area)
		N/A	Incinerator charge rate restriction: cannot exceed 1,200 lb/hr of Type 0 waste and used oil.
ES-S37	100 ton capacity hydrated lime storage tank	CD-S0008064	Fabric filter (178 ft^2 of filter area, nominal)
ES-S07	Two steam jacketed wastewater treatment plant sludge (calcium fluoride) dryers	CD-S0002304	Impingement-type wet scrubber
		CD-S0002302	Cyclonic wet scrubber (4 gal/min of water nominal injection rate)
ES-FM12	Natural gas and/or No. 2 fuel oil-fired 350 horsepower boiler	N/A	Fuel sulfur content restriction—sulfur content of fuel oil cannot exceed 0.4% by weight
ES-FM14	Natural gas and/or No. 2 fuel oil-fired 350 horsepower boilers	N/A	Fuel sulfur content restriction—sulfur content of fuel oil cannot exceed 0.4% by weight
ES-S04	Natural gas and/or No. 2 fuel oil-fired 600 horsepower boiler	N/A	Fuel sulfur content restriction—sulfur content of fuel oil cannot exceed 0.4% by weight
ES-S35	Diesel fuel-fired 650 kW emergency generator	N/A	Operating restriction—cannot exceed 240 operating hours per 12-month period
ES-S39	Diesel fuel-fired load 1,250 KW shedding generator	N/A	Operating restriction—cannot exceed 1,320 operating hours per 12-month period
		N/A	Fuel sulfur content restriction—sulfur content of fuel oil cannot exceed 0.2% by weight
ES-S40	Diesel fuel-fired load 1,250 KW shedding generator	N/A	Operating restriction—cannot exceed 1,320 operating hours per 12-month period
		N/A	Fuel sulfur content restriction—sulfur content of fuel oil cannot exceed 0.2% by weight
ES-FM03	System 541X dissolver and liquid filter area exhaust	CD-H0007144	Impingement plate-type wet scrubber (762 gal/min of water nominal injection rate)
ES-FM04	System 546X FMOX conversion area exhaust		

(continued)

Table 3.6-23. Existing Permitted Air Emission Sources for GNF-A Nuclear Fuel Operations at the Wilmington Site (continued)

Emission Source		Emission Control Device	
Permit ID No.	**Description**	**Permit ID No.**	**Description**
ES-FM06	Process operation in the uranium waste recovery system	CD-H0008002 (Alt. ID No. S-965)	Cross flow gravity spray chamber (120 gal/min of water nominal injection rate)
		CD-S0007450	Condenser
		ID No. CD-S0008740	Venturi scrubber (30 gal/min of water nominal injection rate)
		CD-H0008000	Plate tower scrubber (3 gal/min of water nominal injection rate)
ES-FM15	Powder preparation system hammermills (9 mills) (ID Nos. W0008021-W0008026 and W0008028-W0008030)	CD-0008030	Fabric filter housing unit (7 ft^2 of filter area, nominal) ducted to the system 2020 exhaust
ES-H3001	Dry conversion process (DCP) lines (3 lines)	CD-CP06005 and CD-CP06006	HF recovery system including two countercurrent absorption columns HF emissions cannot exceed 0.63 lb/day and 0.064 lb/hr
ES-H3003	HF building emergency vent	CD-CP09010	Two-stage wet scrubber system (25 gal/min of water nominal injection rate)
ES-S58	Drum sand blasting unit	CD-H0002030	Filter housing unit (3,616 ft^2 filter area nominal injection rate)
ES-FM01	One combined exhaust from the north chemical area dust collection system (system 541) and the south chemical area dust collection system (system 546)	CD-H0007143	Spray-type wet scrubber (600 gal/min of water nominal injection rate)
ES-FC02	One FCO etch line	CD-M0007940	Cross flow wet scrubber (250 gal/min of water nominal)
ES-FC06	One grit blasting operation composed of two grit blasting units	CD-M0002200 and CD-M0002208	Two filter housing units (1,410 ft^2 filter area each, nominal)
N/A	All VOC-containing material not in use (including waste material); spills; wipe rags; sponges, fabric, wood, paper products, and other absorbent materials; solvents used to clean supply lines and other coating equipment; mixing, blending, and manufacturing vats and containers; and spent cleaning solvent	N/A	Work practices

N/A = Not applicable.

Reference: NC DAQ, 2004b.

Table 3.6-24. Criteria Air Pollutant Emission Inventory for Existing Stationary Sources at the Wilmington Site

Criteria Air Pollutant	Total Annual Emissions (ton/yr) [a]
CO	3.5
NOx	7.0
PM (TSP)	1.6
PM_{10}	1.6
$PM_{2\ 5}$	0.1
SO_2	0.2
VOC [b]	0.4

Reference: NC DAQ, 2007.

[a] Emission totals reported to and accepted by NC DAQ for compliance with current Site air permits. Based on site operations for the year 2004.

[b] VOCs meeting federal definition as photochemically reactive.

Table 3.6-25. Hazardous/Toxic Air Pollutant Emission Inventory for Existing Stationary Sources at the Wilmington Site

Hazardous/Toxic Air Pollutant	Total Annual Emissions (lb/yr) [a]
Acetaldehyde	1.1
Acrolein	0.1
Ammonia (as NH_3)	237
Benzene	1.5
Butadiene, 1,3-	0.1
Chromic acid (VI) (Component of SolCR6 and CRC)	0.002
Chromium (VI) soluble chromate compounds (component of CRC)	0.002
Chromium—all/total (including chromium (VI) categories, metal, and others)	0
Fluorides (sum of all fluoride compounds)	60
Formaldehyde	7
Hydrogen chloride (hydrochloric acid)	6
Hydrogen fluoride (hydrofluoric acid as mass of HF—component of fluorides)	32
Methyl ethyl ketone	1
Methylene diphenyl diisocyanate (MDI) (component of 83329/POMTV)	0.1
Nitric acid	393
Polycyclic organic matter (including PAH, dioxins; NC & AP 42 historic)	0.3
Polycyclic organic matter (Specific compounds listed by EPA for determination of title V major source status)	0.1
Sulfuric acid	4
Toluene	3
Trichloroethane, 1,1,2-	63
Xylene	0.4

Reference: NC DAQ, 2007.

[a] Emission totals reported to and accepted by NC DAQ for current Site air permits. Based on site operations for the year 2004.

Figures

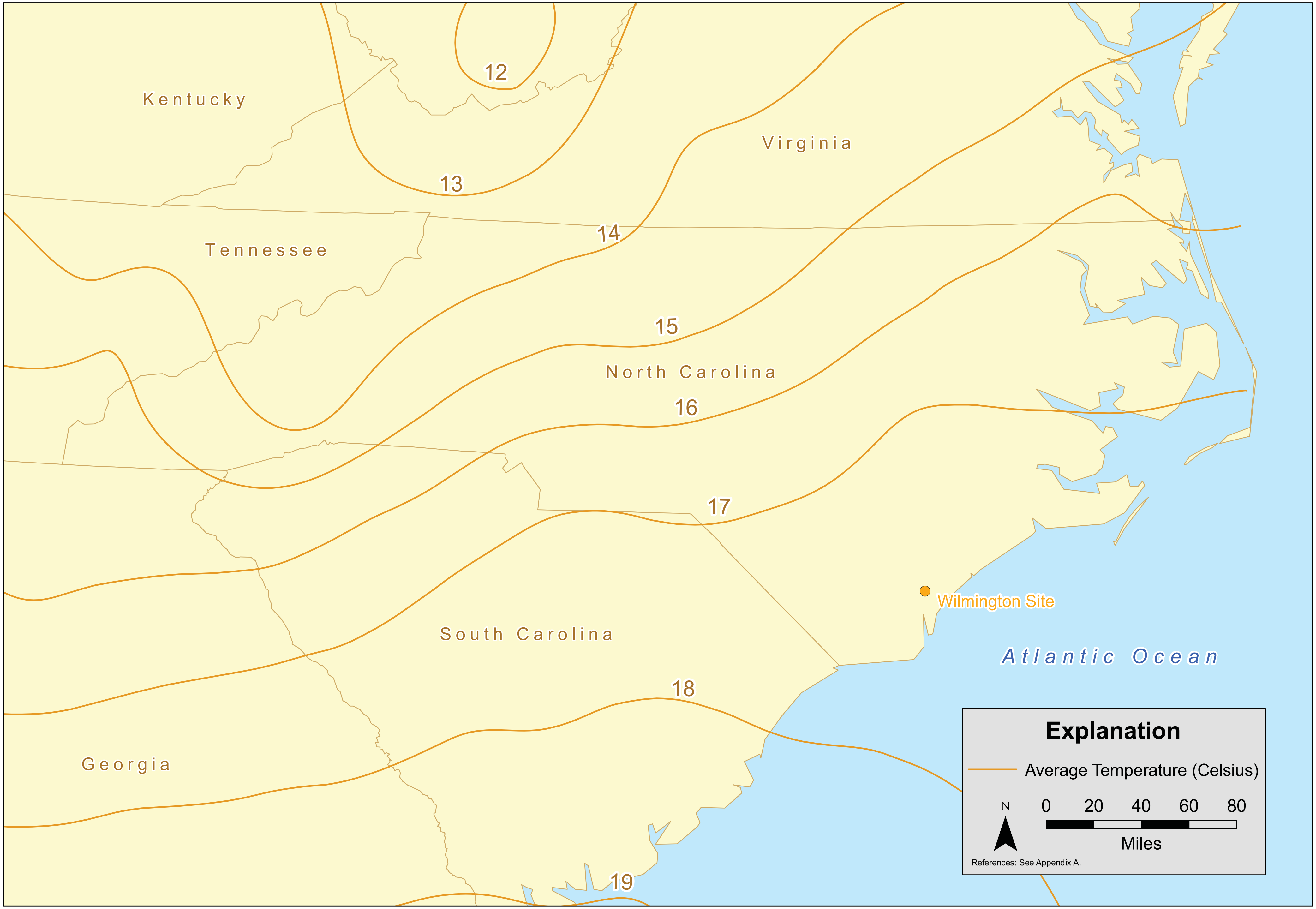


Figure 3.6-1. Mean annual average temperatures for North Carolina.

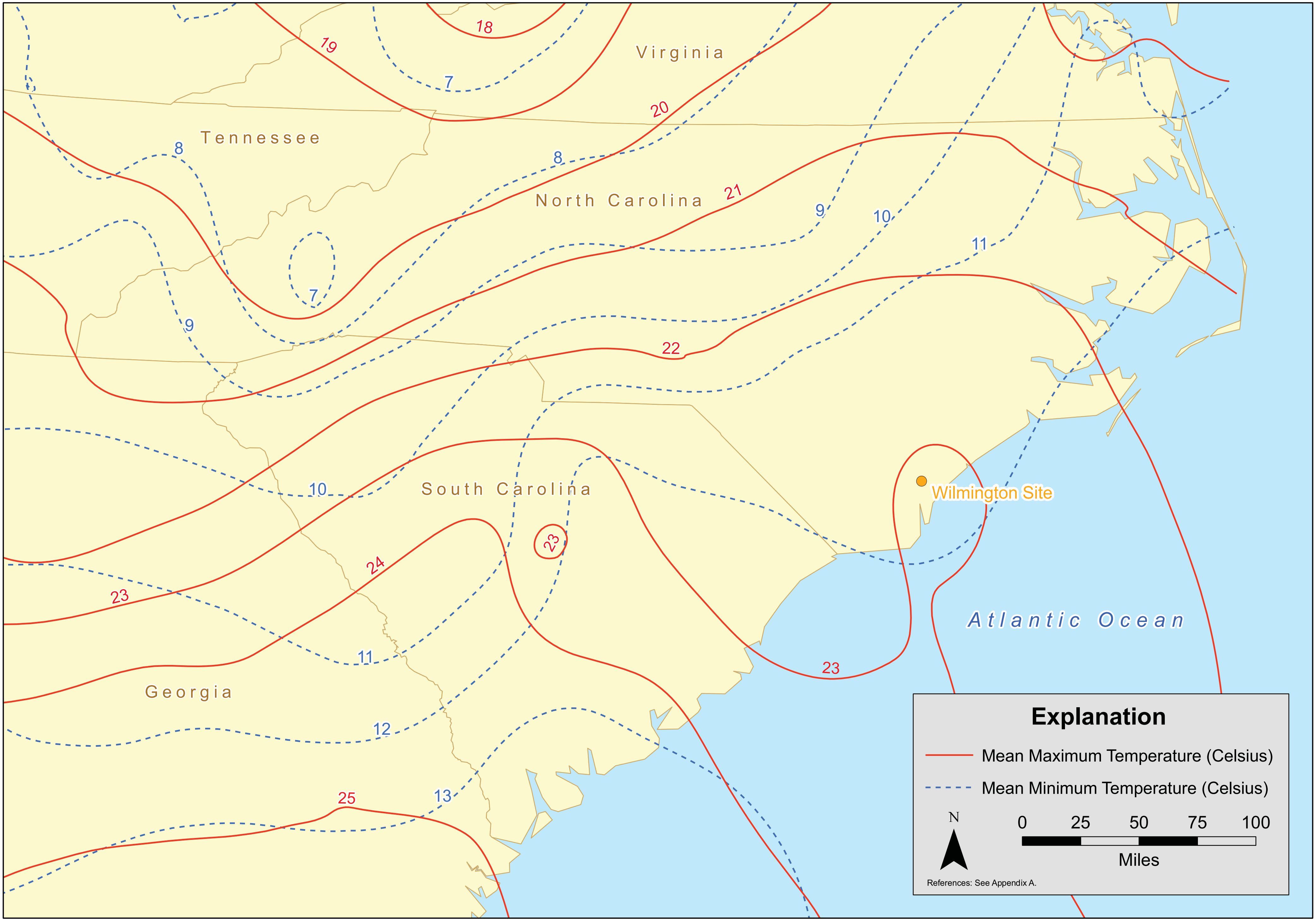
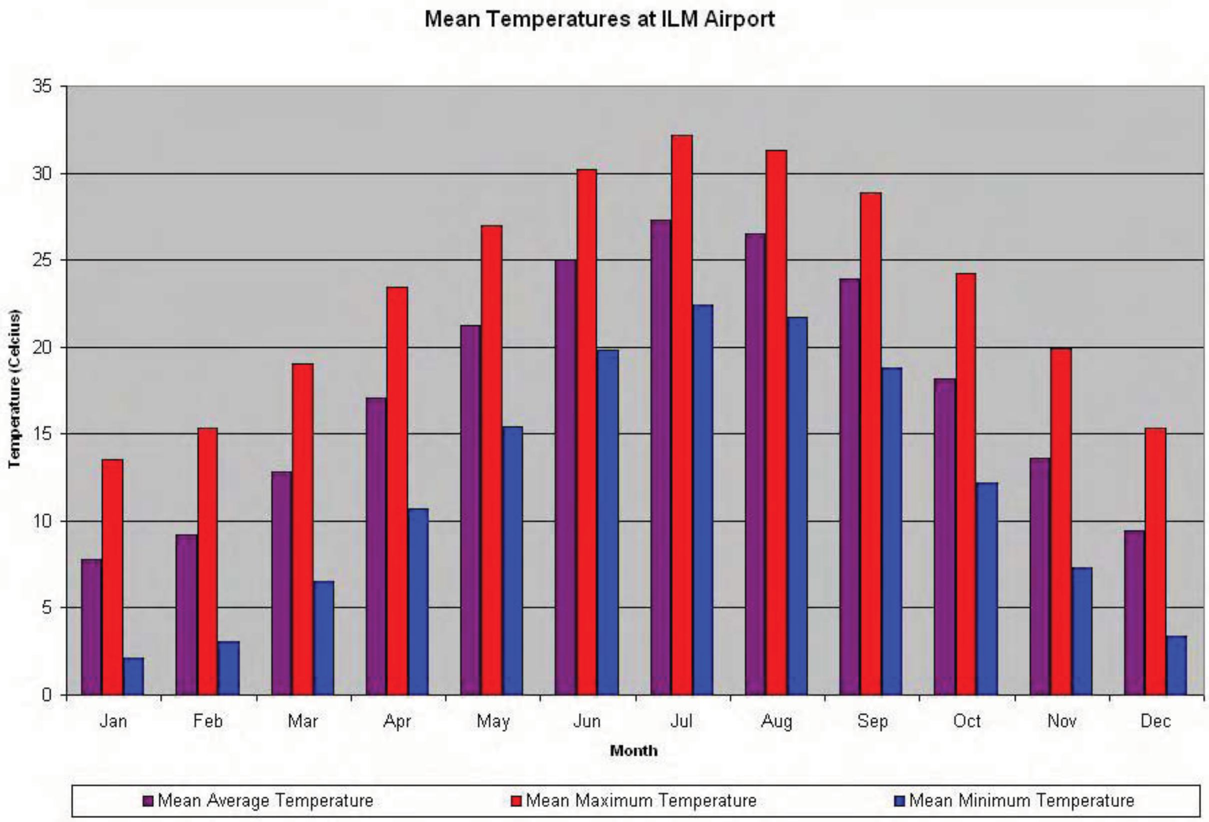


Figure 3.6-2. Mean annual maximum and minimum temperatures for North Carolina.



Reference: NOAA, 2004a.

Figure 3.6-3. Mean monthly temperature for Wilmington International Airport.

