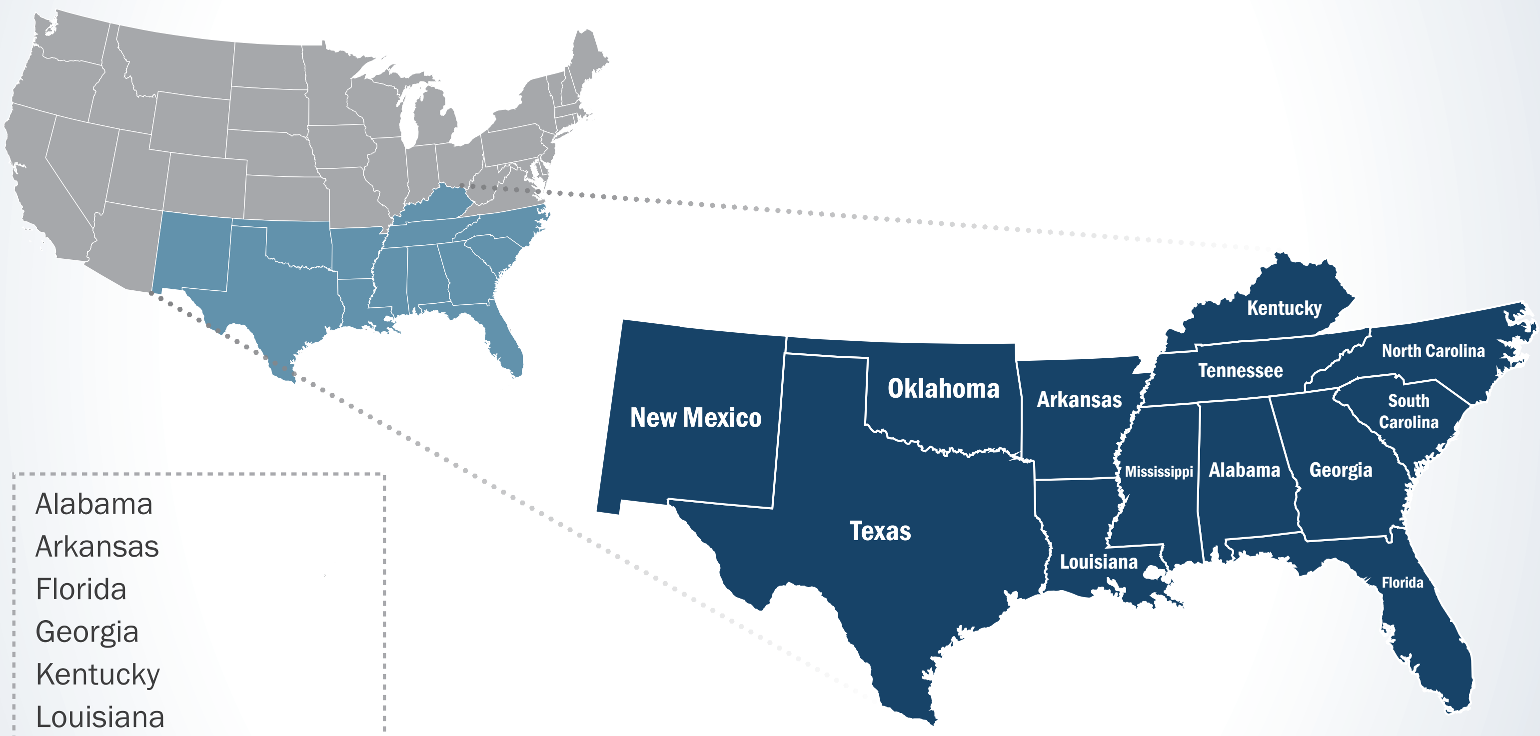
Nationwide Public Safety Broadband Network

Draft Programmatic Environmental Impact Statement for the Southern United States

VOLUME 9 - CHAPTER 11



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First Responder Network Authority

FirstNet®

Nationwide Public Safety Broadband Network

Draft Programmatic Environmental Impact Statement for the Southern United States

VOLUME 9 - CHAPTER 11

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Cooperating Agencies
Federal Communications Commission
General Services Administration
U.S. Department of Agriculture—Rural Utilities Service
U.S. Department of Agriculture—U.S. Forest Service
U.S. Department of Agriculture—Natural Resource Conservation Service
U.S. Department of Defense—Department of the Air Force
U.S. Department of Energy
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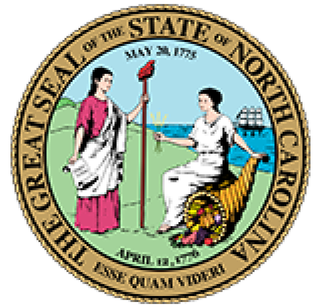
11. NORTH CAROLINA



American Indian tribes with a rich cultural history lived in what is now the state of North Carolina for centuries before the 1600s. North Carolina is the site of the famous "Lost Colony" of Roanoke, which was established in 1584. In 1587, one of the colonial leaders sailed to England for additional supplies and returned to find that the entire colony had disappeared. North Carolina was eventually settled successfully in the early 1700s; in 1789, North Carolina became the 12th colony to ratify the Constitution and become a state (North Carolina Secretary of State 2015). This chapter provides details about the existing environment of North Carolina as it relates to the Proposed Action.

General facts about North Carolina are provided below:

State Nickname: The Old North State or The Tar Heel State (SOSNC, 2016)
Land Area: 48,618 square miles; **U.S. Rank:** 28 (U.S. Census Bureau, 2015a)
Capital: Raleigh
Counties: 100 (U.S. Census Bureau, 2015b)
2015 Estimated Population: 10,042,082; **U.S. Rank:** 9 (U.S. Census Bureau, 2015a) (U.S. Census Bureau, 2015b)
Most Populated Cites: Charlotte, Raleigh, and Greensboro (U.S. Census Bureau, 2015b)
Main Rivers: French Broad, Deep River, Pee Dee River, Lumber River, Northeast Cape Fear River, Cape Fear River, Neuse River, Tar River, Roanoke River, Chowan River, and Haw River (NCDENR, 2013)
Bordering Waterbodies: Atlantic Ocean
Mountain Ranges: Smoky Mountains, Blue Ridge Mountains, and Appalachian Mountains (including the Black Mountains) (SOSNC, 2016b)
Highest Point: Mount Mitchell (6,684 ft.) (USGS, 2015a)

11.1. Affected Environment

11.1.1. Infrastructure

11.1.1.1. Definition of Resource

This section provides information on key North Carolina infrastructure resources that could potentially be affected by FirstNet projects. Infrastructure consists of the systems and physical structures that enable a population in a specified area to function. Infrastructure is entirely manmade with a high correlation between the type and extent of infrastructure and the degree to which an area is characterized as "developed." Infrastructure includes a broad array of facilities such as utility systems, streets and highways, railroads, airports, buildings and structures, ports, harbors and other manmade facilities. Individuals, businesses, government entities, and virtually all relationships between these groups depend on infrastructure for their most basic needs, as well as for critical and advanced needs (e.g., emergency response, health care, and telecommunications).

Section 11.1.1.3 provides an overview of North Carolina's traffic and transportation infrastructure, including road and rail networks and waterway facilities. North Carolina's public safety infrastructure could include any infrastructure utilized by a public safety entity[1] as defined in Title VI of the Middle Class Tax Relief and Job Creation Act of 2012 (Public Law [Pub. L.] No. 112-96, Title VI Stat. 156 (codified at 47 United States Code [U.S.C.] 1401 et seq.) (the Act), including infrastructure associated with police, fire, and emergency medical services (EMS). However, other organizations can qualify as public safety services as defined by the Act. Public safety services in North Carolina are presented in more detail in Section 11.1.1.4. Section 11.1.1.5 describes North Carolina's public safety communications infrastructure and commercial telecommunications infrastructure. An overview of North Carolina utilities, such as power, water, and sewer, is presented in Section 11.1.1.6.