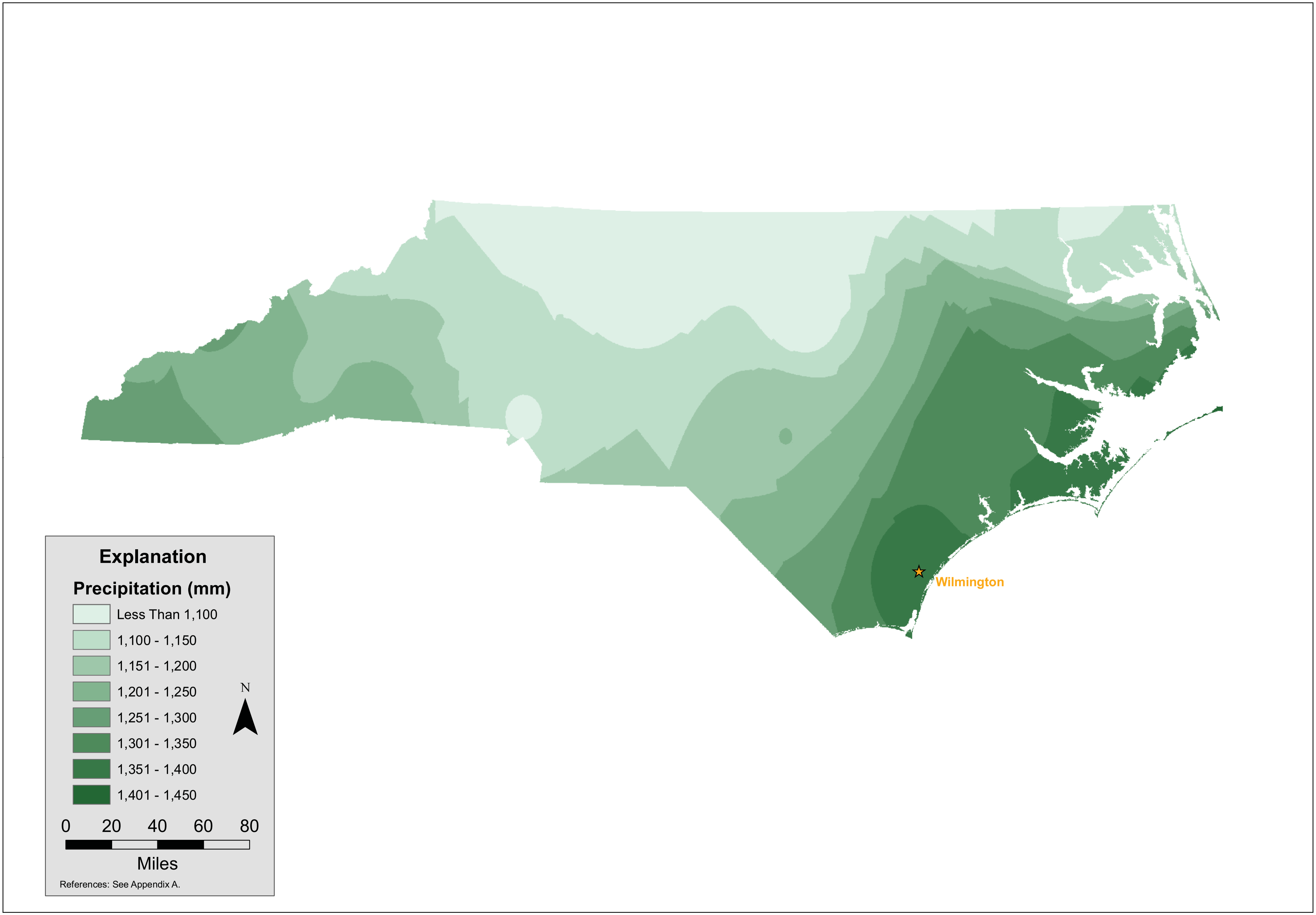
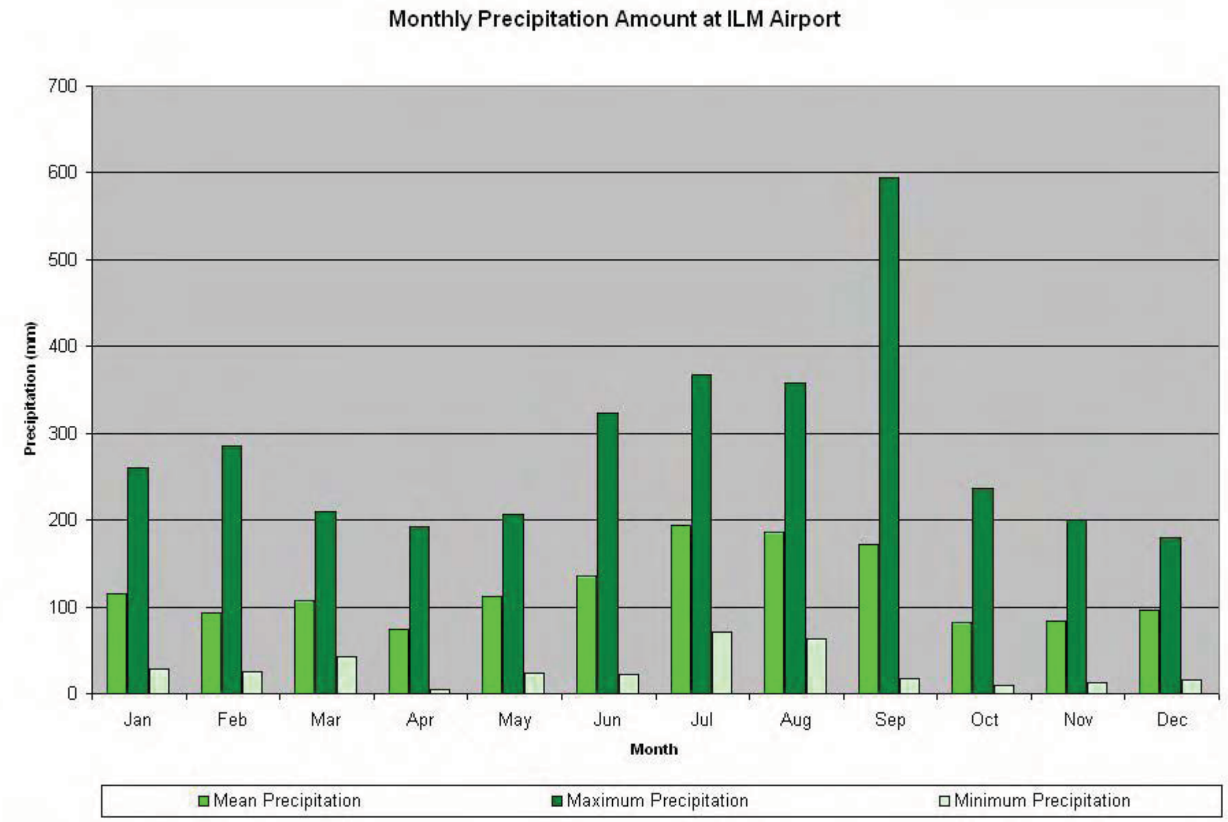


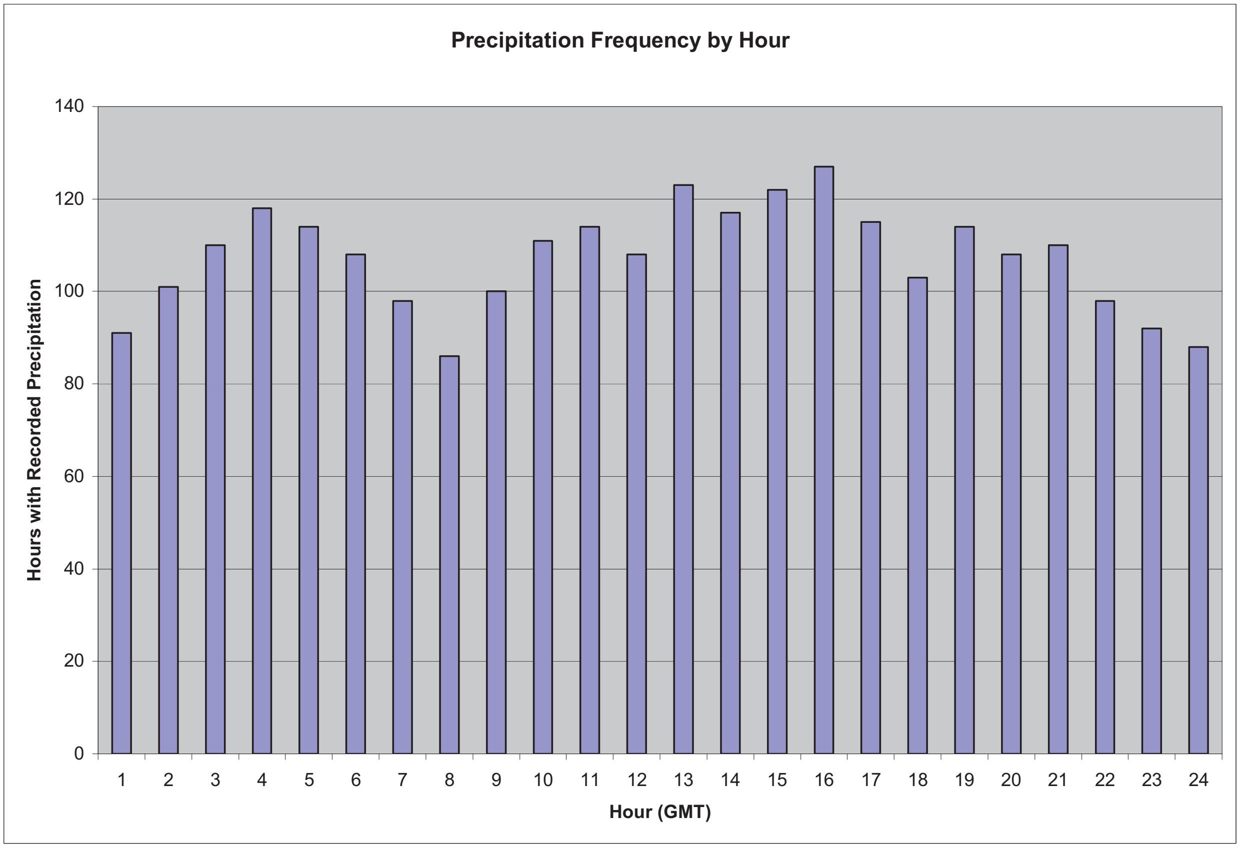
Figure 3.6-4. Mean annual precipitation for North Carolina.



Reference: NOAA, 2004a.

Note: Greenwich Mean Time (GMT) is 5 hours ahead of Eastern Standard Time, and 4 hours ahead of Eastern Daylight Time.

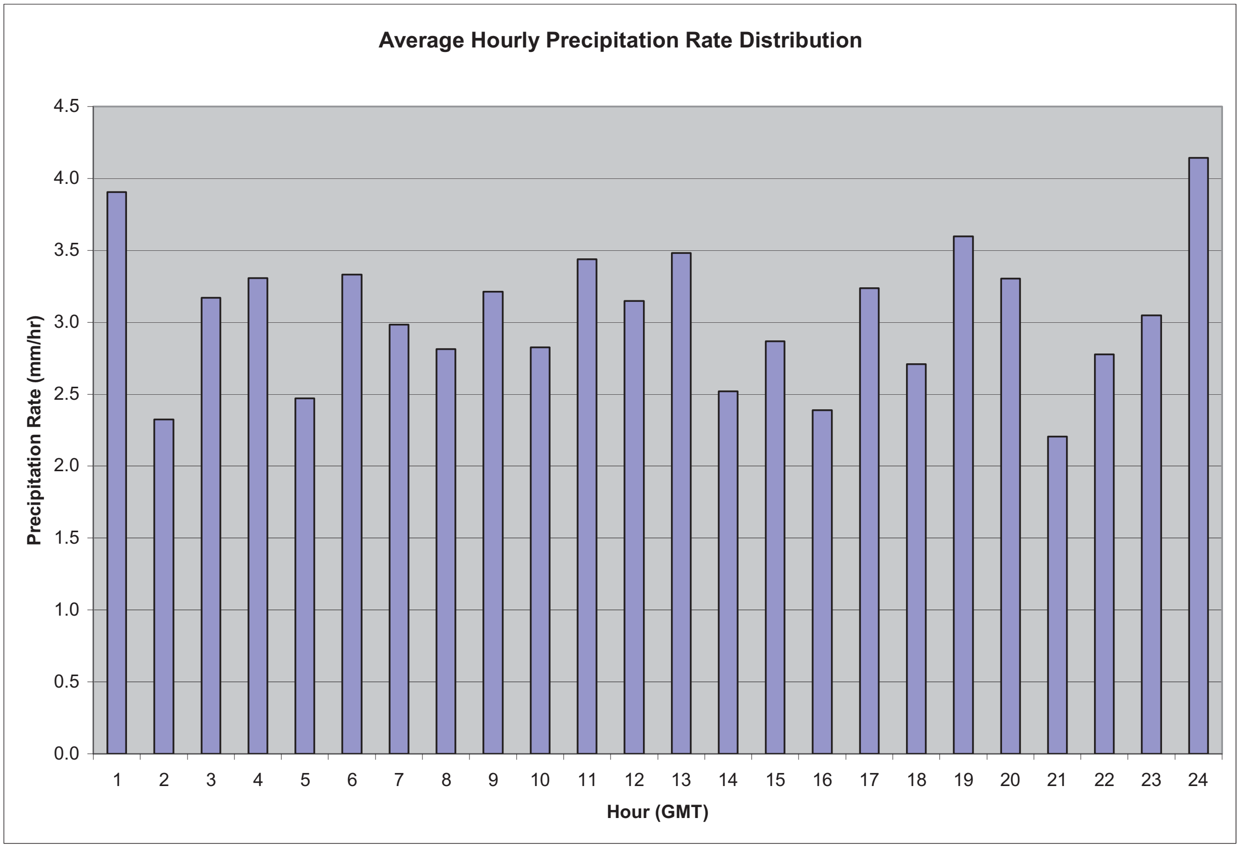
Figure 3.6-5. Monthly precipitation for Wilmington International Airport.



Reference: NOAA, 2005b.

Note: Greenwich Mean Time (GMT) is 5 hours ahead of Eastern Standard Time, and 4 hours ahead of Eastern Daylight Time.

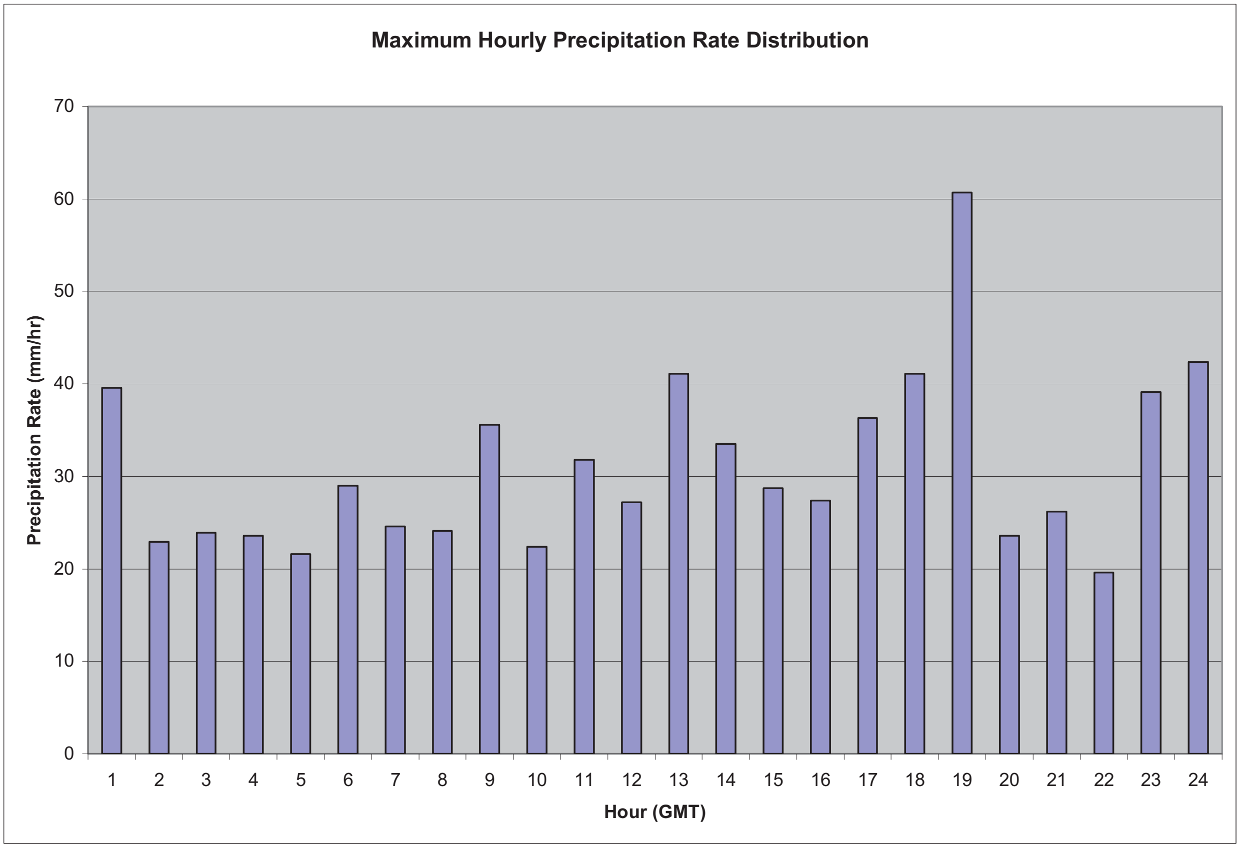
Figure 3.6-6. Frequency of precipitation for Wilmington International Airport for each hour of the day (1992–1996).



Reference: NOAA, 2005b.

Note: Greenwich Mean Time (GMT) is 5 hours ahead of Eastern Standard Time, and 4 hours ahead of Eastern Daylight Time.