11.1.1.2. Specific Regulatory Considerations

Multiple North Carolina laws and regulations pertain to the state's public utility and transportation infrastructure and its public safety community. Table 11.1.1-1 identifies the relevant laws and regulations, the affected agencies, and their jurisdiction as derived from the state's applicable statutes and administrative rules referenced in column one. Appendix C, Environmental Laws and Regulations, identifies applicable federal laws and regulations.

[1] The term "public safety entity" means an entity that provides public safety services (7 United States Code [U.S.C.] § 1401(26)).

Table 11.1.1-1: Relevant North Carolina Infrastructure Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
North Carolina General Statutes: Chapter 62 Public Utilities	North Carolina Department of Environment Quality (NCDEQ), Division of Energy, Mineral, and Land Resources	Works to obtain the optimum benefits from and acquisition of energy resources and facilities; encourages the development, conservation and responsible use of energy and energy-related facilities, installations, and products as part of a balanced economy and healthy environment; supports the exploration, development, and production of domestic energy supplies.
North Carolina General Statutes: Chapter 62A Public Safety Telephone Service and Wireless Telephone Service	Office of Information Technology Services & Division of Emergency Management	Plans for the prevention of, preparation for, response to, and recovery from natural or manmade emergencies; provides for the cooperation and coordination of activities relating to emergency mitigation, preparedness, response, and recovery among agencies and officials of the state; establishes mutual aid agreements with other states and with the federal government; adopts rules regarding hazardous materials emergency response.
North Carolina General Statutes: Chapter 62 Public Utilities	North Carolina Utilities Commission (NCUC)	Regulates the rates, services and operations, and expansion of public utilities in relation to long-term energy conservation and management policies and statewide development requirements; promotes the development of renewable energy and energy efficiency; develops regulatory policies to govern the provision of telecommunications services to the public which promote efficiency, technological innovation, economic growth, and permit telecommunications utilities a reasonable opportunity to compete.
North Carolina General Statutes: Chapter 20 Motor Vehicles;	North Carolina Department of Transportation (NCDOT), Division of Motor Vehicles (DMV)	Has authority and general supervision over all matters relating to the construction, maintenance, and design of state transportation projects; establishes rules, regulations and ordinances for the placing or erection of telephone, telegraph, electric and other lines that may cause a hazard on highways; authorizes and regulates airports or landing fields; regulates railroads and motor carriers; and the manufacture; sale; licensing, and operation of motor vehicles; designates scenic byways.

11.1.1.3. Transportation

This section describes the transportation infrastructure in North Carolina, including specific information related to the road networks, airport facilities, rail networks, harbors (this Programmatic Environmental Impact Statement [PEIS] defines "harbor" as a body of water deep enough to allow anchorage of a ship or boat), and ports. The movement of vehicles is commonly referred to as traffic, as well as the circulation along roads. Roadways in the state can range from multilane road networks with asphalt surfaces, to unpaved gravel or private roads.

Information regarding the existing transportation systems in North Carolina is based on a review of maps, aerial photography, and federal and state data sources.

The NCDOT has jurisdiction over freeways and major roads, airports, railroads, mass transit, and ports in the state; local counties have jurisdiction for local streets and roads. The mission of the NCDOT is “connecting people, products and places safely and efficiently with customer focus, accountability and environmental sensitivity to enhance the economy and vitality of North Carolina” (NCDOT, 2016).

North Carolina has an extensive and complex transportation system across the entire state. The state’s transportation network consists of:

- 106,202 miles of public roads (FHWA, 2014) and 18,117 bridges (FHWA, 2015a);
- over 3,200 miles of rail network that includes passenger rail and freight (NCDOT, 2015a);
- 468 aviation facilities, including airstrips and heliports (FAA, 2015a);
- 31 harbors (U.S. Harbors, 2015); and
- 2 major ports, including both public and private facilities (North Carolina State Ports Authority, 2012).

Road Networks

As identified in Figure 11.1.1-1, the major urban centers of the state from northwest to southeast are Asheville, Charlotte, Greensboro, Raleigh-Durham, Fayetteville, Jacksonville, and Wilmington (USDOC, 2013a). North Carolina has seven major interstates connecting its major metropolitan areas to one another, as well as to other states. Travel outside the major metropolitan areas is conducted on interstates, and state and county roads. Table 11.1.1-2 lists the interstates and their start/end points in North Carolina. Per the national standard, even numbered interstates run from west to east with the lowest numbers beginning in the south; odd numbered interstates run from north to south with the lowest numbers beginning in the west (FHWA, 2015b).

Table 11.1.1-2: North Carolina Interstates

Interstate	Southern or western terminus in NC	Northern or eastern terminus in NC
I-26	TN line at Ebbs Chapel	SC line at Columbus
I-40	TN line at Cataloochee	U.S.-117 in Wilmington
I-73	U.S.-220 near Ellerbe	Joseph M Bryan Blvd. in Greensboro
I-74	U.S.-220 near Ellerbe	VA line at Lowgap
I-77	SC line at Charlotte	VA line at Lowgap
I-85	SC line at Grover	VA line at Hawtree
I-95	SC line at Rowland	VA line at Pleasant Hill

In addition to the Interstate System, North Carolina has both National Scenic Byways and State Scenic Byways. National and State Scenic Byways are roads that are recognized for one or more archaeological, cultural, historic, natural, recreational, and scenic qualities (FHWA 2013). Figure 11.1.1-1 illustrates the major transportation networks, including roadways, in North Carolina. Section 11.1.8, Visual Resources, describes the National and State Scenic Byways found in North Carolina from an aesthetic perspective.