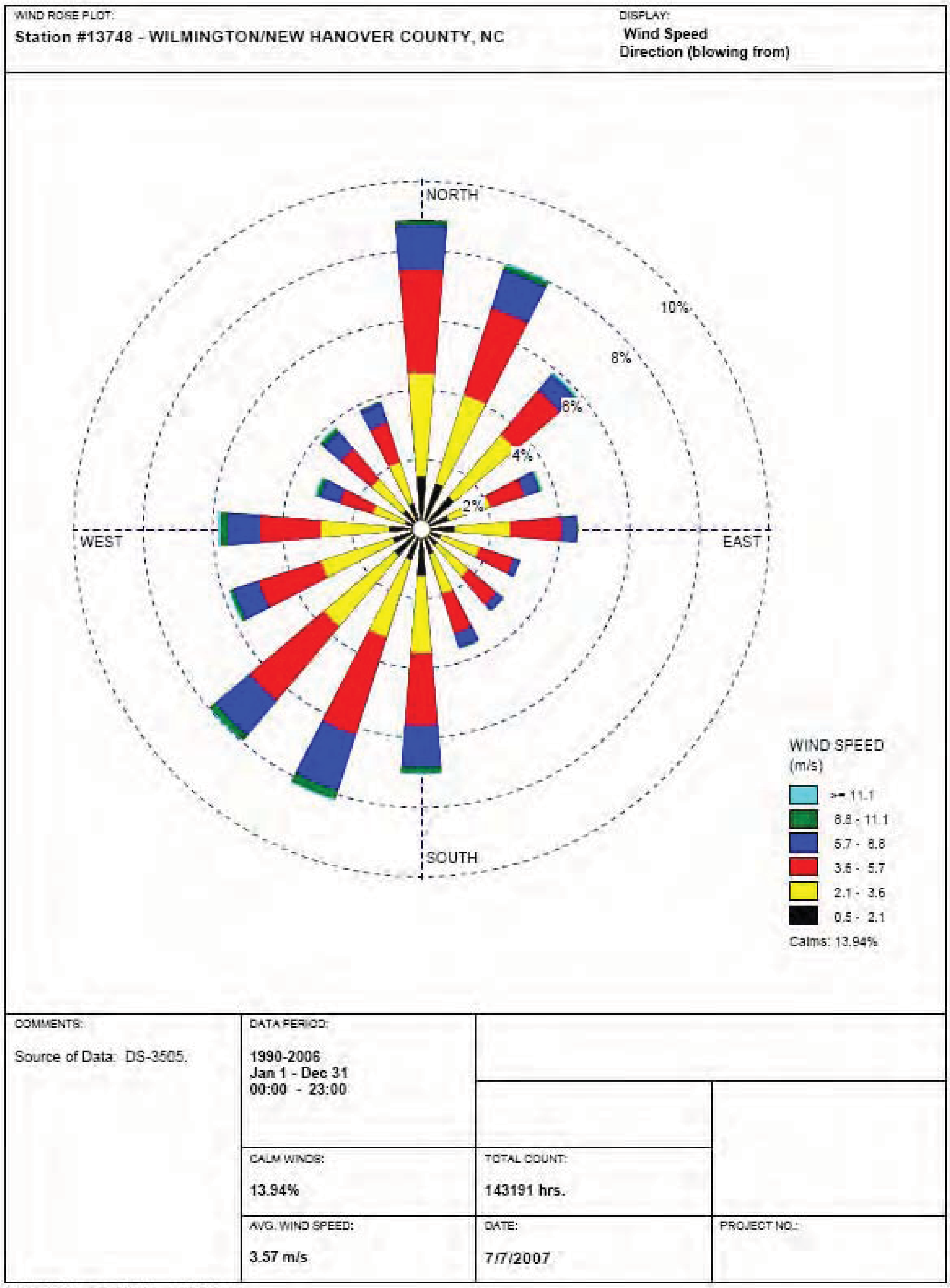
Figure 3.6-7. Distribution of average hourly precipitation rates for Wilmington International Airport (1992–1996).



Reference: NOAA, 2005b.

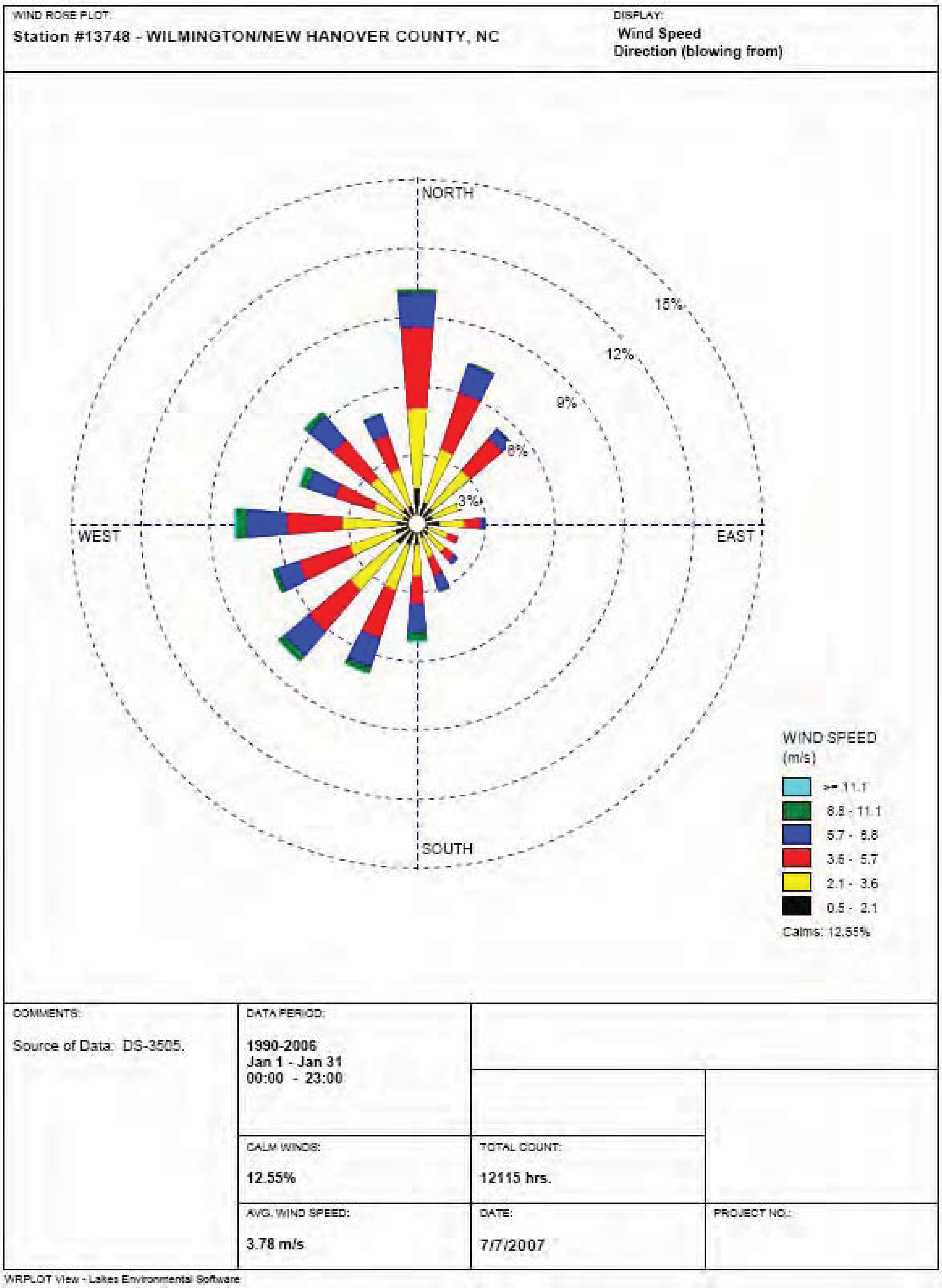
Note: Greenwich Mean Time (GMT) is 5 hours ahead of Eastern Standard Time, and 4 hours ahead of Eastern Daylight Time.

Figure 3.6-8. Distribution of maximum hourly precipitation rates for Wilmington International Airport (1992–1996).



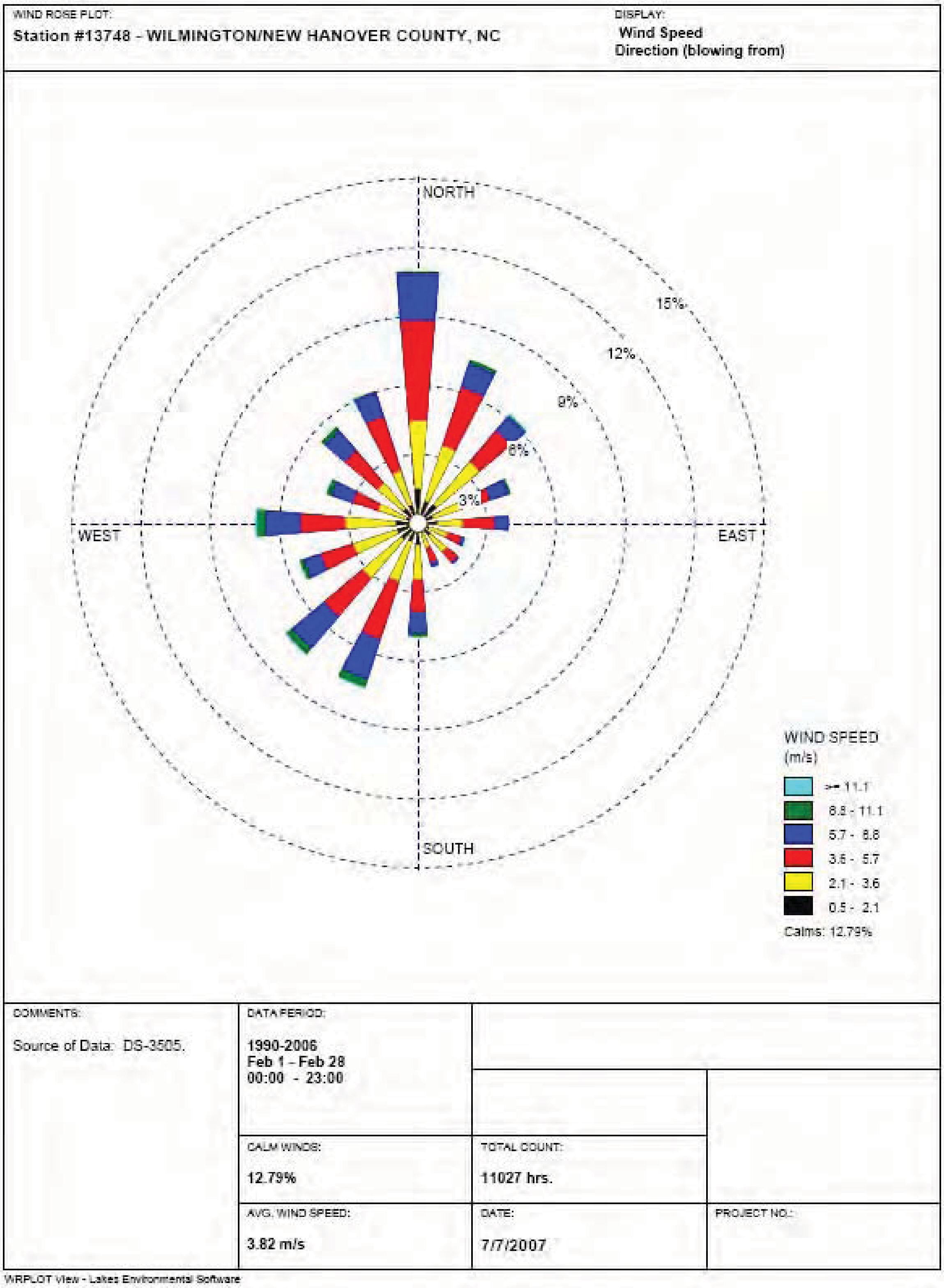
Reference: NOAA, 2005b.

Figure 3.6-9. Wind rose for Wilmington International Airport for 1990 through 2006 wind data.



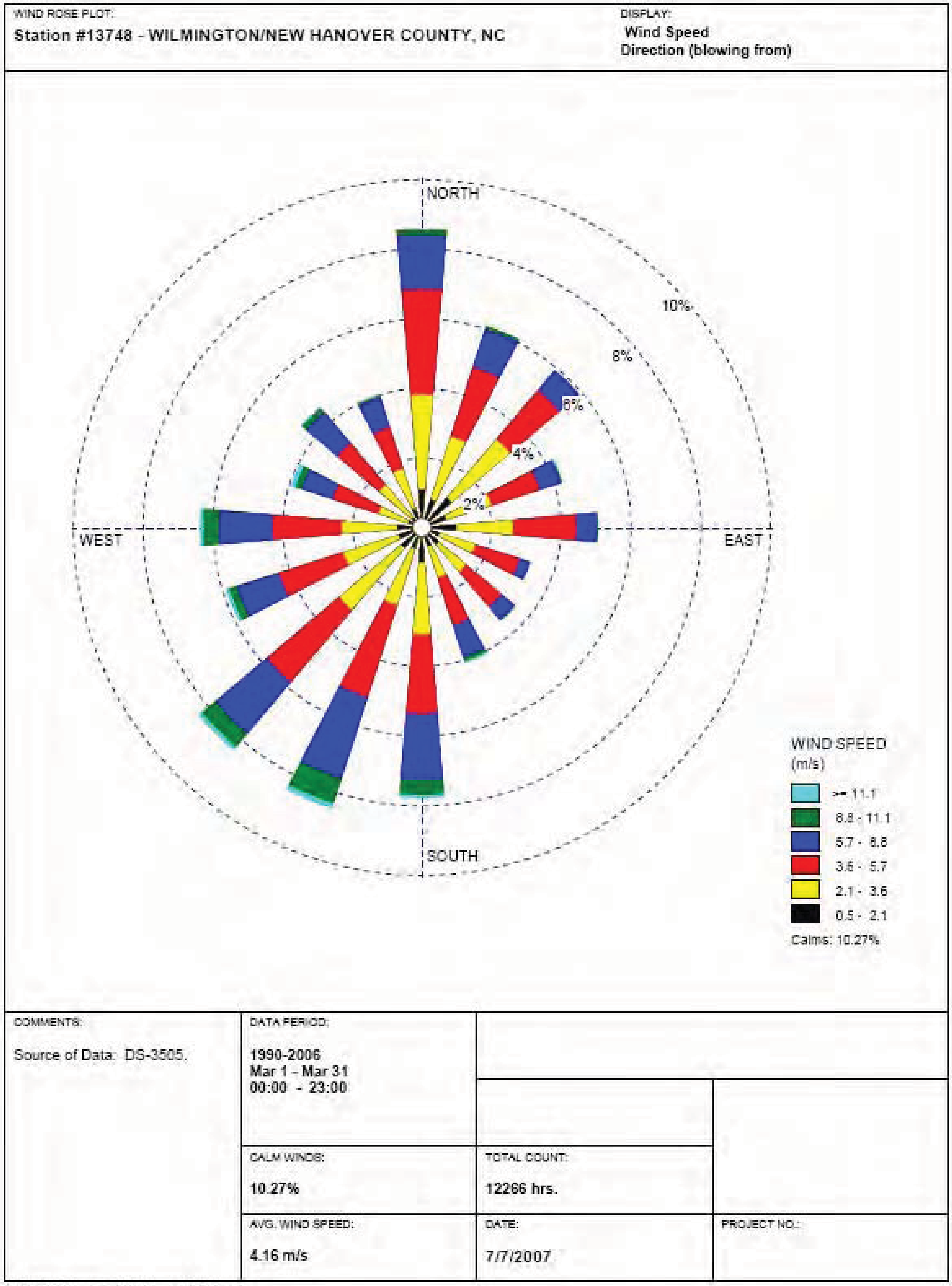
Reference: NOAA, 2005b.

Figure 3.6-10. Wind rose for Wilmington International Airport for January wind data (1990–2006).



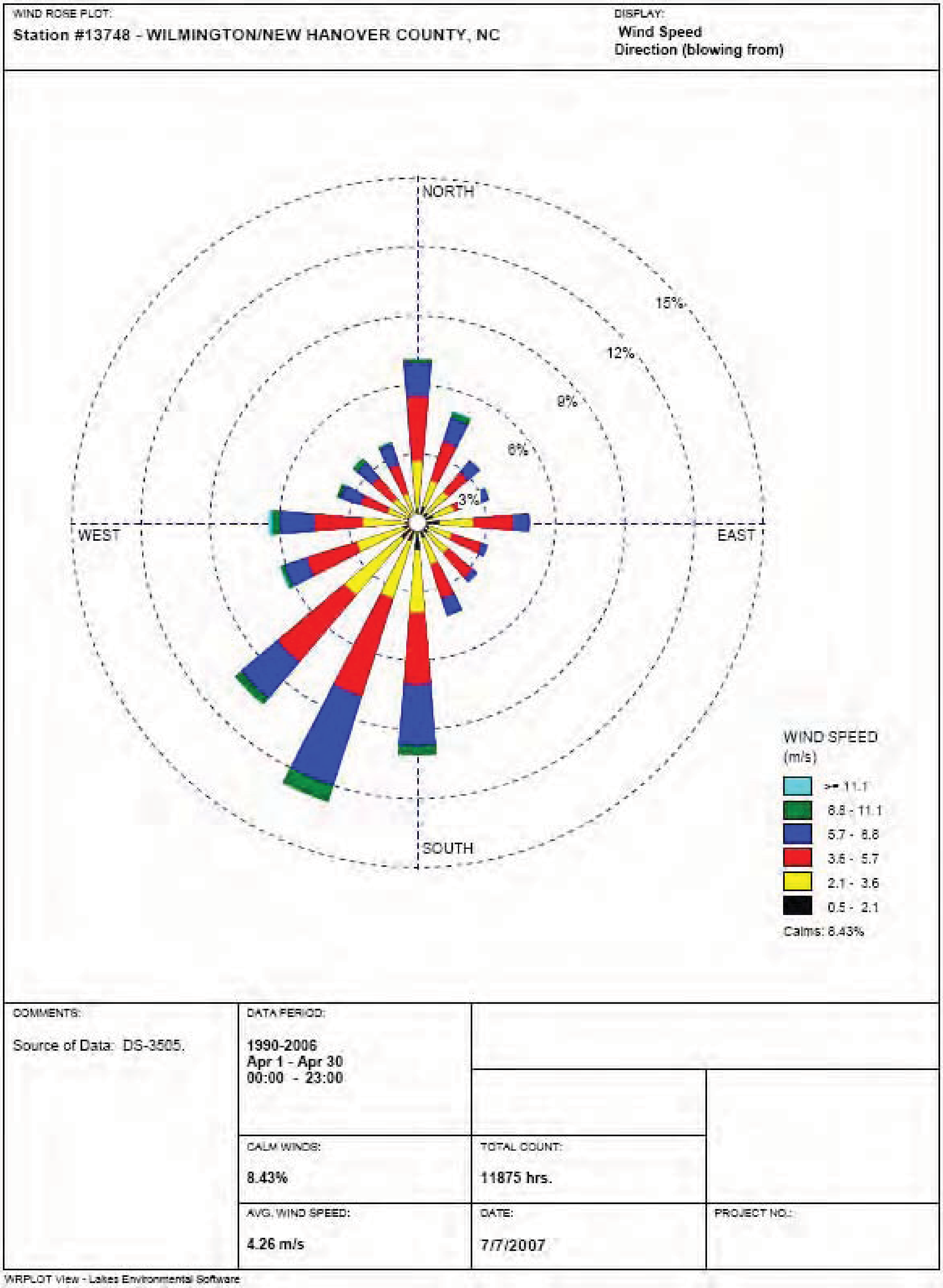
Reference: NOAA, 2005b.

Figure 3.6-11. Wind rose for Wilmington International Airport for February wind data (1990–2006).



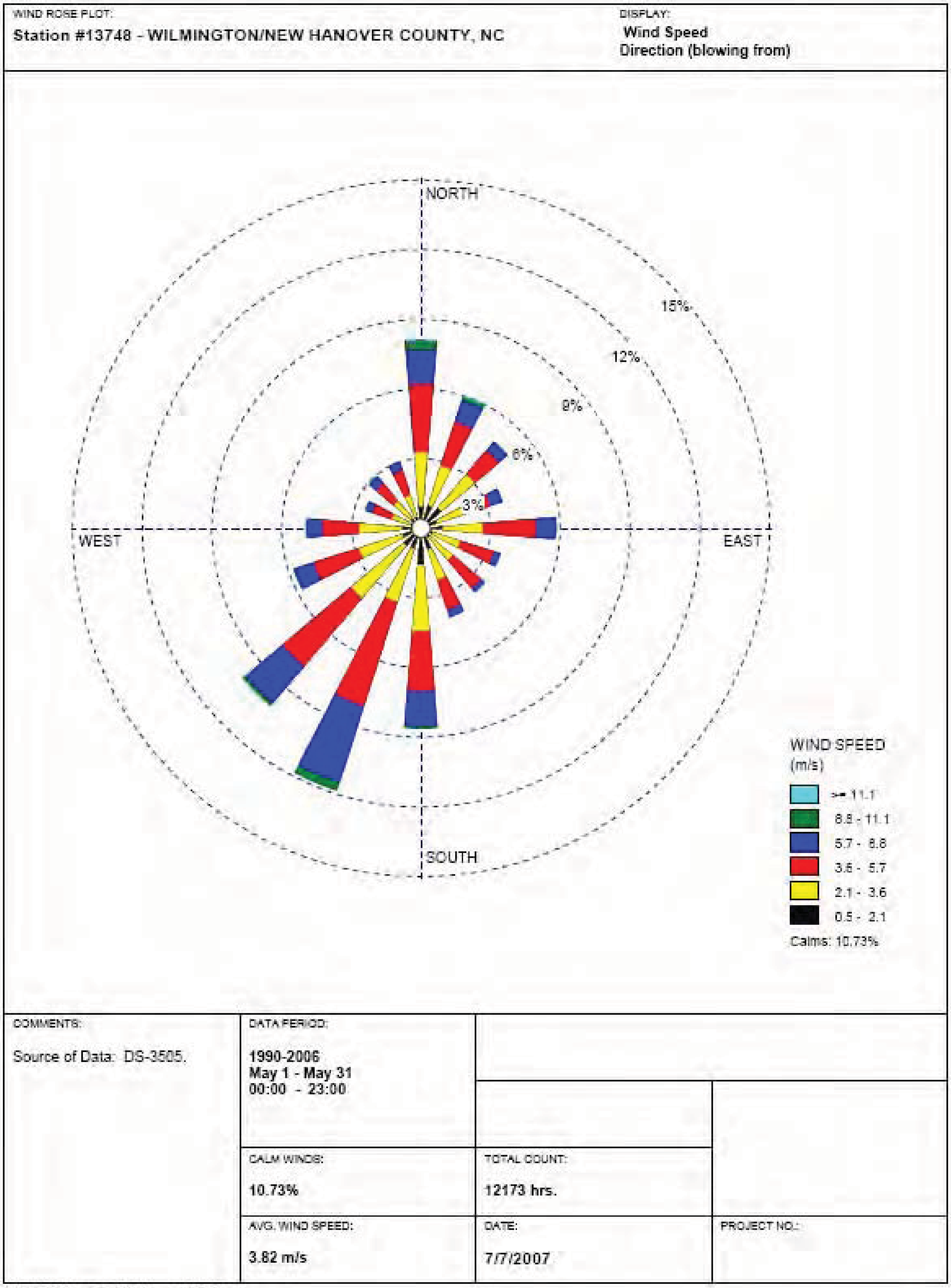
Reference: NOAA, 2005b.

Figure 3.6-12. Wind rose for Wilmington International Airport for March wind data (1990–2006).



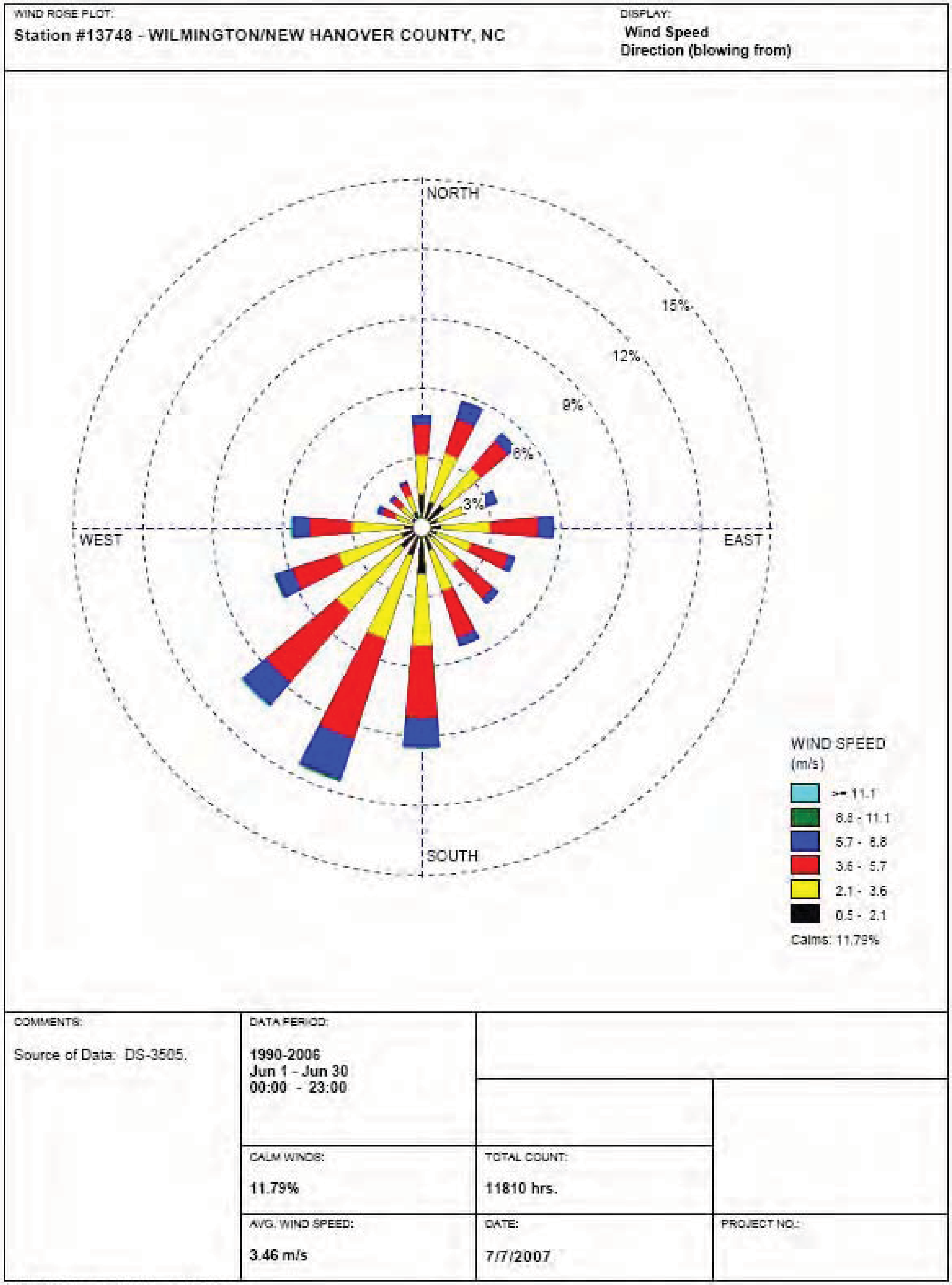
Reference: NOAA, 2005b.

Figure 3.6-13. Wind rose for Wilmington International Airport for April wind data (1990–2006).



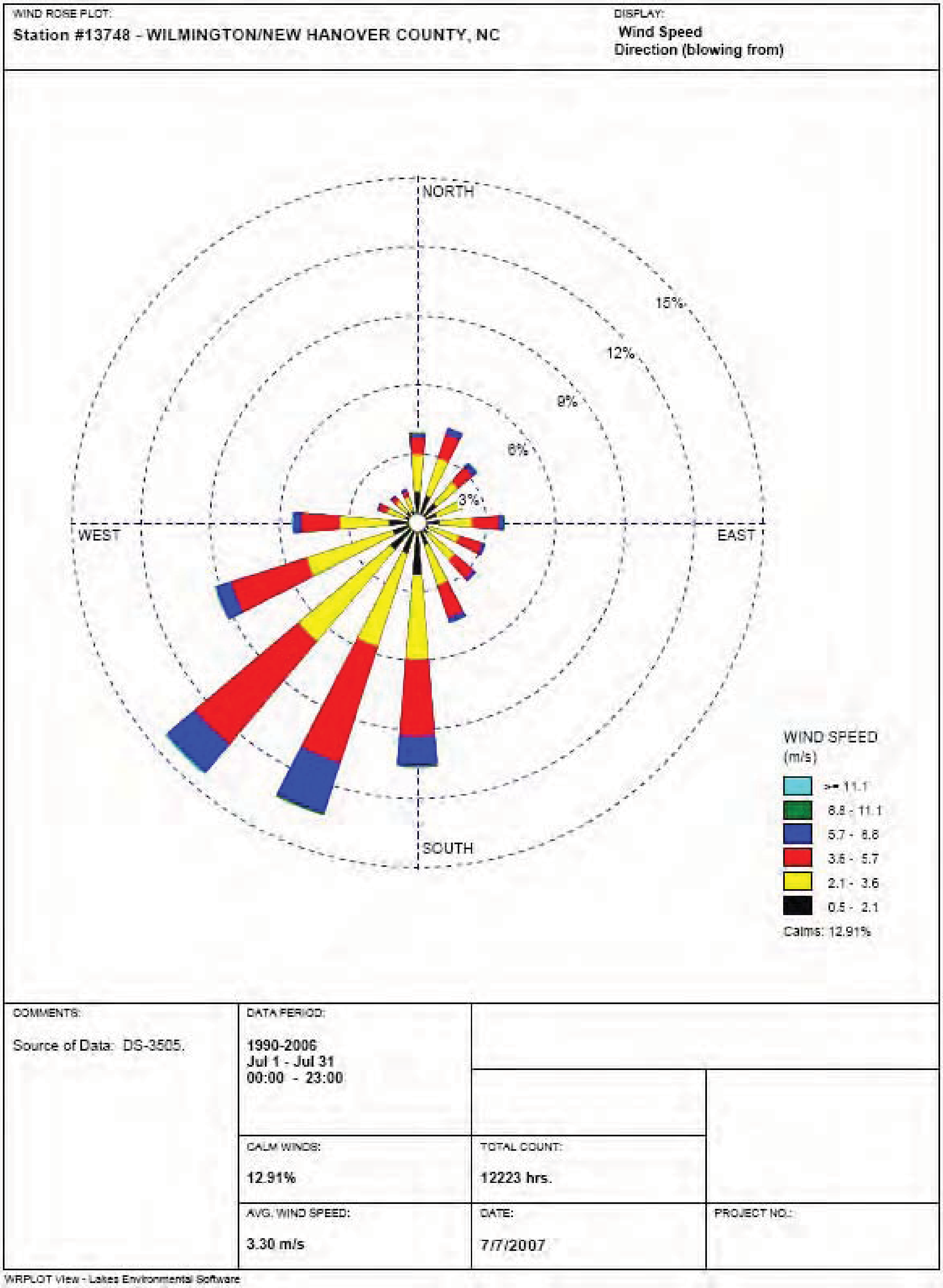
Reference: NOAA, 2005b.

Figure 3.6-14. Wind rose for Wilmington International Airport for May wind data (1990–2006).



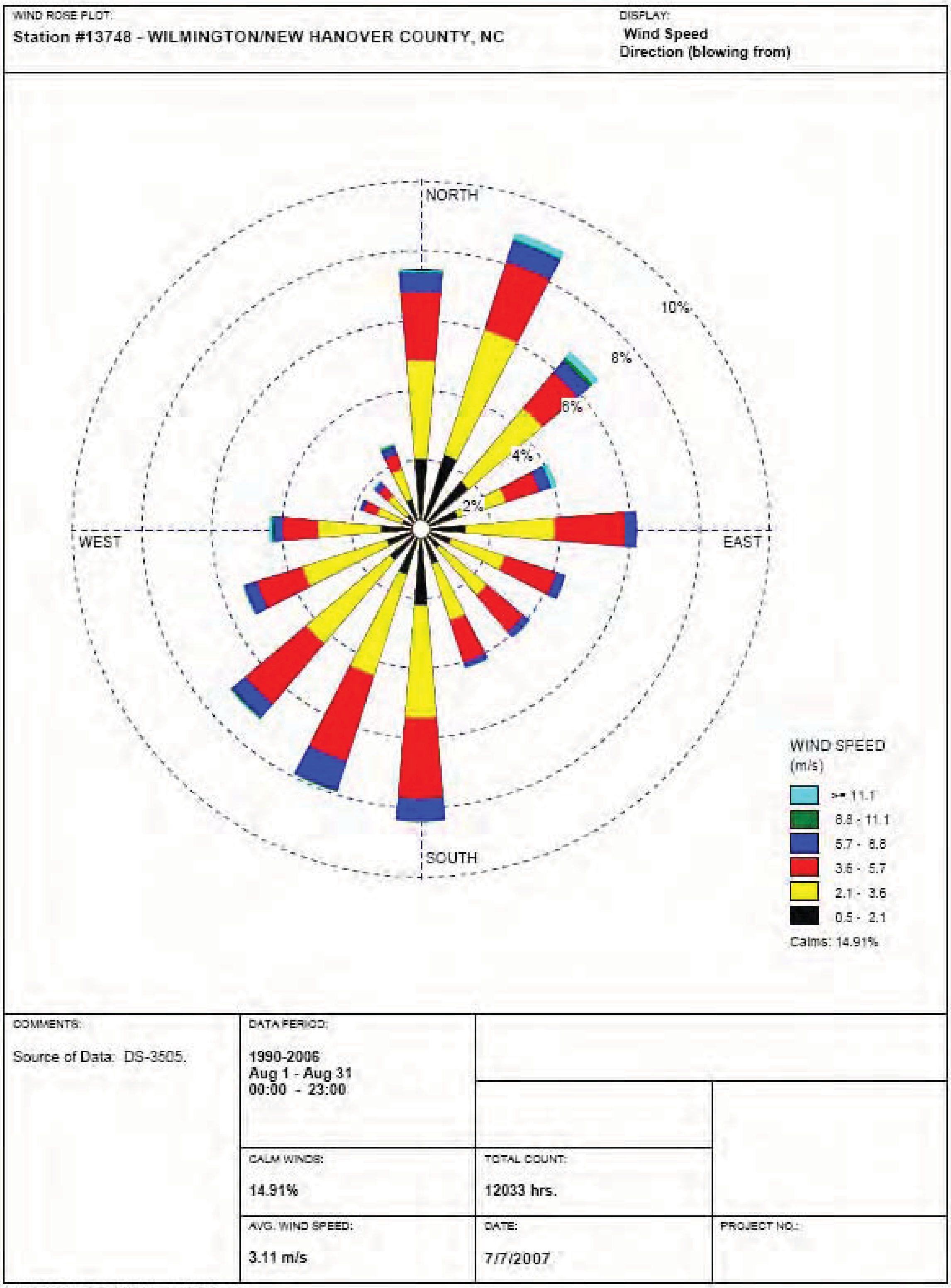
Reference: NOAA, 2005b.

Figure 3.6-15. Wind rose for Wilmington International Airport for June wind data (1990–2006).



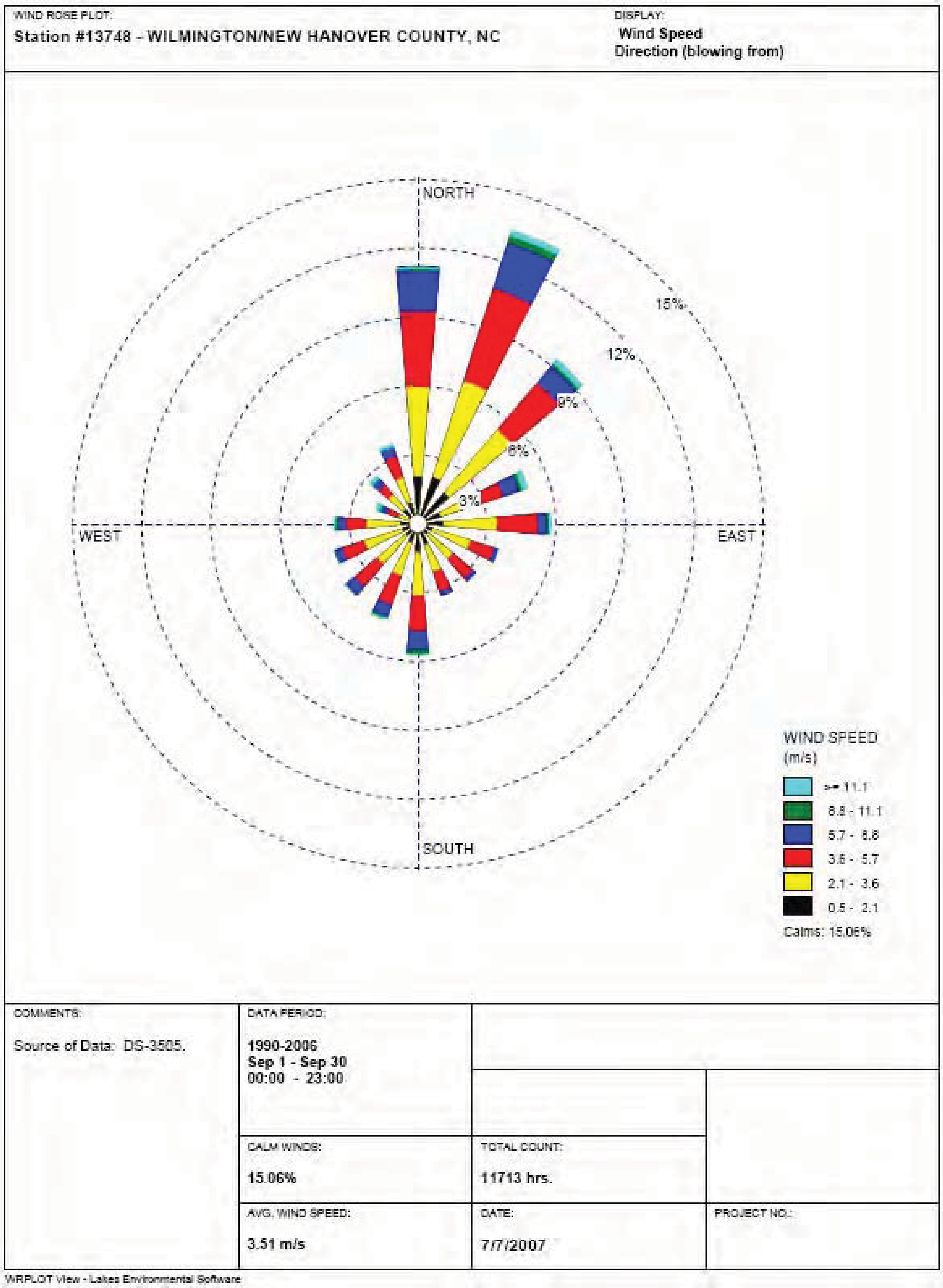
Reference: NOAA, 2005b.