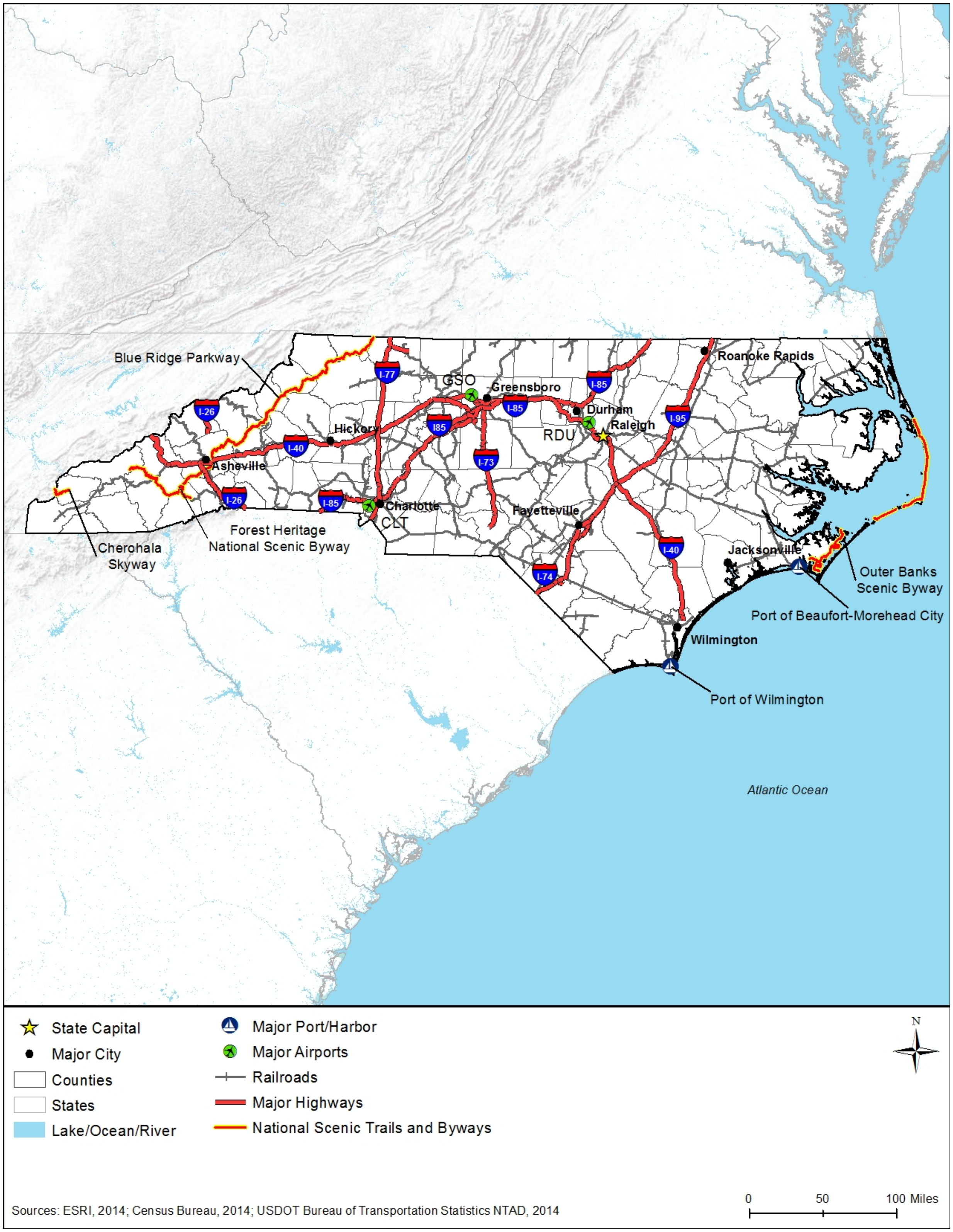


Figure 11.1.1-1: North Carolina Transportation Networks

National Scenic Byways are roads with nationwide interest; the byways are designated and managed by the U.S. Department of Transportation's Federal Highway Administration (FHWA). North Carolina has four National Scenic Byways (FHWA, 2015c):

- Blue Ridge Parkway;
- Cherohala Skyway;
- Forest Heritage National Scenic Byway; and
- Outer Banks Scenic Byway.

State Scenic Byways are roads with statewide interest; State Scenic Byways are designated and managed by NCDOT. Some State Scenic Byways may be designated on portions of National Scenic Byways. North Carolina has 55 State Scenic Byways that crisscross the entire state (NCDOT, 2008): [2]

- Alligator River Route
- Appalachian Medley
- Averasboro Battlefield Scenic Byway
- Birkhead Wilderness Route
- Black Mountain Rag
- Blue-Gray Scenic Byway
- Brunswick Town Road
- Cape Fear Historic Byway
- Cherohala Skyway
- Clayton Bypass Scenic Byway
- Colonial Heritage Byway
- Crowders Mountain Drive
- Devil's Stompin' Ground Road
- Drovers Road
- Edenton-Windsor Loop
- Flint Hill Ramble
- Football Road
- Forest Heritage Scenic Byway
- French Broad Overview
- Grassy Island Crossing
- Green Swamp Byway
- Hanging Rock Scenic Byway
- Historic Flat Rock Scenic Byway
- Indian Heritage Trail
- Indian Lakes Scenic Byway
- Interstate 26 Scenic Highway
- Lafayette's Tour
- Little Parkway
- Meteor Lakes Byway
- Mill Bridge Scenic Byway
- Mission Crossing
- Mt. Mitchell Scenic Drive
- Nantahala Byway
- New River Valley Byway
- North Durham Country Byway
- Outer Banks Scenic Byway
- Pacolet River Byway
- Pamlico Scenic Byway
- Pee Dee Valley Drive
- Perquimans Crossing
- Pisgah Loop Scenic Byway
- Pottery Road
- Roanoke Voyages Corridor
- Rolling Kansas Byway
- Sandhills Scenic Drive
- Scots-Welsh Heritage Byway
- Smoky Mountain Scenic Byway
- South Mountain Scenery
- Tar Heel Trace
- Upper Yadkin Way
- U.S. 421 Scenic Byway
- Uwharrie Scenic Road
- Waterfall Byway
- Whitewater Way
- Yadkin Valley Scenic Byway

[2] The total number of State Scenic Byways may not include those segments of National Scenic Byways that are also designated as State Scenic.

Airports

Air service to the state is provided by three international airports.

- Charlotte/Douglas International Airport (CLT) is owned and operated by the City of Charlotte (CLT, 2015). In 2014, CLT served 44,279,504 passengers, facilitated 545,178 aircraft operations, and handled 132,351 tons of cargo (CLT, 2015). It was the 6th busiest airport in the nation in 2014 for total number of operations and the 8th busiest in the nation for the number of passengers served (CLT, 2015).
- Piedmont Triad International Airport (GSO) is owned, operated, and managed by the Piedmont Triad Airport Authority (PTI, 2016a). In 2015, PTI served 109,498 passengers, handled 13,510,607 pounds of enplaned and 12,666,640 pounds of deplaned cargo (PTI, 2016b) (PTI, 2016c).
- Raleigh-Durham International Airport (RDU) is managed by the Raleigh-Durham Airport Authority (RDU, 2015). In 2014, RDU served 4,744,162 passengers, handled 76,424,370 pounds of enplaned and 91,600,879 pounds of deplaned cargo, and facilitated 183,557 aircraft operations (RDU, 2014).

Figure 11.11-1 illustrates the major transportation networks, including airports, in the state. Section 11.1.7, Land Use, Recreation, and Airspace, provides detail on airports and airspace in North Carolina.

Rail Networks

North Carolina is connected to a network of passenger rail (Amtrak) and freight rail. North Carolina has over 3,200 miles of railroad tracks that reach 86 of the state’s 100 counties (NCDOT, 2015a). Figure 11.1.1-1 illustrates the major transportation networks, including rail lines, in North Carolina.

Amtrak runs three lines through North Carolina. Amtrak stops at 16 communities in North Carolina and over 70 percent of the state’s population resides within 30 miles of a train station (NCDOT, 2015a). In 2013, Amtrak served almost 1,000,000 passengers in North Carolina (NCDOT, 2015a). The most popular route within North Carolina is between the cities of Charlotte and Raleigh; the most heavily traveled interstate route is between Raleigh and Washington, DC (NCDOT, 2015a). Table 11.1.1-3 provides a complete list of Amtrak lines that run through North Carolina.

Table 11.1.1-3: Amtrak Train Routes Serving North Carolina

Route	Starting Point	Ending Point	Length of Trip
Carolinian/Piedmont	New York, NY	Charlotte, NC	13 hours 30 minutes
Crescent	New York, NY	New Orleans, LA	30 hours
Silver Service/Palmetto	New York, NY	Tampa/Miami, FL	28+ hours

Source: (Amtrak, 2015a) (Amtrak, 2015b)

Two Class I freight rail companies operate in North Carolina: the Norfolk Southern Railway and CSX Transportation; in addition, 20 short line railroads run in the state (NCDOT, 2015a). In

2012, 10.4 million tons of freight rail originated in North Carolina and 47.9 tons of freight terminated in the state (NCDOT, 2015a).

Harbors and Ports

North Carolina's eastern coast is contains numerous beaches and small harbors. There are 31 named harbors and ports in the state (U.S. Harbors, 2015). South of Cape Hatteras, the cape shields the northern mainland from major storms, and thereby shelters numerous harbors in the Albemarle and Pamlico Sounds. Many of these harbors are used as private or public marinas, such as the facilities in Elizabeth City or Manteo (Marinas, 2015). The states two major ports are Wilmington and Morehead City, both of which are owned and operated by the North Carolina State Ports Authority (NCPorts, 2015a). Facilities for the Port of Wilmington are along the east bank of the Cape Fear River, south of the city of Wilmington, with road access via State Routes 117 or 421 (NCPorts, 2015b). The Port of Morehead City is between the cities of Morehead and Beaufort on a spur of land in the water between the Calico Bay and the Bouge Sound. The Port of Morehead City is served by State Routes 70 or 17, with connections to I-95 or I-40 (NCPorts, 2015c). Port locations are shown in Figure 11.1.1-1.