Figure 3.6-16. Wind rose for Wilmington International Airport for July wind data (1990–2006).



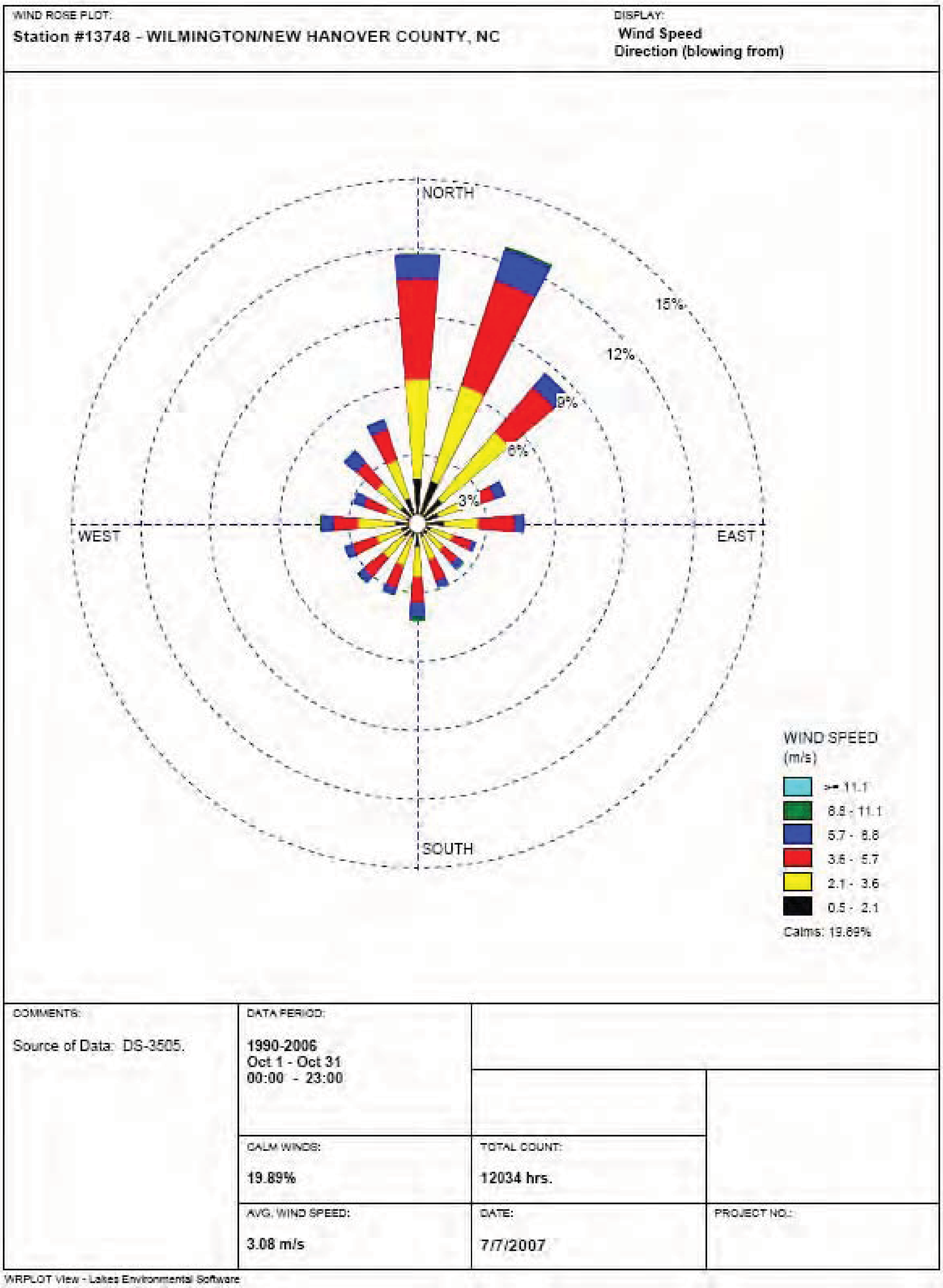
Reference: NOAA, 2005b.

Figure 3.6-17. Wind rose for Wilmington International Airport for August wind data (1990–2006).



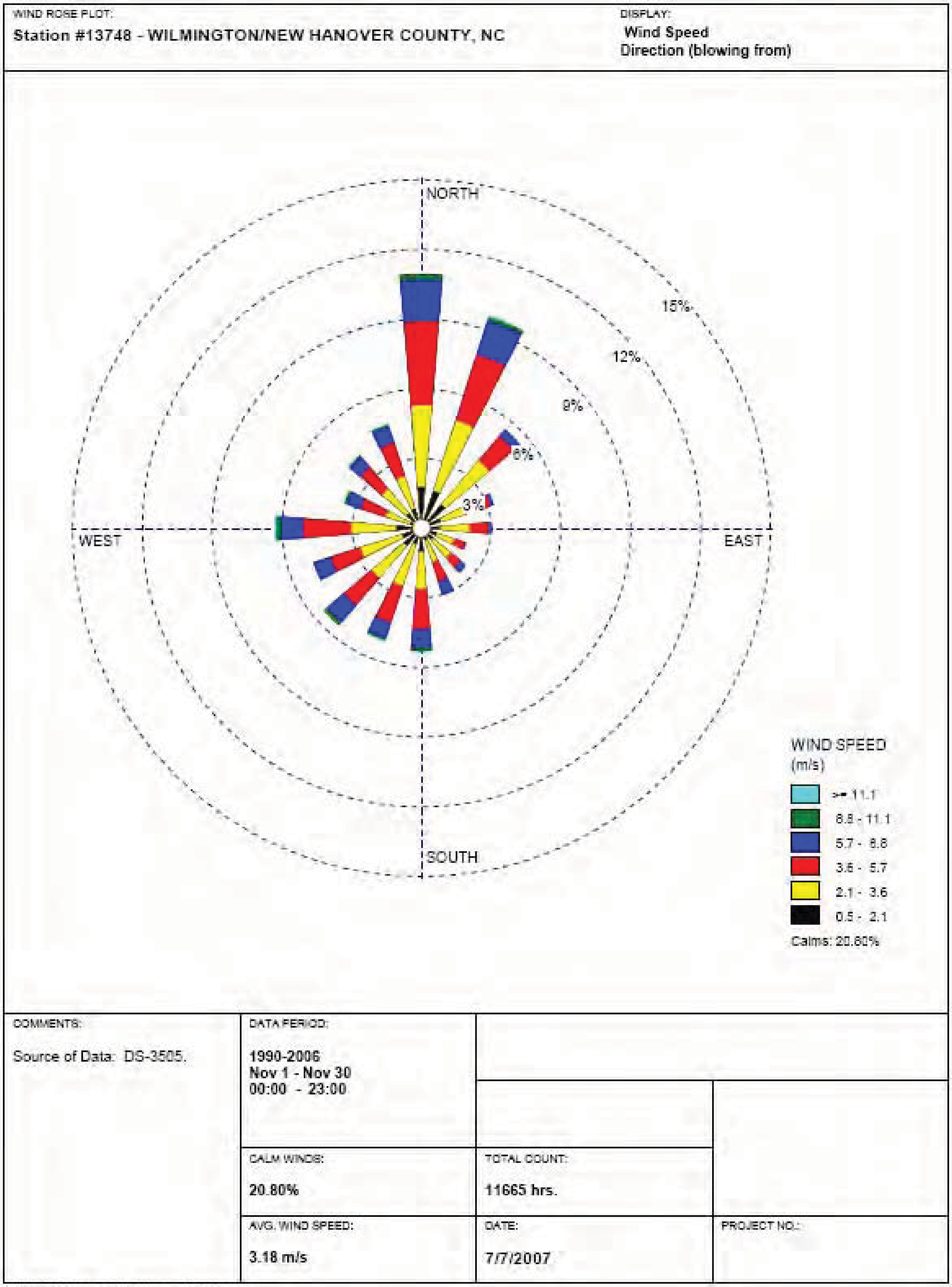
Reference: NOAA, 2005b.

Figure 3.6-18. Wind rose for Wilmington International Airport for September wind data (1990–2006).



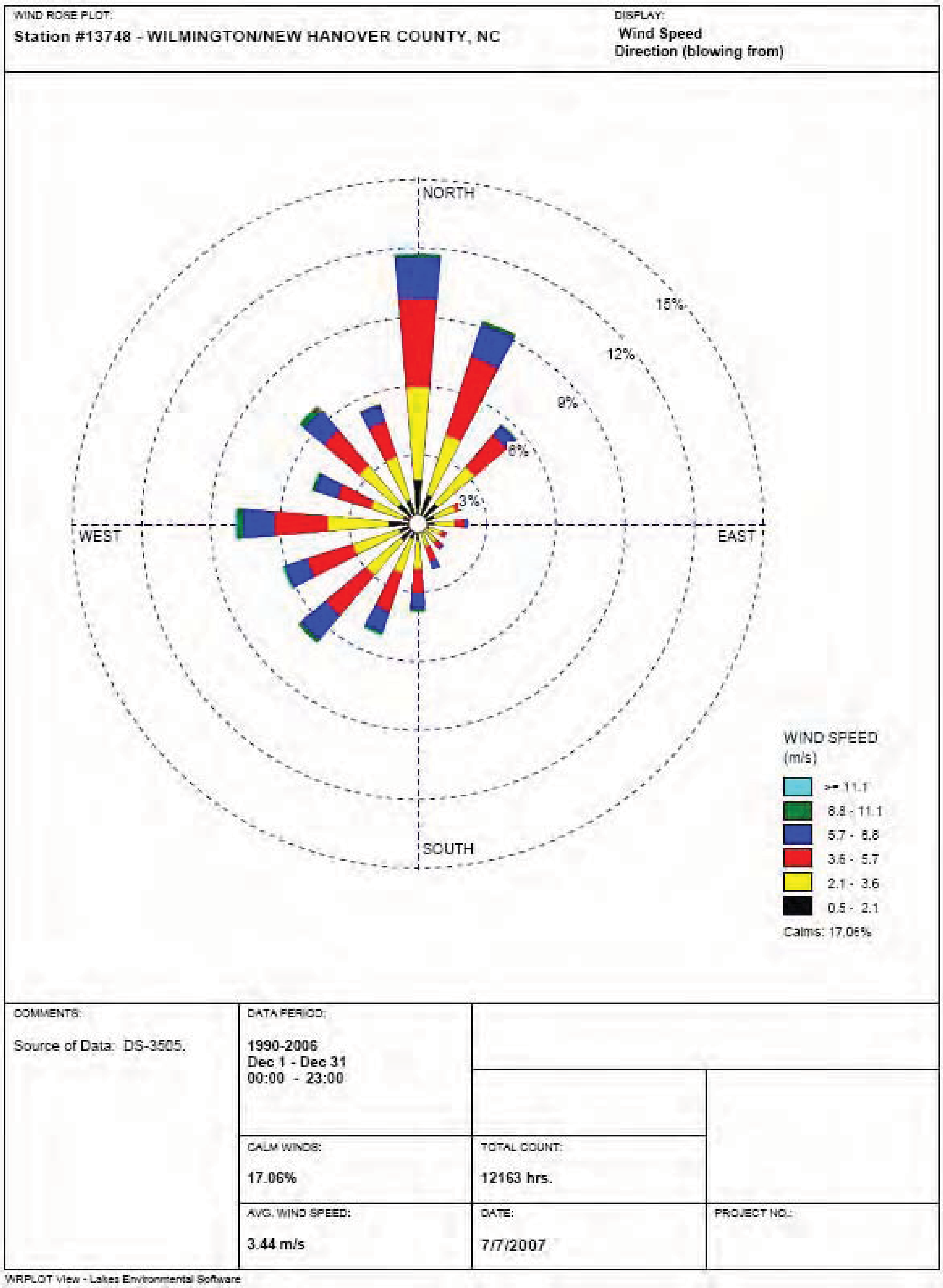
Reference: NOAA, 2005b.

Figure 3.6-19. Wind rose for Wilmington International Airport for October wind data (1990–2006).



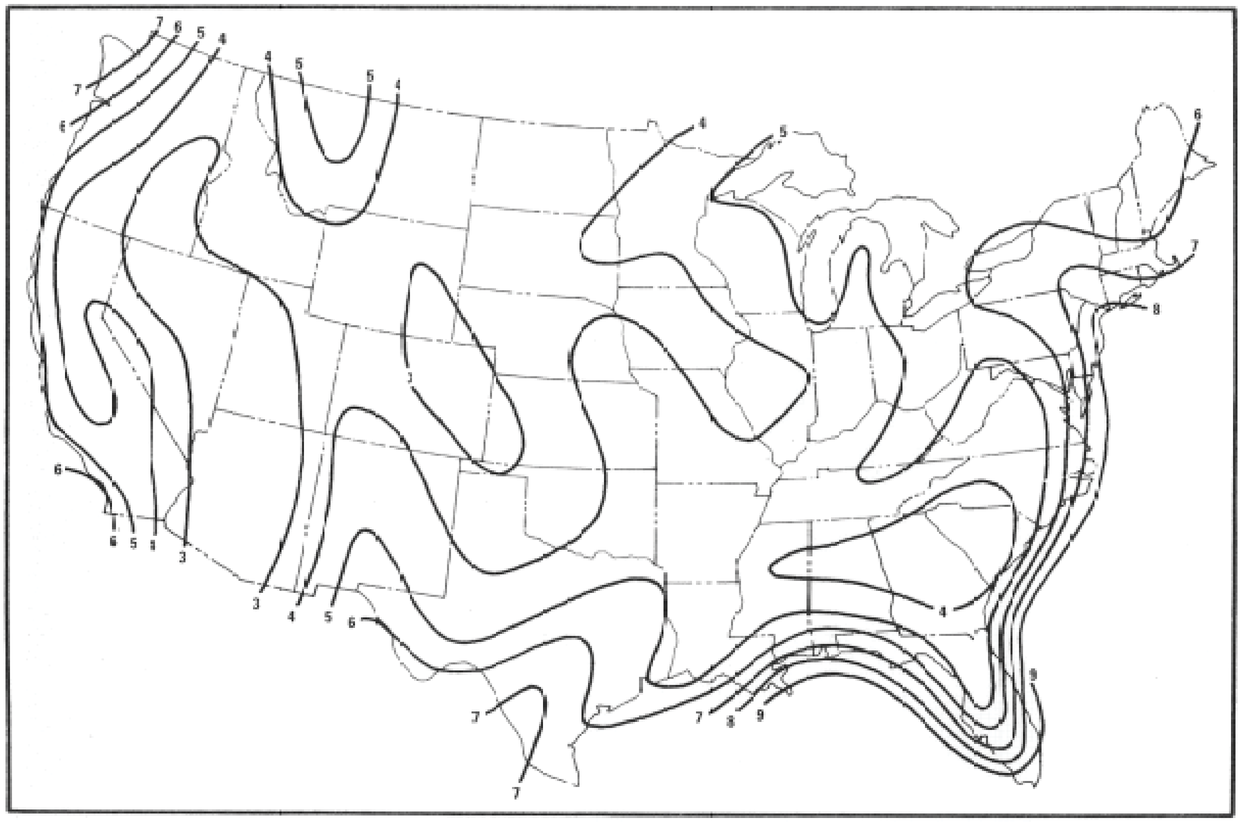
Reference: NOAA, 2005b.

Figure 3.6-20. Wind rose for Wilmington International Airport for November wind data (1990–2006).



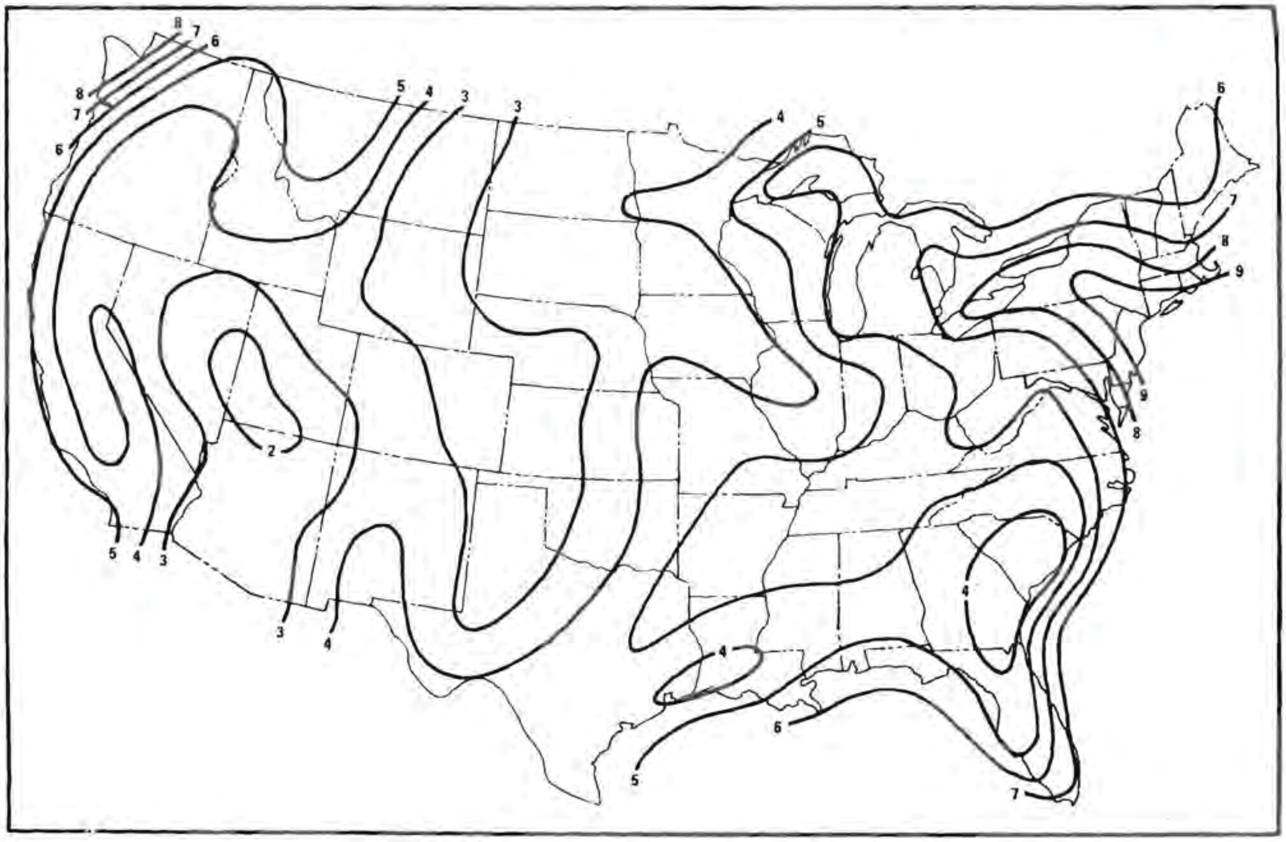
Reference: NOAA, 2005b.