The Port of Wilmington has a 42-foot navigational cannel and terminals equipped for both container cargo and general cargo. Rail services is provided by CSX Transportation (NCPorts, 2015b). Its location near I-85 facilitates intermodal transportation to other large North Carolina cities, such as Greensboro or Charlotte (NCPorts, 2015d). The United States Census Bureau reports that the Port of Wilmington imported \$5.8 billion worth of cargo, weighing 5.3 million tons, and exported \$4.2 billion in cargo, weighing 3.1 million tons in 2013 (U.S. Census Bureau, 2015c).

The Port of Morehead City is the United States' second largest importer of natural rubber. The port ships both bulk and breakbulk cargo. Rail service is provided by Norfolk Southern (NCPorts, 2015e). Proposals have been submitted to construct facilities to handle wood pellets and forest product exports at the port (NCPorts, 2015f). The U.S. Census Bureau reports that the Port of Morehead imported \$372 million in cargo, weighing 1.2 million tons, and exported \$491 million, weighing 731 thousand tons in 2013 (U.S. Census Bureau, 2015c).

11.1.1.4. Public Safety Services

North Carolina public safety services generally consist of public safety infrastructure and first responder personnel throughout the state. The general abundance and distribution of public safety services may roughly follow key state demographic indicators. Table 11.1.1-4 presents North Carolina's key demographics including population; land area; population density; and number of counties, cities/towns, and municipal governments. More information about these demographics is presented in Section 11.1.9, Socioeconomics.

Table 11.1.1-4: Key North Carolina Indicators

North Carolina Indicators	
Estimated Population (2015)	10,042,082
Land Area (square miles) (2010)	48,618
Population Density (persons per sq. mile) (2010)	196.1
Municipal Governments (2013)	548

Sources: (U.S. Census Bureau, 2015a) (U.S. Census Bureau, 2013) (National League of Cities, 2007)

Table 11.1.1-5 presents North Carolina's public safety infrastructure, including fire and rescue stations, law enforcement agencies, and fire departments.

Table 11.1.1-5: Public Safety Infrastructure in North Carolina by Type

Infrastructure Type	Number
Fire and Rescue Stations [a]	1,682
Law Enforcement Agencies [b]	504
Fire Departments [c]	1,083

[a] Data collected by the U.S. Fire Administration in 2015.
[b] Number of agencies from state and local law enforcement include: local police departments, sheriffs' offices, primary state law enforcement agencies, special jurisdictional agencies, and other miscellaneous agencies, collected by the U.S. Bureau of Justice Statistics in 2008.
[c] Data collected by the U.S. Fire Administration in 2015.
Sources: (U.S. Fire Administration, 2015) (U.S. Bureau of Justice Statistics, 2011)

Table 11.1.1-6 identifies first responder personnel including dispatch, fire and rescue, law enforcement, and emergency medical personnel in the state.

Table 11.1.1-6: First Responder Personnel in North Carolina by Type

First Responder Personnel	Number
Police, Fire and Ambulance Dispatchers [a]	3,610
Fire and Rescue Personnel [b]	46,029
Law Enforcement Personnel [c]	35,140
Emergency Medical Technicians and Paramedics [d e]	10,180

[a] BLS Occupation Code: 43-5031.
[b] BLS Occupation Codes: 33-2011 (Firefighters), 33-2021 (Fire Inspectors and Investigators), 33-1021 (First-Line Supervisors of Fire Fighting and Prevention Workers), and 53-3011 (Ambulance Drivers and Attendants, Except Emergency Medical Technicians). Volunteer firefighters reported by the U.S. Fire Administration.
[c] Full-time employees from state and local law enforcement agencies which include: local police departments, sheriffs' offices, primary state law enforcement agencies, special jurisdictional agencies, and other miscellaneous agencies, collected by the U.S. Bureau of Justice Statistics in 2008.
[d] BLS Occupation Code: 29-2041.
[e] All BLS data collected in 2015.
Sources: (U.S. Fire Administration, 2015) (U.S. Bureau of Justice Statistics, 2011) (BLS, 2015a)

11.1.1.5. Telecommunications Resources

There is no central repository of information for public safety communications infrastructure and commercial telecommunications infrastructure; therefore, the following information and data are combined from a variety of sources, as referenced. Communications throughout the state are based on a variety of publicly and commercially owned technologies, including coaxial cable (traditional copper cable), fiber optics, hybrid fiber optics/coaxial cable, microwave, wireless, and satellite systems providing voice, data, and video services (BLS, 2016).

Figure 11.1.1-2 presents a typical wireless configuration including both a narrowband public safety land mobile radio network (traditional radio network) and a commercial broadband access network (wireless technology); backhaul (long-distance wired or wireless connections), core, and commercial networks including a long term evolution (LTE) evolved packet core (modern broadband cellular networks); and network applications (software) delivering voice, data, and video communications (FCC, 2016a).

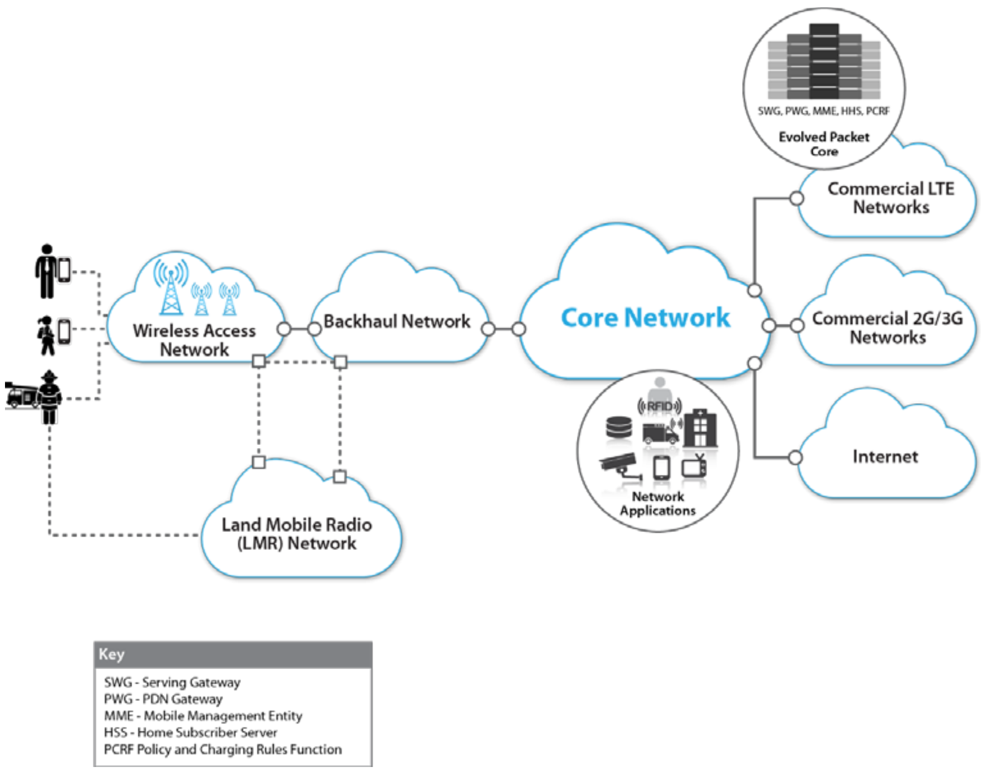


Figure 11.1.1-2: Wireless Network Configuration

Prepared by: Booz Allen Hamilton

Public Safety Communications

In order to protect and best serve the public interest, first responder and law enforcement communities must be able to communicate effectively. The evolution of the communications networks used by public safety stakeholders toward a broadband wireless technology, such as LTE (see Section 11.1.1, Infrastructure), has the potential to provide users with better coverage, while offering additional capacity and enabling the use of new applications that would likely make their work safer and more efficient. Designing such a network presents several challenges due to the uniqueness of the deployment, the requirements, and the nationwide scale (NIST, 2015). Historically, there have been many challenges and impediments to timely and effective sharing of information. Communication interoperability has also been a persistent challenge, along with issues concerning spectrum availability, embedded infrastructure, and differing standards among stakeholders (NTFI, 2005). This has caused a fragmented approach to communications implementation across the U.S. and at the state level, including in North Carolina.