Figure 3.6-21. Wind rose for Wilmington International Airport for December wind data (1990–2006).



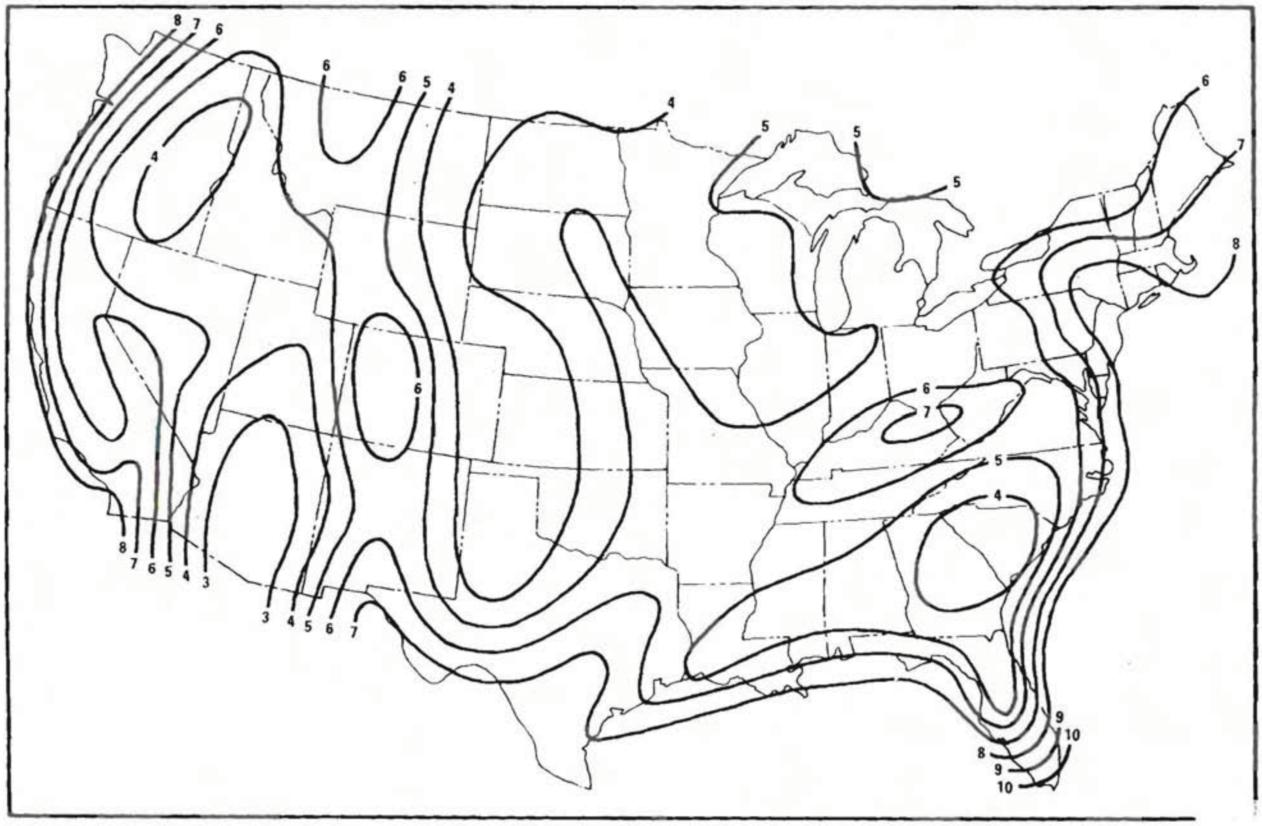
Reference: Holzworth, 1972.

Figure 3.6-22. Mean annual morning mixing heights for the continental United States (m x 10^2).



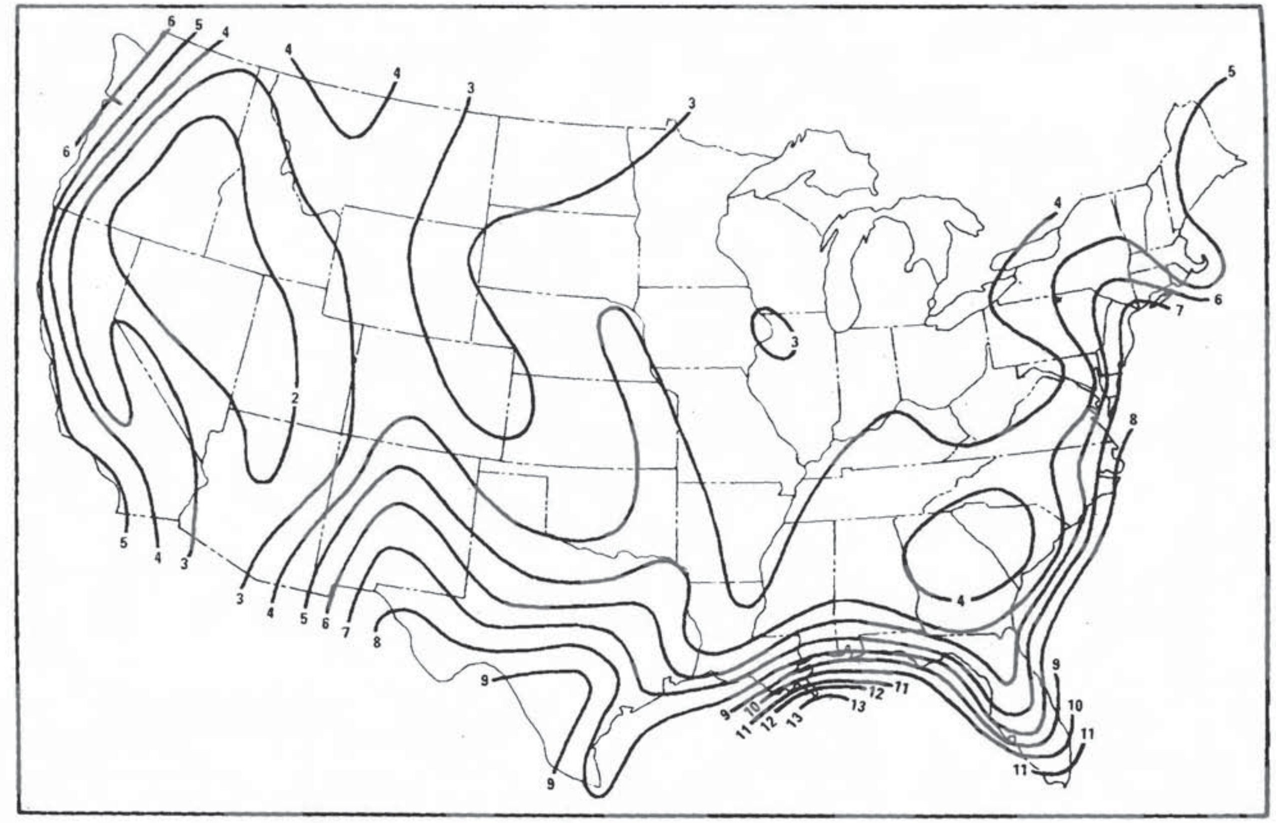
Reference: Holzworth, 1972.

Figure 3.6-23. Mean morning mixing heights in winter for the continental United States (m x 10^2).



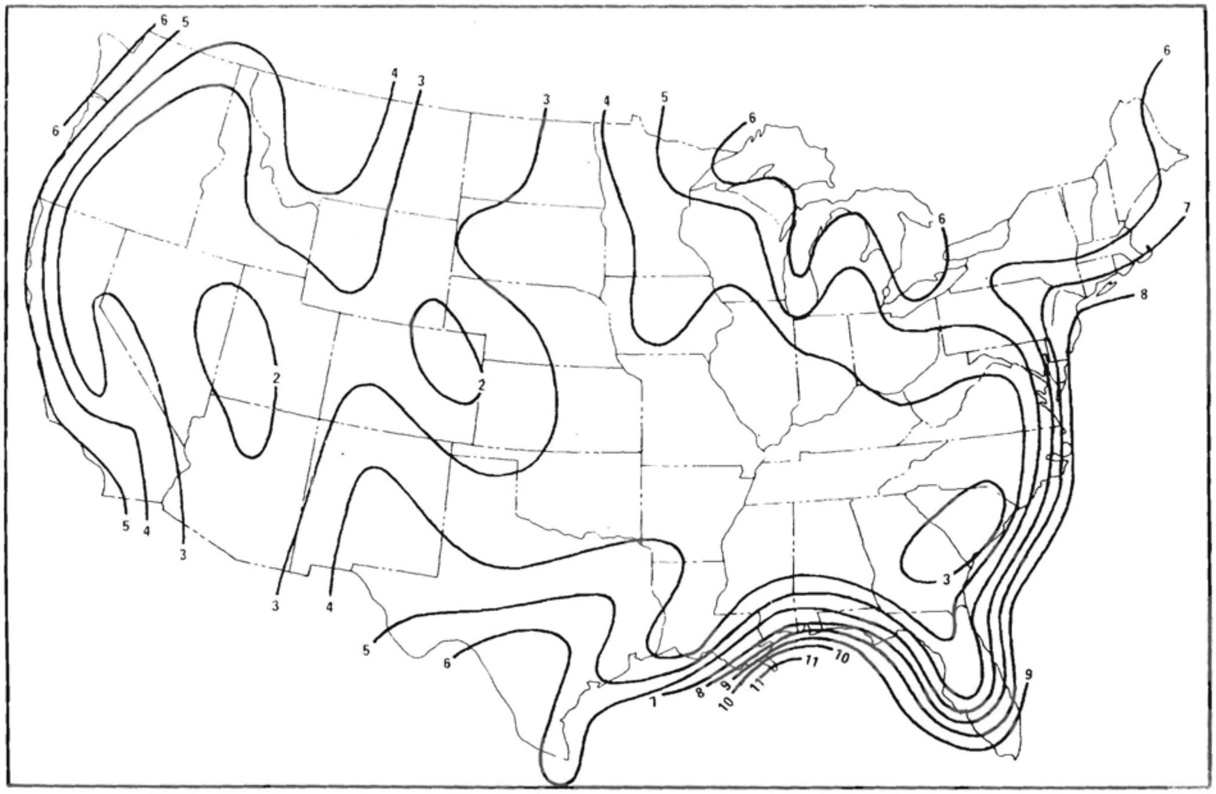
Reference: Holzworth, 1972.

Figure 3.6-24. Mean morning mixing heights in spring for the continental United States (m x 10^2).



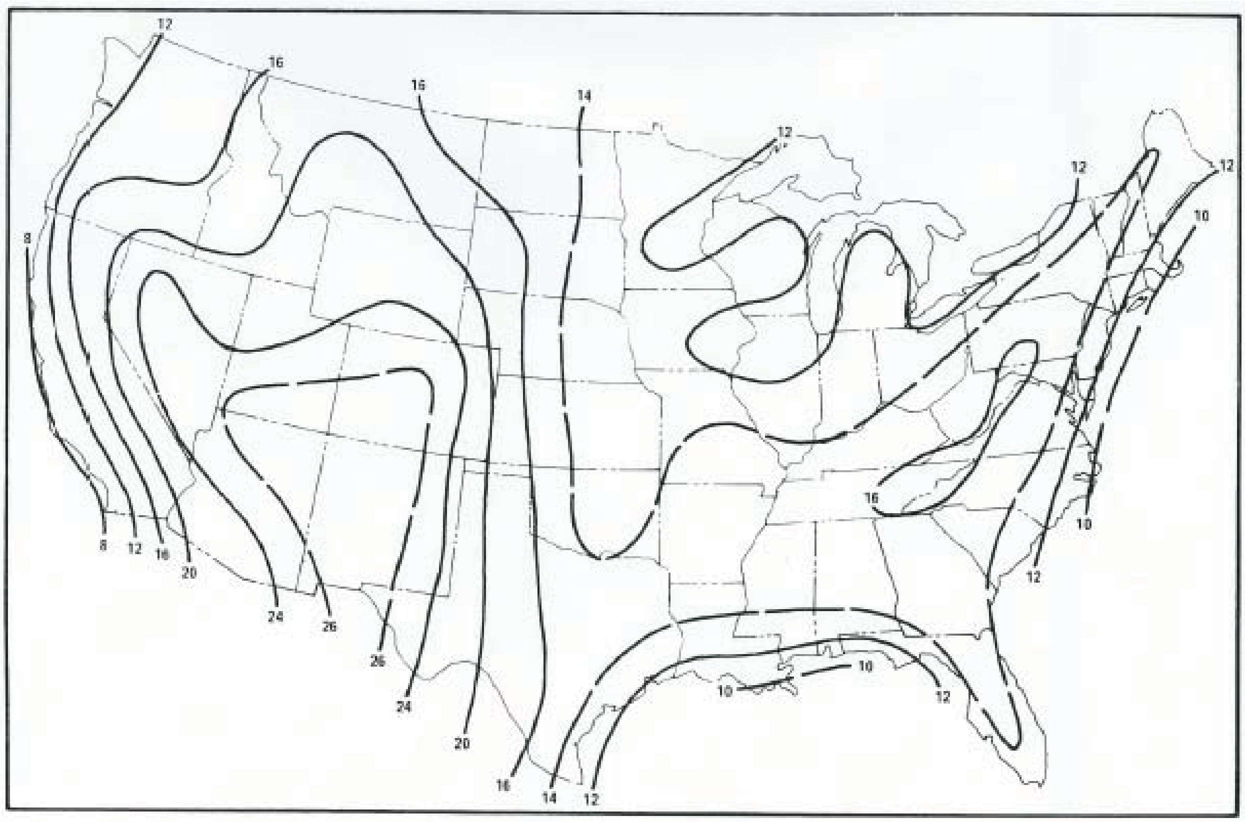
Reference: Holzworth, 1972.

Figure 3.6-25. Mean morning mixing heights in summer for the continental United States ($m \times 10^2$).



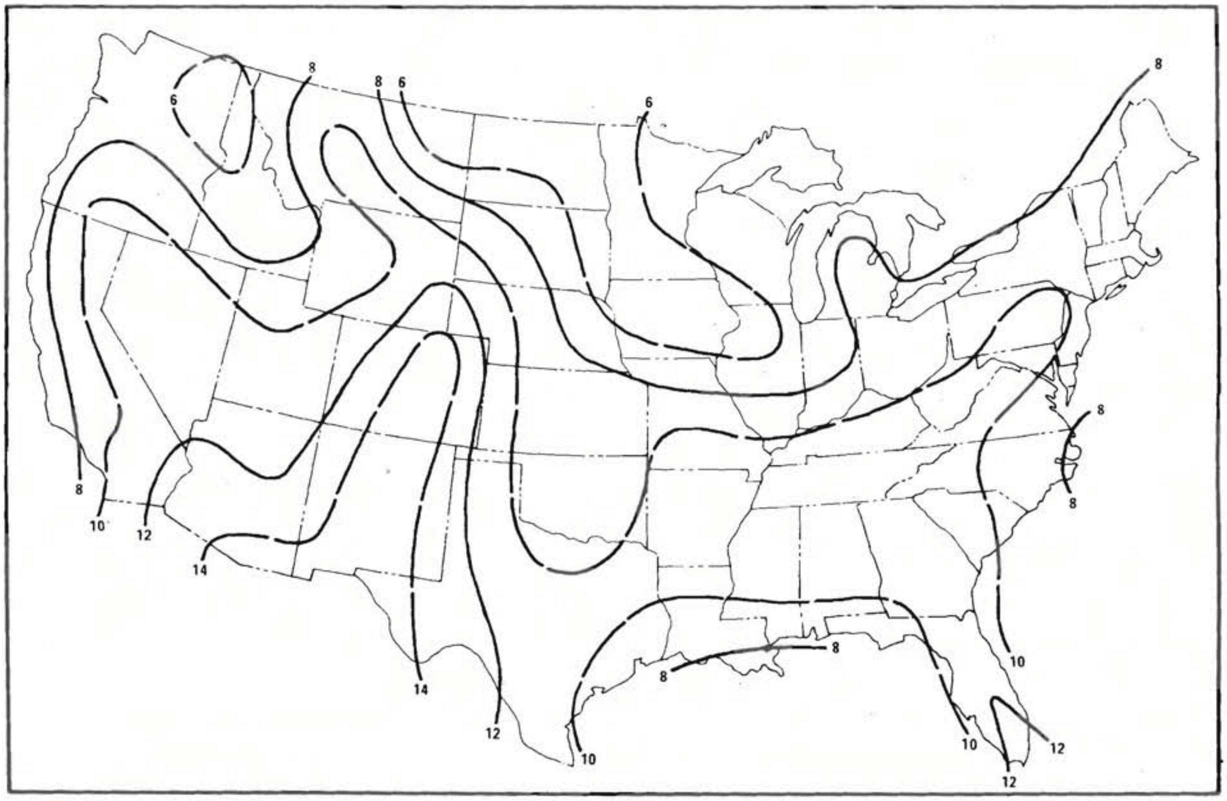
Reference: Holzworth, 1972.

Figure 3.6-26. Mean morning mixing heights in autumn for the continental United States ($m \times 10^2$).



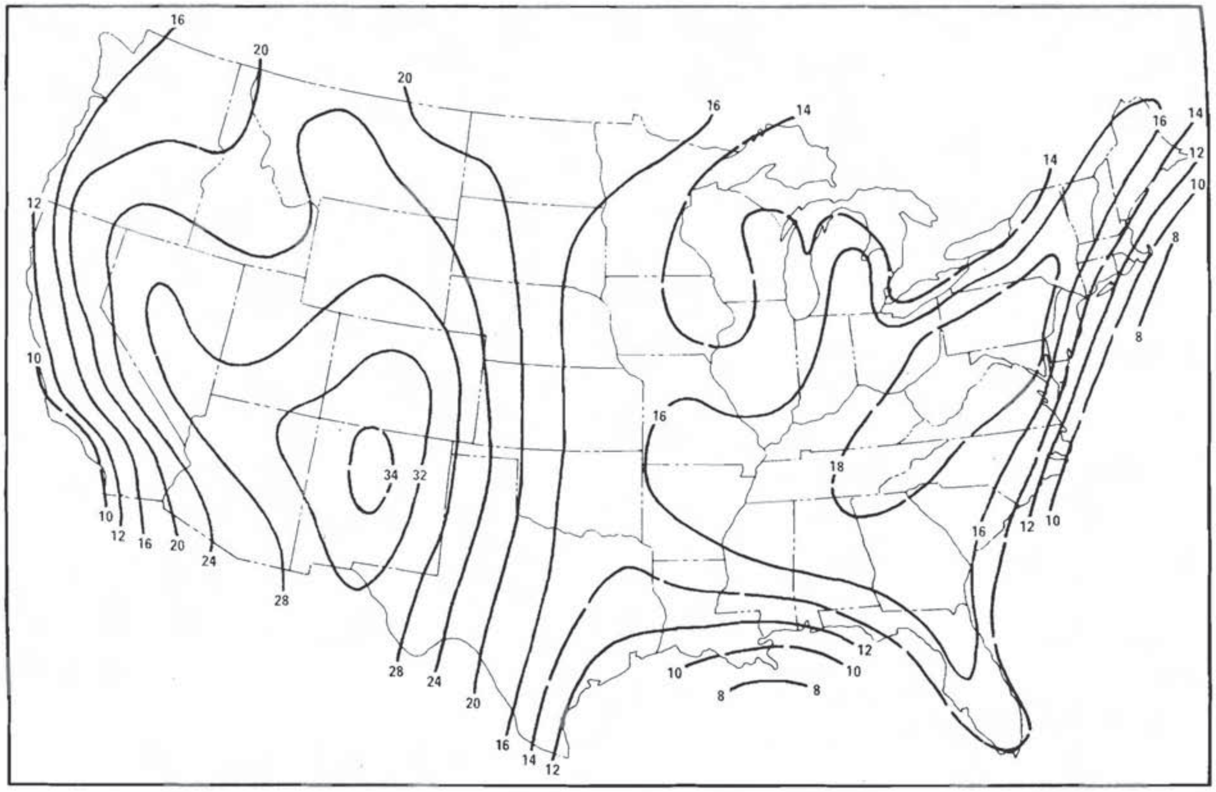
Reference: Holzworth, 1972.

Figure 3.6-27. Mean annual afternoon mixing heights for the continental United States (m x 10^2).



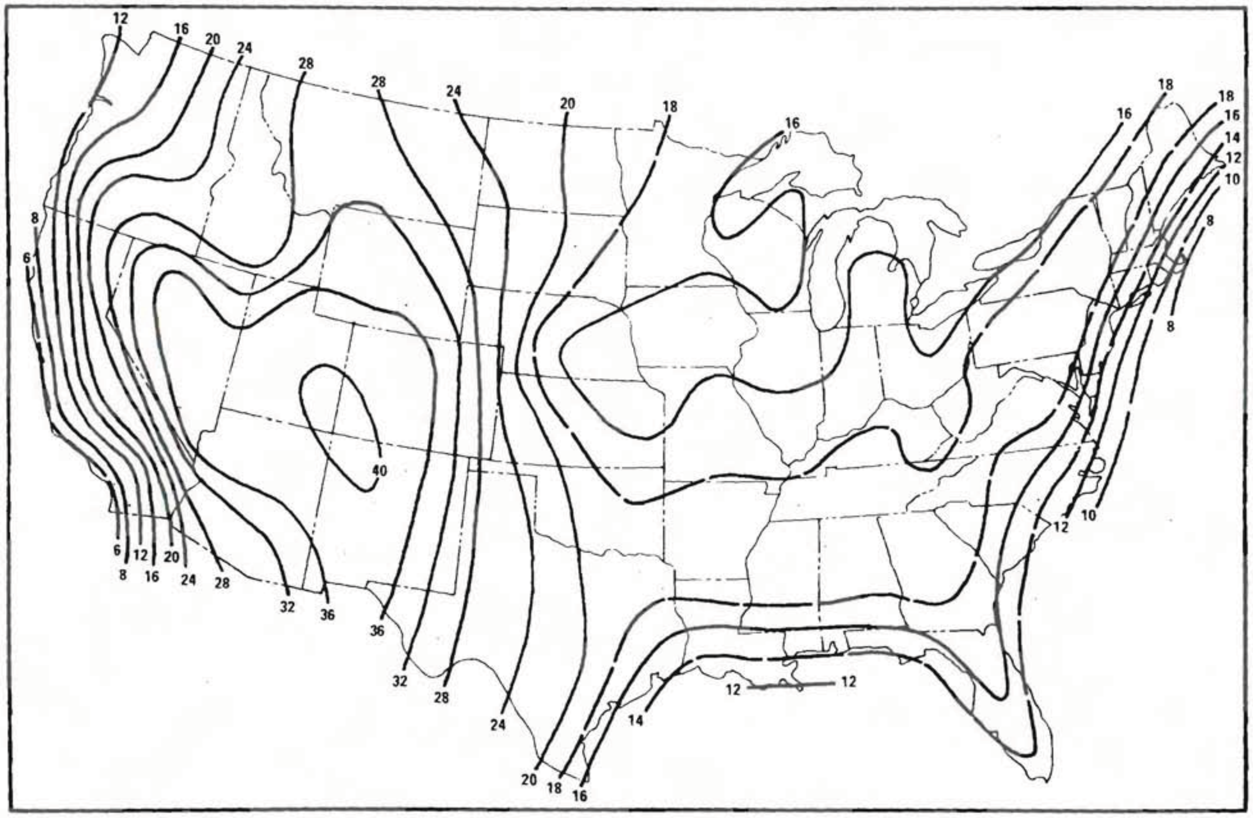
Reference: Holzworth, 1972.

Figure 3.6-28. Mean afternoon mixing heights in winter for the continental United States ($m \times 10^2$).



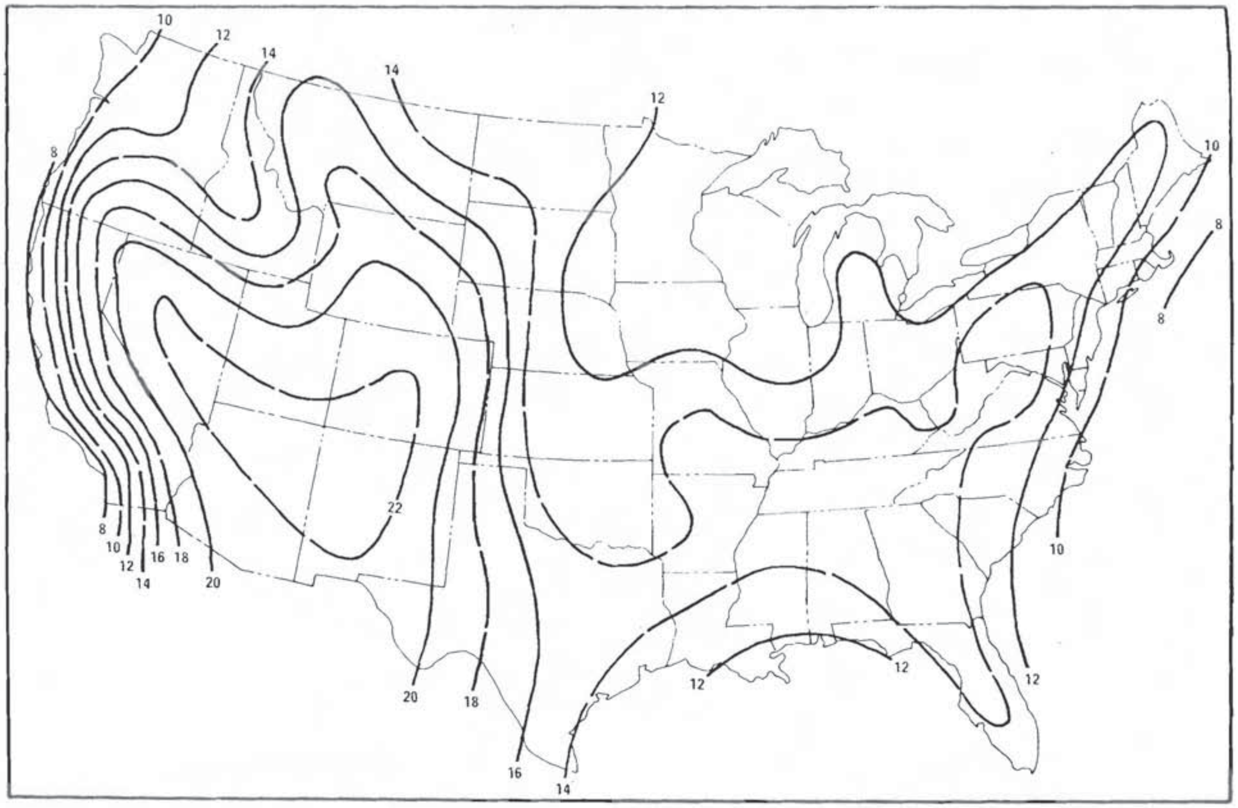
Reference: Holzworth, 1972.

Figure 3.6-29. Mean afternoon mixing heights in spring for the continental United States (m x 10^2).



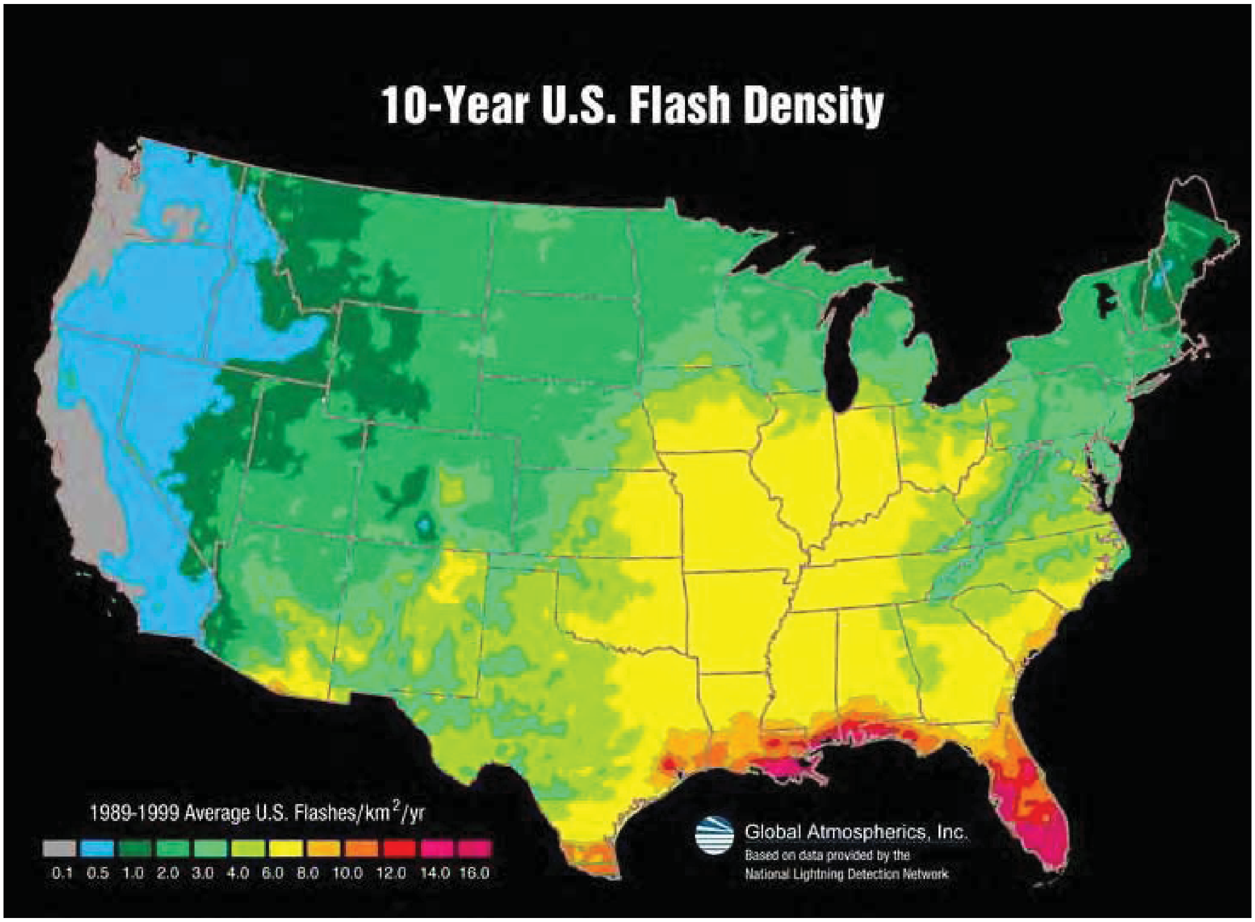
Reference: Holzworth, 1972.

Figure 3.6-30. Mean afternoon mixing heights in summer for the continental United States ($m \times 10^2$).



Reference: Holzworth, 1972.

Figure 3.6-31. Mean afternoon mixing heights in autumn for the continental United States (m x 10^2).



Reference: NOAA, 2000.

Figure 3.6-32. Lightning flash density map of the continental United States.

Figure 3.6-33. Number of tornado touch downs by county in southeastern North Carolina (1950-2004).

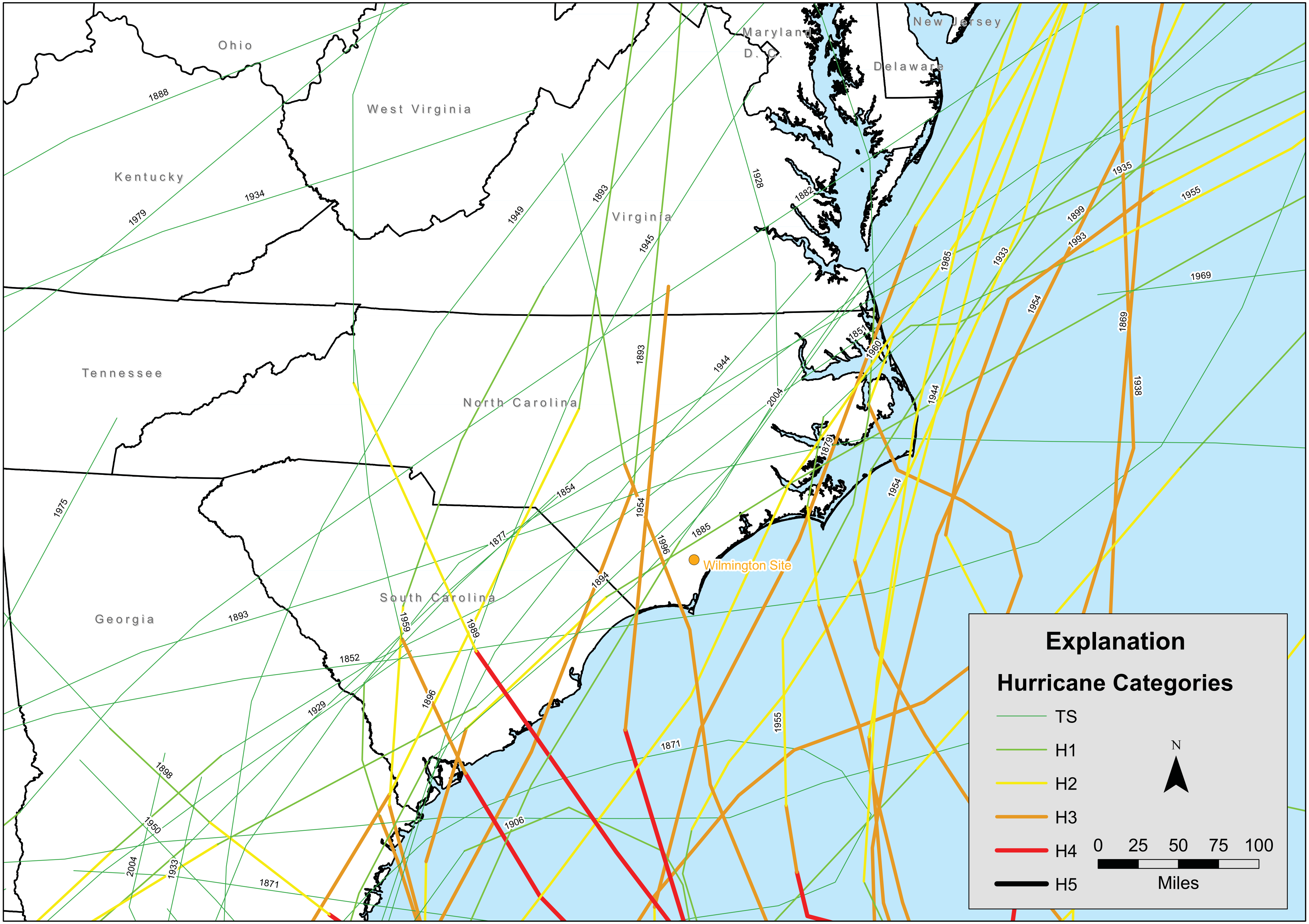


Figure 3.6-34. Storm tracks for major hurricanes making landfall in the Carolinas and surrounding states (1851-2004).