There are five key reasons why public safety agencies often cannot connect through existing communications (NTFI, 2005):

- Incompatible and aging communications equipment;
- Limited and fragmented funding;
- Limited and fragmented planning;
- A lack of coordination and cooperation; and
- Limited and fragmented radio spectrum.

To help enable the public safety community to incorporate disparate Land Mobile Radio networks with a nationwide public safety LTE broadband network, the U.S. Department of Commerce Public Safety Communications Research Program (PSCR) – Boulder Laboratories, in 2015, prepared a locations-based services (LBS) research and development roadmap to examine the current state of location-based technologies, forecast the evolution of LBS capabilities and gaps, and identify potential research and development opportunities that would improve the public safety community's use of LBS within operational settings. This is the first of several technology roadmaps that PSCR plans to develop over the next few years (PSCR, 2015).

Like most states, North Carolina's public safety land mobile radio (LMR) network environment is facing transition and reflects the challenges of the need for greater system capabilities. These require investment in 800 MHz upgrades, site expansion investment in sustainment of local legacy Very High Frequency (VHF)[2] networks, planning for adoption of broadband, and an overall technology modernization.[3]

North Carolina's Voice Interoperable Plan for Emergency Responders (VIPER) Statewide P25 Network, a 700 MHz/800 MHz LMR system, provides statewide coverage for public safety and emergency communications agencies in the state. It also interoperates with South Carolina's statewide public safety network (RadioReference.com, 2015a). The managing agency for the VIPER statewide network is the North Carolina State Highway Patrol.

In 2009, the Microelectronics Center of North Carolina (MCNC), the operator of the North Carolina Research and Education Network (NCREN), was awarded a National Information Telecommunications Administration (NTIA) Broadband Technology Opportunities Program (BTOP) fiber infrastructure grants, which significantly extended fiber connectivity and capacity throughout North Carolina. The grant was focused on improving educational and research/university facilities' connectivity and end-user access to higher speed service (NTIA, 2010a).

[3] VHF band covers frequencies ranging from 30 MHz to 300 MHz (NTIA, 2005).

In 2010, the City of Charlotte was awarded a BTOP 700 MHz infrastructure grant for the CharMeck project, in order to enable broadband public safety communications in Charlotte and Mecklenburg County (NTIA, 2010b). The plan was to construct 24 new towers; however, the broadband project was restructured and the remaining $8.8 million funds from the original $16.7 million grant are being redeployed to LMR network infrastructure improvement (City of Charlotte, 2015).

Figure 11.1.1-3 depicts the NCREN fiber network footprint, which the state has indicated it can leverage in its modernization plans and transition to broadband public safety communications in future. Because of the BTOP MCNC grant, the presence of fiber points and interconnection points, especially in underserved and rural counties, increased significantly (MCNC, 2015).

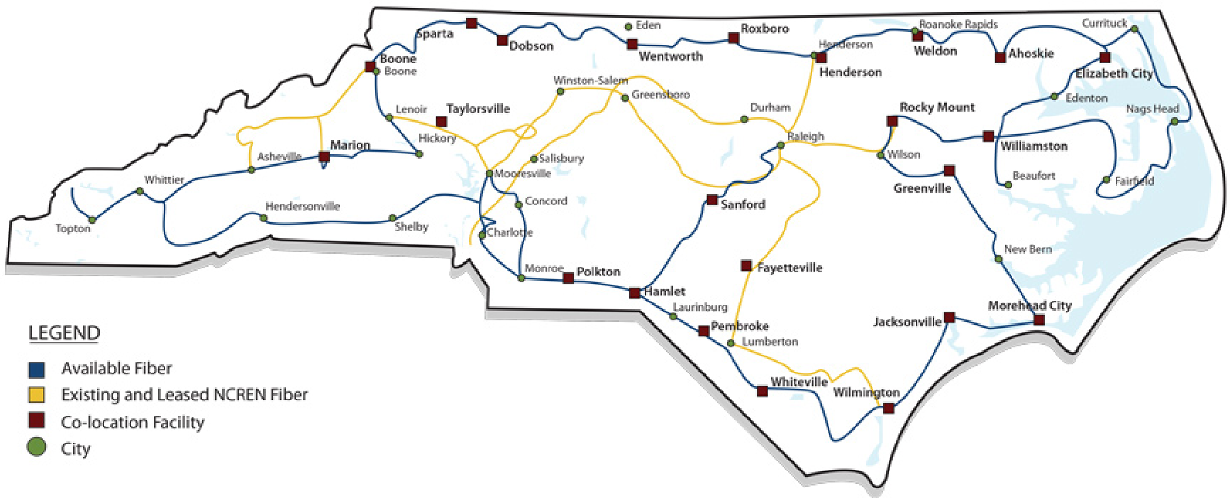


Figure 11.1.1-3: North Carolina Research and Education Network Fiber Footprint

Source: (MCNC, 2015)

Statewide/Multi-County Public Safety Networks

North Carolina's VIPER statewide network's network design and wireless infrastructure deployment is organized around three zones or major regions in North Carolina: (Zone 1) Piedmont (including central region), (Zone 2) Central North Carolina, and (Zone 3) Eastern North Carolina (RadioReference.com, 2015a). Figure 11.1.1-4 depicts the VIPER Zones and respective counties covered by the statewide P25 system.

The VIPER network will be a 214 LMR tower site network (when fully deployed) of which 210 are currently operational; the network serves 78,000 users across 268 emergency responding agencies (NCDPS, 2015). The VIPER network enjoys very high adoption across a broad range of public safety and emergency responder agencies across state highway patrol, sheriff, fire, EMS, university police, and emergency management (RadioReference.com, 2015a).

County/City Public Safety Networks

There are 23 public safety digital P25 networks operating in North Carolina, which serve county public safety as well as city/town local public safety users. These P25 networks interoperate with the statewide P25 VIPER network and the majority of these networks operate on the 800 MHz frequency band. Table 11.1.1-7 provides the network names/locations as well as the operating frequencies for each network (Project 25.org, 2015).

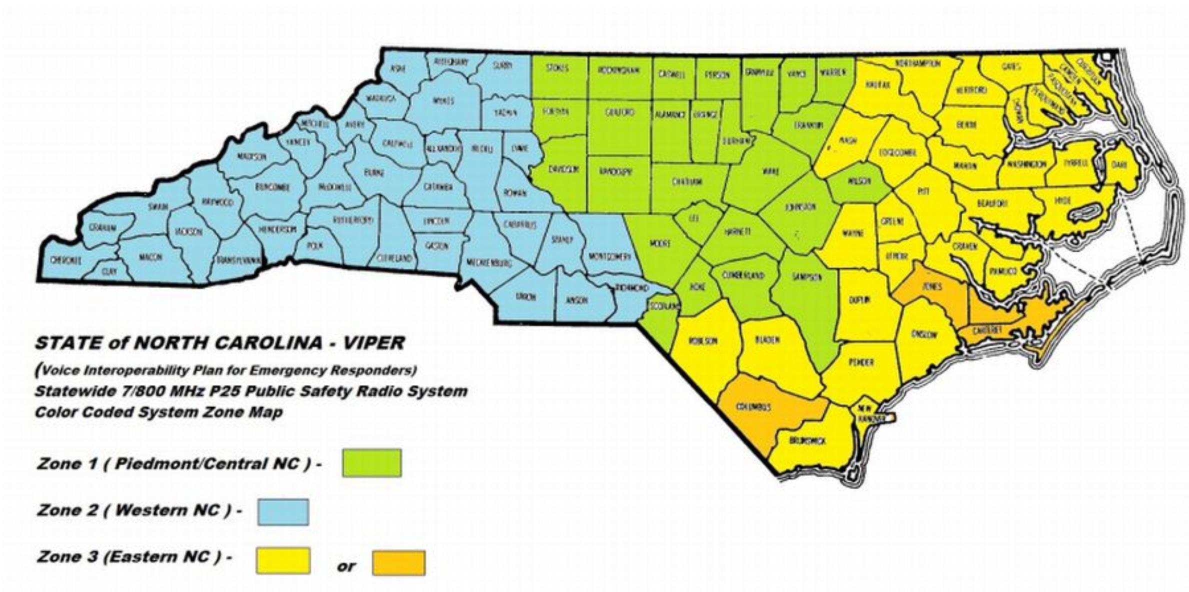


Figure 11.1.1-4: VIPER Zone County Assignments and Coverage

Source: (RadioReference.com, 2015b)

In addition to the widespread adoption of digital P25 systems in multiple counties in North Carolina, the state's local public safety county and city agencies continue to depend on a variety of analog VHF networks and non-P25 digital network technologies such as Enhanced Digital Access Communications System (EDACS). Examples of key EDACS North Carolina systems include Harnett County Public Safety and Johnston County Public Safety (RadioReference.com, 2015c).

Table 11.1.1-7: North Carolina Public Safety P25 Networks

Project 25 Network	Frequency Band
Buncombe County Public Safety System P25	700 MHz
Cary City Services (P25) System	800 MHz
Charlotte/Mecklenburg County (P25)	800 MHz
City of Durham	800 MHz
Cleveland County Public Safety System	800 MHz
Dare County Public Safety System P25	800 MHz
Franklin County Project 25	VHF
Greensboro/Guilford County	800 MHz
Hickory Public Safety P25	800 MHz
High Point Public Safety	800 MHz
Jacksonville/Onslow County	800 MHz
New Bern Public Safety (P25) System	800 MHz
New Hanover County P25 System	800 MHz
New Hanover Regional Medical Center (P25)	800 MHz

Project 25 Network	Frequency Band
Statesville Public Safety System	800 MHz
Tarboro	800 MHz
VIPER Statewide P25	700 MHz/800 MHz
Wake County Simulcast	800 MHz
Wayne County P25	VHF
Wilson P25	800 MHz
Onslow County/Jacksonville City	800 MHz
Pitt County, Greenville NC	700 MHz
Salisbury Rowan County	800 MHz

Source: (Project 25.org, 2015)

Public Safety Answering Points (PSAPs)

According to the Federal Communication Commission's (FCC) Master PSAP registry, there are 157 PSAPs in North Carolina serving North Carolina's 100 counties (FCC, 2015b).

Commercial Telecommunications Infrastructure

North Carolina's commercial telecommunications industry and infrastructure is robust with multiple service providers, offering products and services via the full spectrum of telecommunications technologies (FCC, 2014a) (FCC, 2014b). The following subsections present information on North Carolina's commercial telecommunications infrastructure, including information on the number of carriers and technologies deployed; geographic coverage; voice, Internet access, and wireless subscribers; and the quantity and location of telecommunications towers, fiber optic plant, and data centers.

Carriers, Coverage, and Subscribers

North Carolina's commercial telecommunications industry provides the full spectrum of telecommunications technologies and networks, including coaxial cable (traditional copper cable), fiber optics, hybrid fiber optics/coaxial cable, microwave, wireless, and satellite systems. Table 11.1.1-8 presents the number of providers of switched access[4] lines, Internet access[5], and mobile wireless services including coverage.

Table 11.1.1-8: Telecommunications Access Providers and Coverage in North Carolina as of December 31, 2013

Commercial Telecommunications Access Providers	Number of Service Providers	Coverage of Households
Switched access lines [a]	177	97.8% of households [b]
Internet access [b]	0	58% of households
Mobile wireless [c]	22	91% of population

[a] Switched access lines are a service connection between an end user and the local telephone company's switch (the basis of older telephone services); this number of

[4] "A service connection between an end user and the local telephone company's switch; the basis of plain old telephone services." (FCC 2014b)
[5] Internet access includes DSL, cable modem, fiber, satellite, and fixed wireless providers.

service providers was reported by the FCC as of December 31, 2013 in Table 17 as the total of ILEC and non-ILEC providers (FCC, 2014b).

[b] Household coverage data provided by the FCC in "Universal Service Monitoring Report" as a Voice Penetration percentage (percentage of household with a telephone in the unit) and is current as of 2013.

[c] Internet access providers are presented in Table 21 by technology provided; the number of service providers is calculated by subtracting the reported Mobile Wireless number from the total reported number of providers. Household coverage is provided in Table 13 (FCC, 2014a).

[d] Mobile wireless provider data was retrieved from the FCC National Broadband Map website (www.broadbandmap.gov/data-download). The process of the data collection is explained in the broadband footnote.

Sources: (FCC 2014a) (FCC 2014b) (NTIA, 2014) (FCC, 2013)

Table 11.1.1-9 shows the wireless providers in North Carolina along with their geographic coverage. The following four maps (Figures 11.1.1-5 through 11.1.1-8) show: the combined coverage for the top two providers, AT&T Mobility and Verizon Wireless' coverage; Sprint and T-Mobile's coverage, Cricket Wireless' coverage, and; the coverage of all other providers with less than 5 percent coverage area, respectively.[6]

Table 11.1.1-9: Wireless Telecommunications Coverage by Providers in North Carolina

Wireless Telecommunications Providers	Coverage
AT&T Mobility LLC	90.91%
Verizon Wireless	88.13%
Sprint	52.48%
T-Mobile	14.78%
Cricket Wireless	10.82%
Other[a]	11.93%

[a] Other: Provider with less than 5% coverage area include: Electronics Service Co; North Carolina Wireless; StarVision; Ellerbe Telephone Company; Dnet Internet Services; RidgeComms; MAIN; Media Cast; Chatham Wireless; Skyrunner, Inc.; Electronic Solutions, Inc.; Cashiers Valley Computers; InteliPort, Inc.; TriCounty Telecom; SkyeNet Wireless; Communications Inc.; Epproach Communications, LLC.
Source: (NTIA, 2014)

[6] The broadband map utilized data collected as part of the broadband American Recovery and Reinvestment Act initiative. The data was retrieved from the FCC National Broadband Map website (www.broadbandmap.gov/data-download). Each state's broadband data was downloaded accordingly. The data pertaining to broadband data/coverage for census blocks, streets, addresses, and wireless were used. Census blocks, roads, and addresses were merged into one file and dissolved by similar business and provider names. Square miles were calculated for each provider. The maps show all providers over 5% on separate maps; providers with areas under 5% were merged and mapped as "North Carolina Other Fiber Providers". All Wireless providers were mapped as well; those with areas under 5% were merged and mapped as "North Carolina Other Wireless Providers". Providers under 5% were denoted in their respective tables.