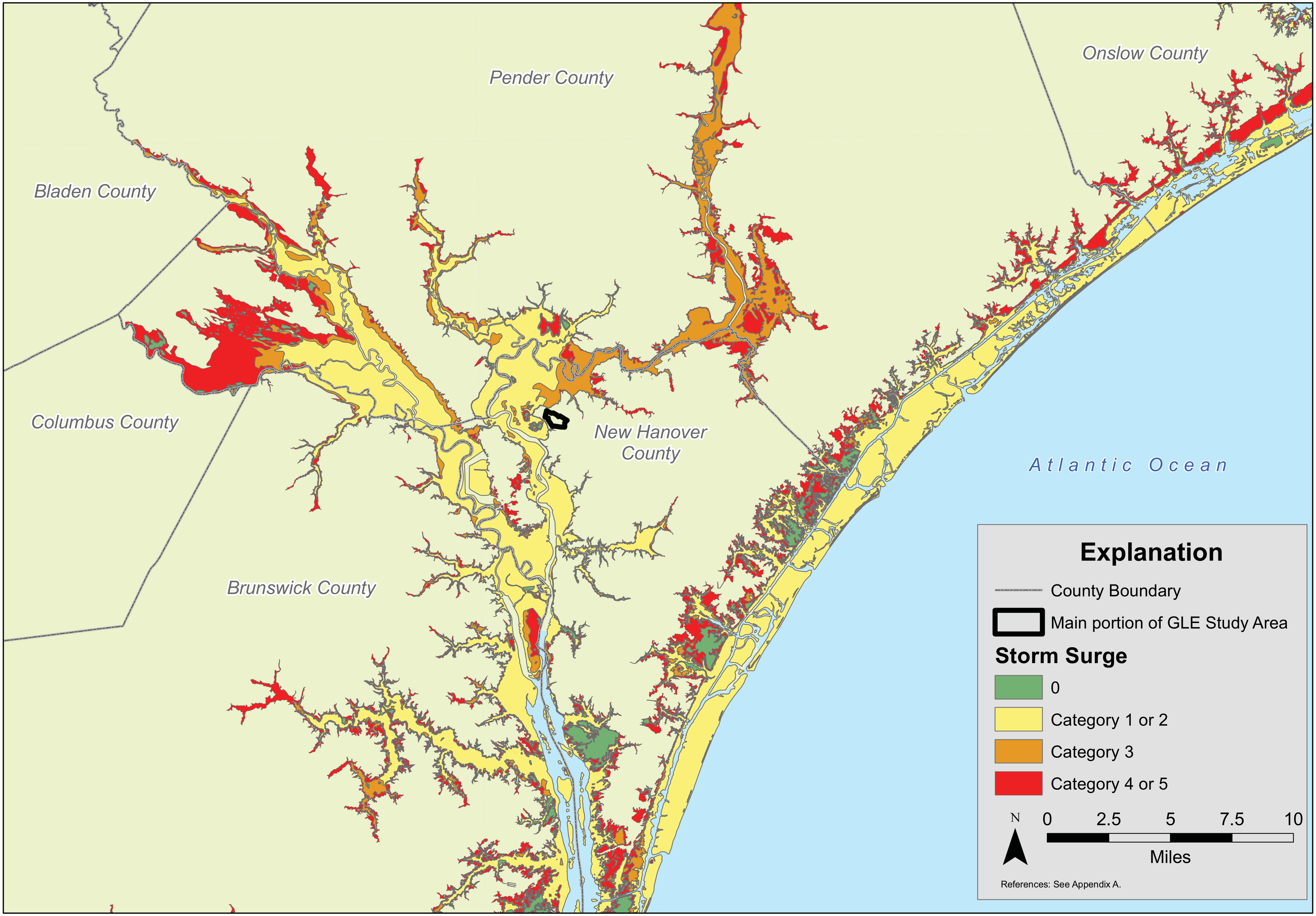


Figure 3.6-35. Hurricane storm surge areas.

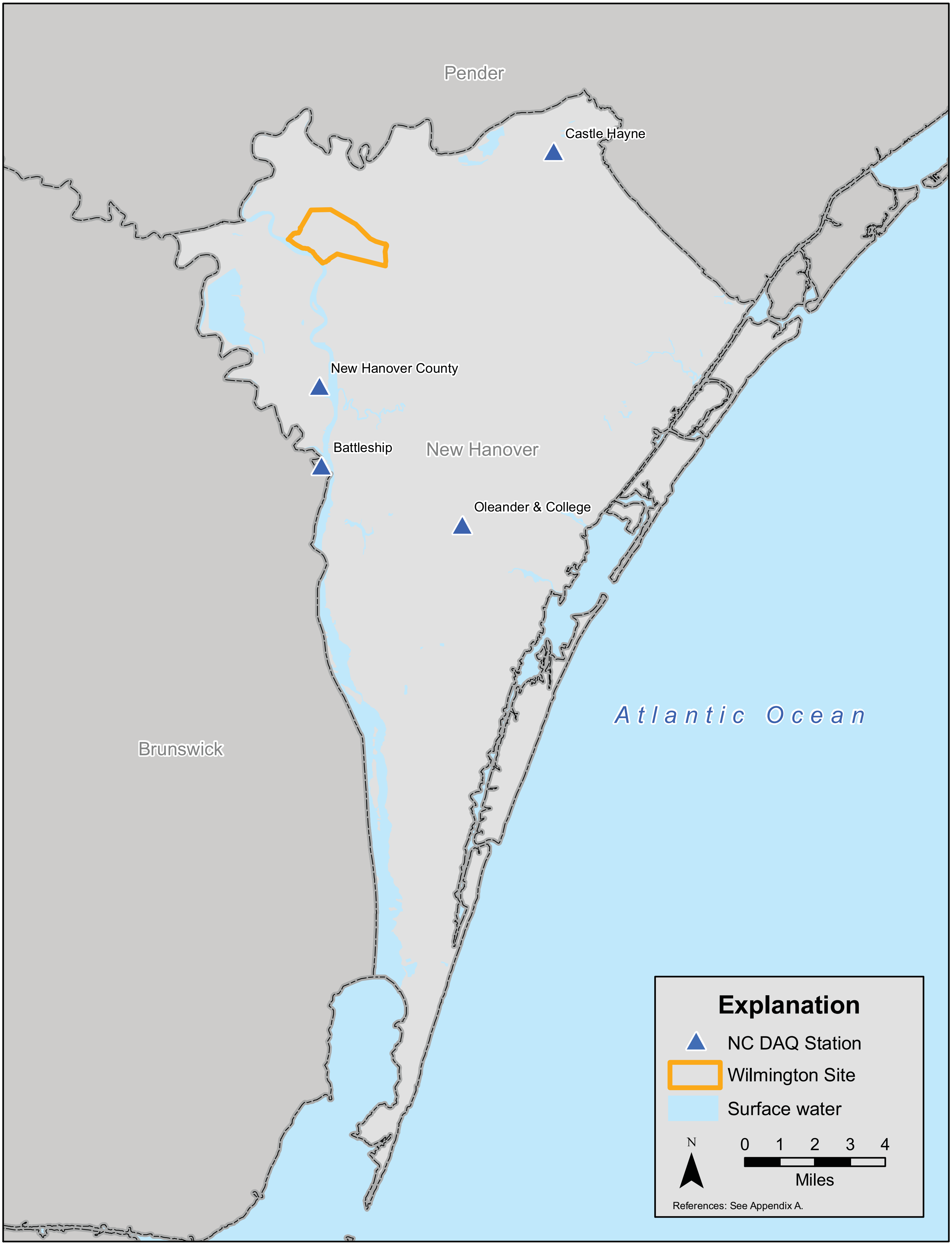


Figure 3.6-36. NC DAQ air quality monitoring station locations in New Hanover County.

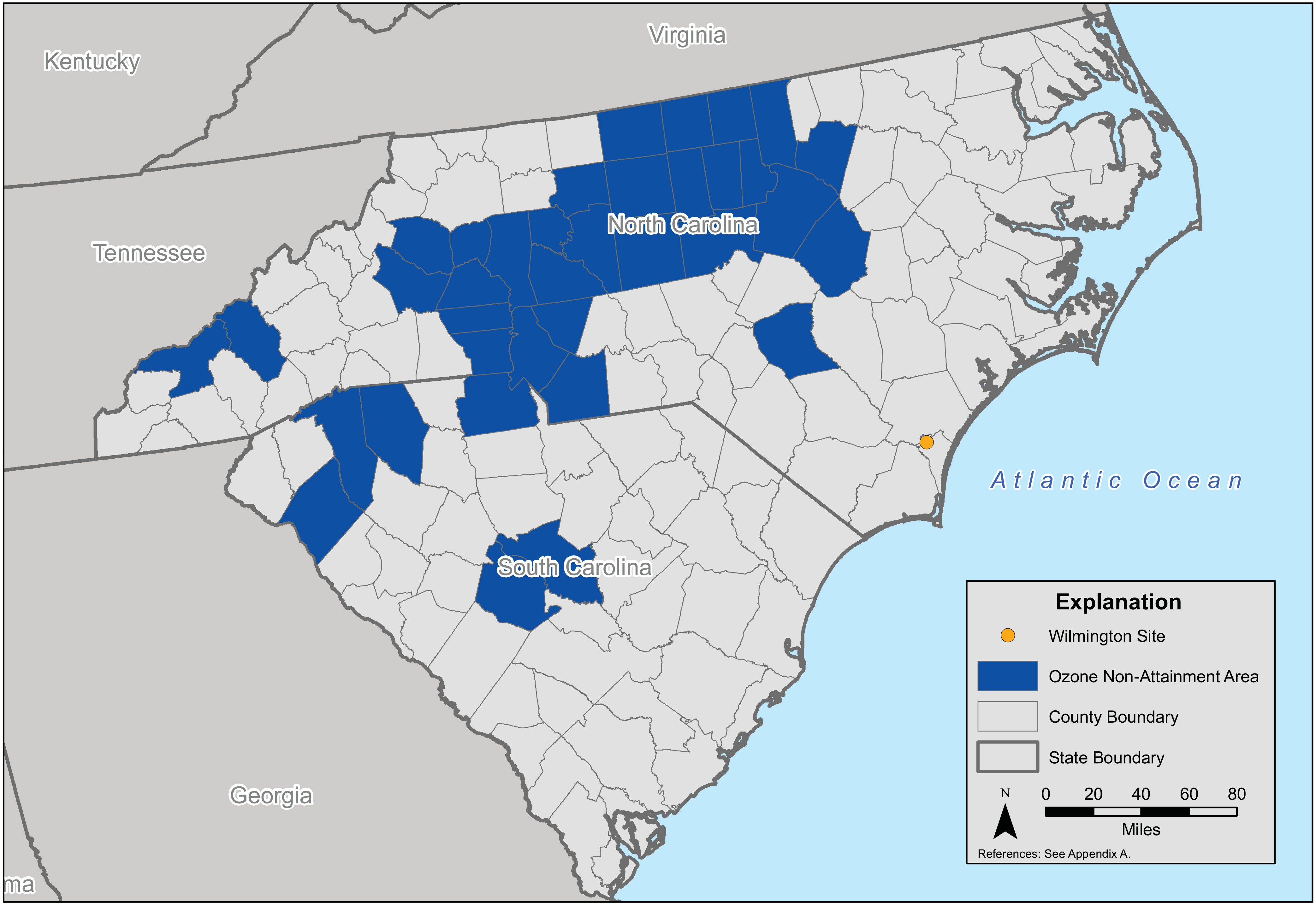


Figure 3.6-37. Wilmington Site location relative to ozone non-attainment areas.

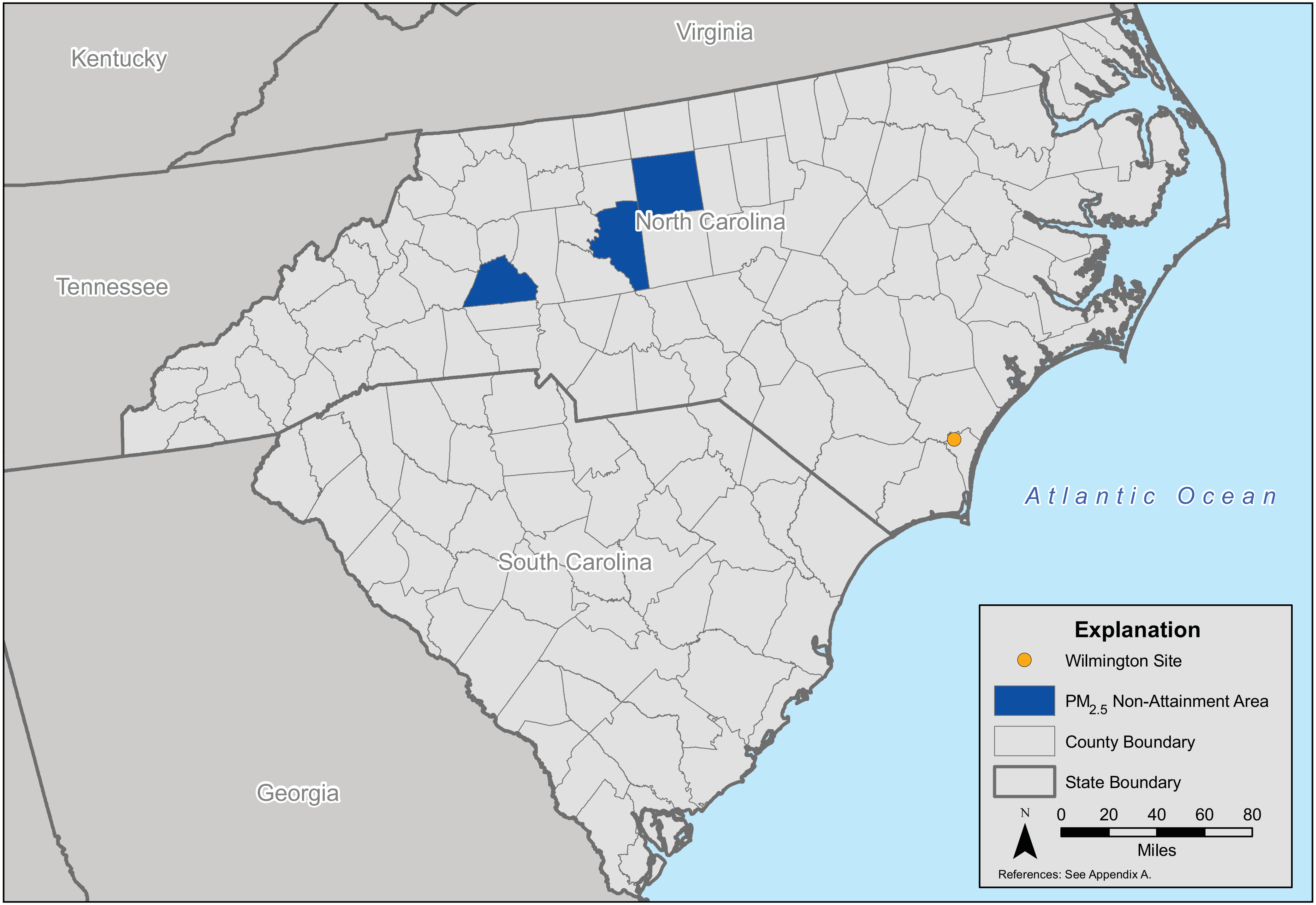


Figure 3.6-38. Wilmington Site location relative to $PM_{2.5}$ non-attainment areas.

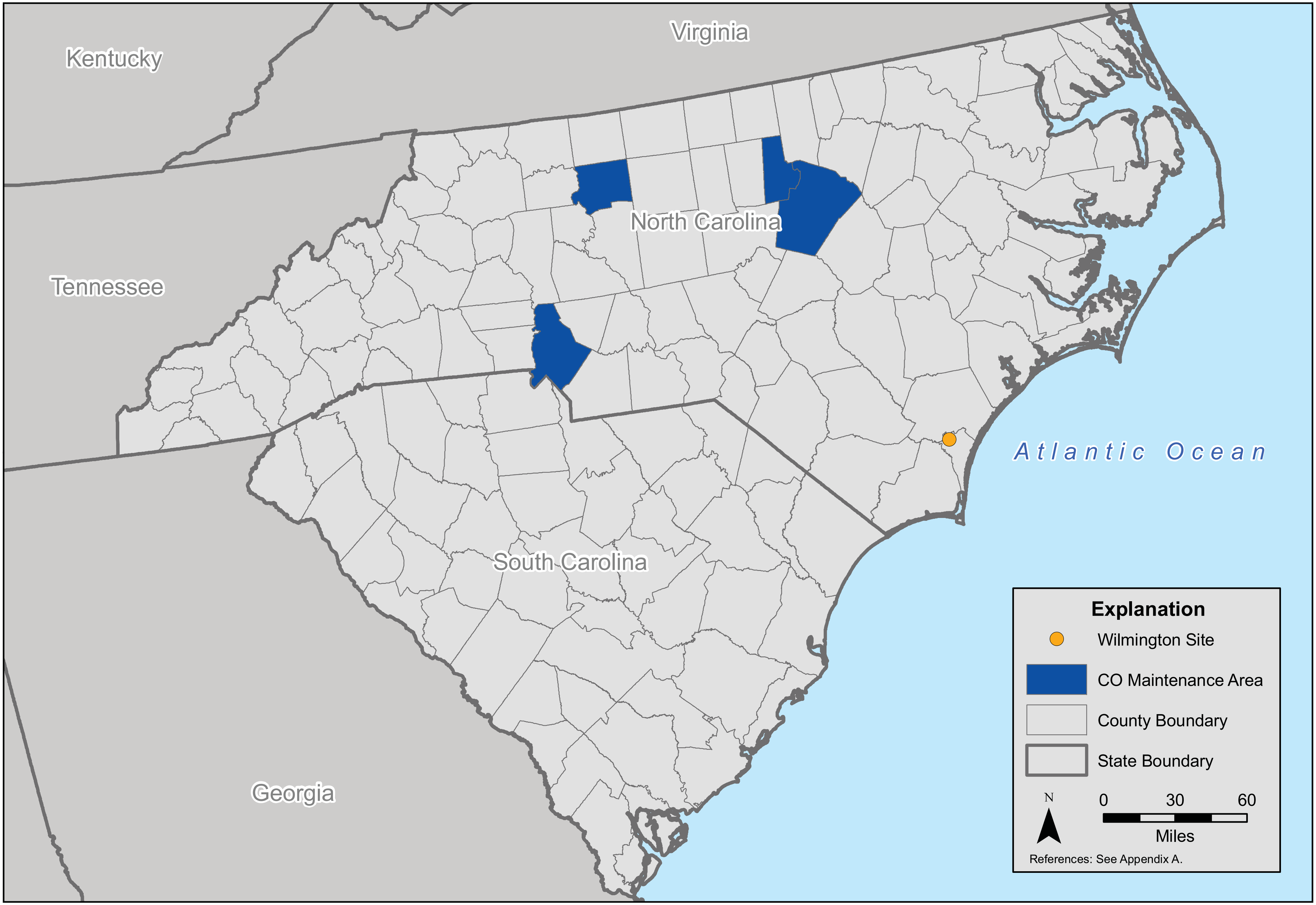


Figure 3.6-39. Wilmington Site location relative to carbon monoxide (CO) maintenance areas.