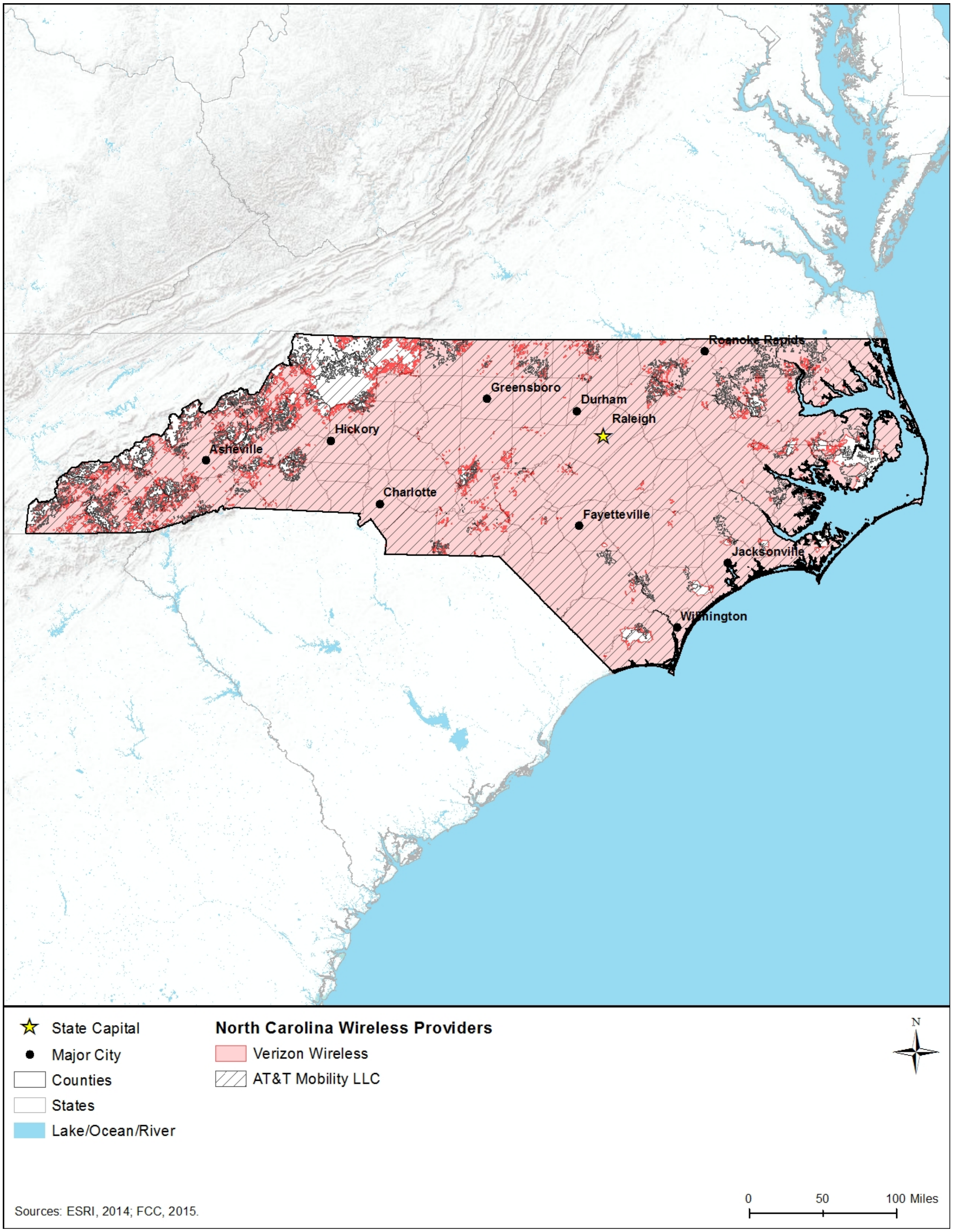


Figure 11.1.1-5: AT&T and Verizon Wireless Availability in North Carolina

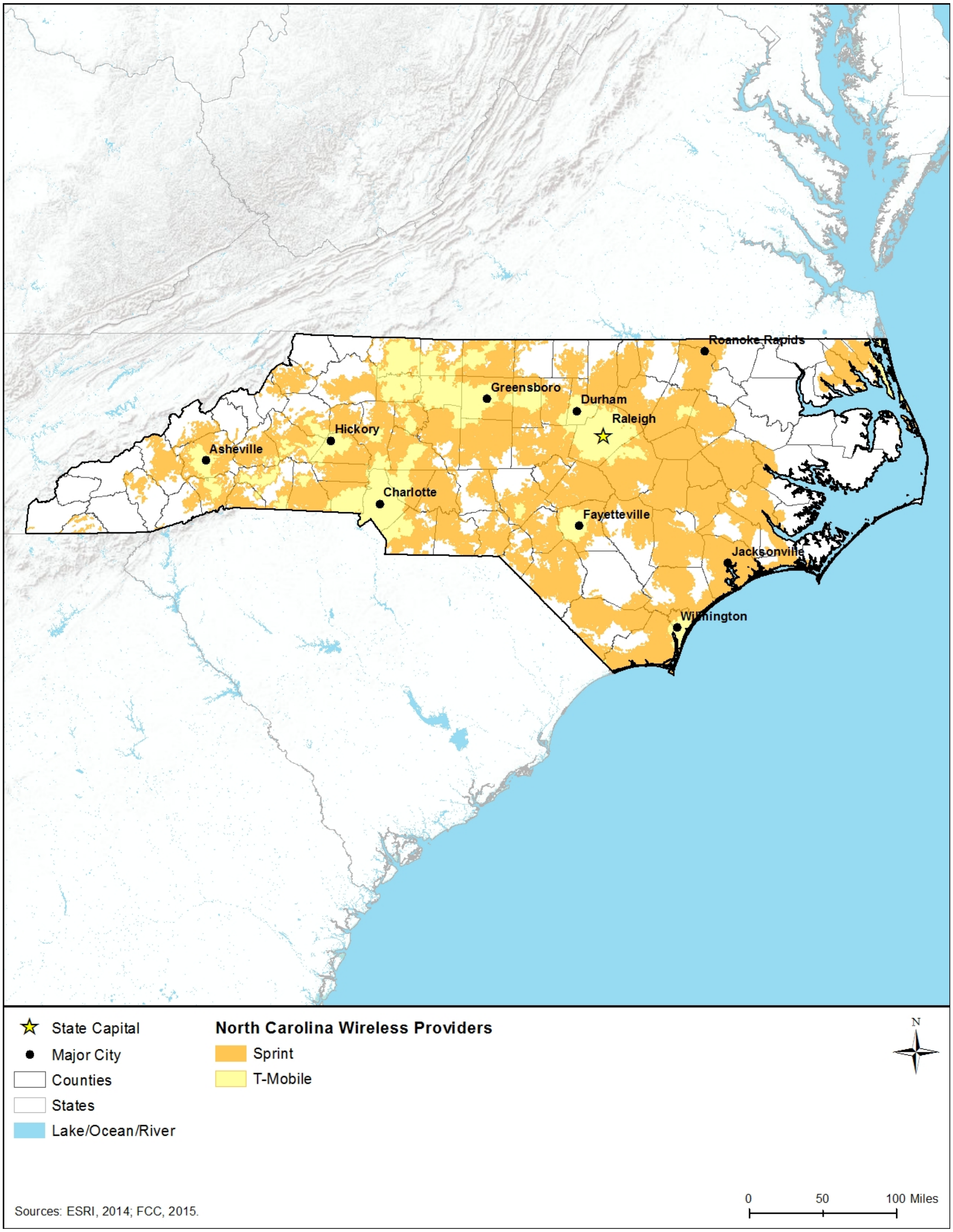


Figure 11.1.1-6: Sprint and T-Mobile Wireless Availability in North Carolina

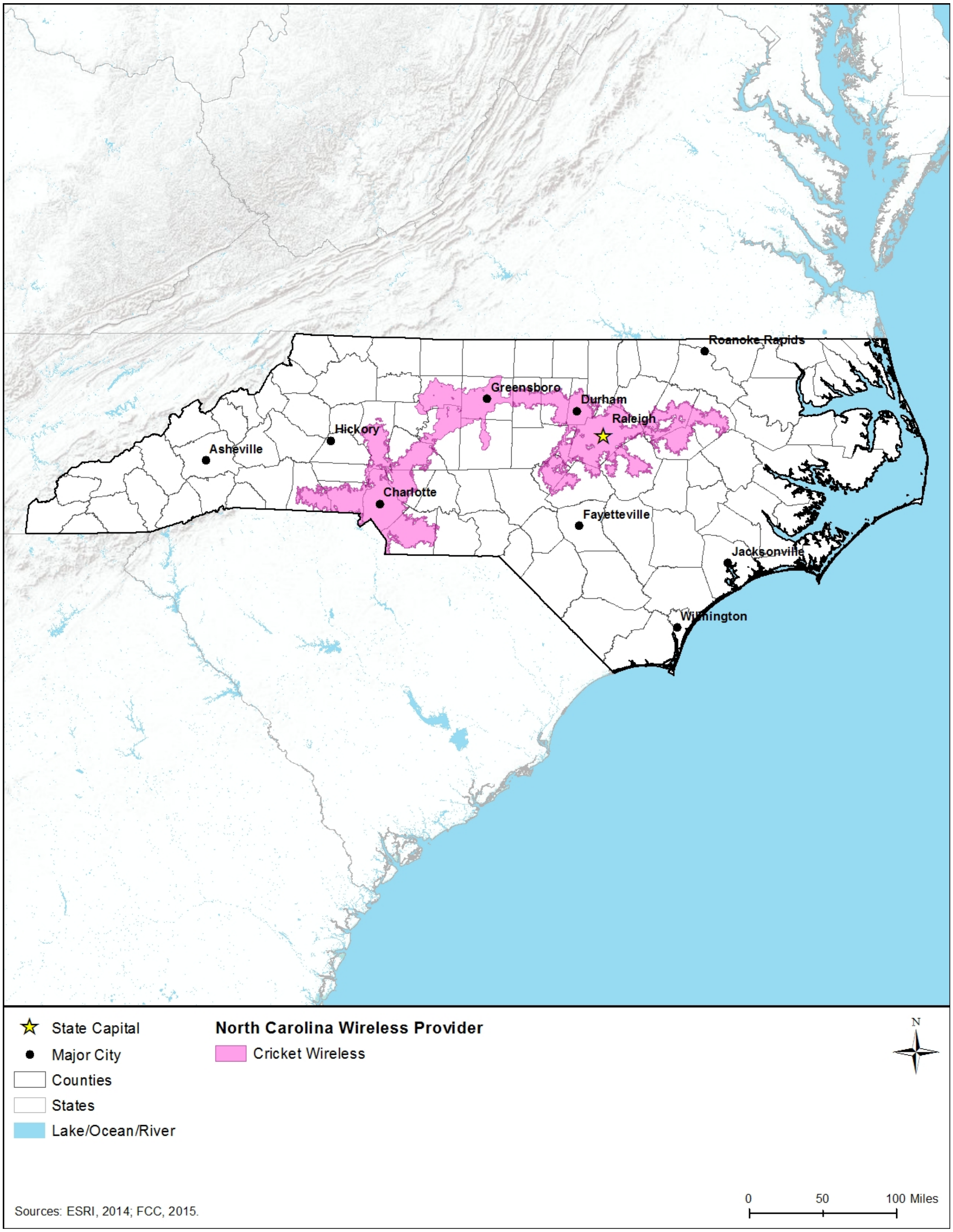


Figure 11.1.1-7: Cricket Wireless' Availability in North Carolina

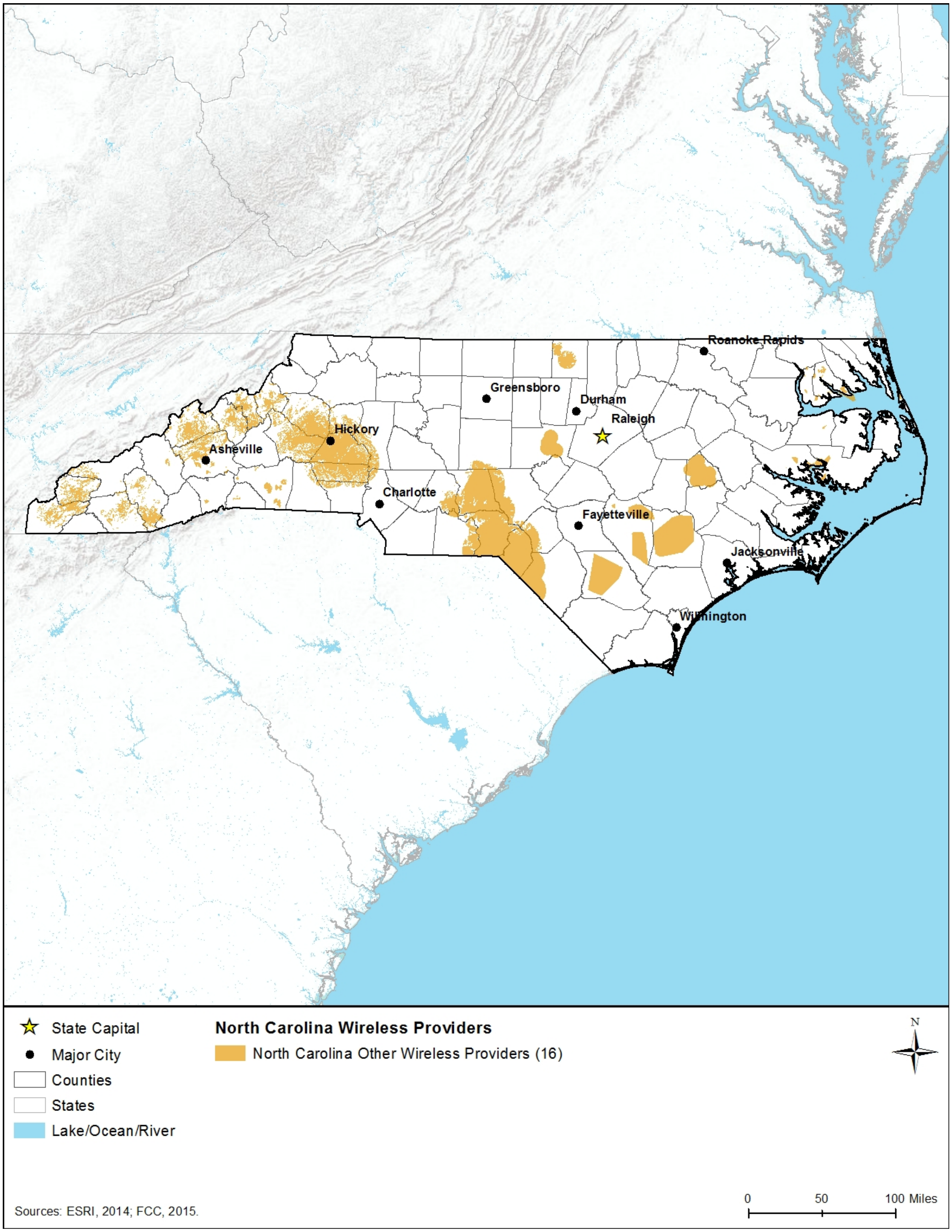


Figure 11.1.1-8: Other Providers Wireless Availability in North Carolina

Towers

There are many types of domestic towers employed today by the telecommunications industry, government agencies, and other owners. Towers are designed and used for a variety of purposes, and the height, location, and supporting structures and equipment are all designed, constructed, and operated according to the technical specifications of the spectrum used, the type of equipment mounted on the tower, geographic terrain, need for line-of-sight transmissions to other towers, radio frequency needs, and other technical specifications. There are three general categories of stand-alone towers: monopole, lattice, and guyed. Typically, monopole towers are the smallest, followed by lattice towers at a moderate height, and guyed towers at taller heights (with the guyed wires providing tension support for the taller heights) (CSC, 2007). In general, taller towers can provide communications coverage over larger geographic areas, but require more land for the actual tower site, whereas shorter towers provide less geographic coverage and require less land for the tower site (USFS, 2009a). Figure 11.1.1-9 presents representative examples of each of these categories or types of towers.

Monopole
100 – 200 feet
Source: http://laps.noaa.gov/birk/laps_intranet/site_photos/Monarch/tower.jpg

Lattice
200 – 400 feet
Source: Personal Picture

Guyed
200 – 2,000 feet
Source: http://www.esrl.noaa.gov/gmd/ccgg/insitu/

Figure 11.1.1-9: Types of Towers

Prepared by: Booz Allen Hamilton

Telecommunications tower infrastructure proliferates throughout North Carolina, although tower infrastructure is concentrated in the higher and more densely populated areas of North Carolina. Owners of towers and some types of antennas are required to register those infrastructure assets with the FCC (FCC, 2016b).[7] Table 11.1.1-10 presents the number of towers (including broadcast towers) registered with the FCC in North Carolina, by tower type, and Figure 11.1.1-10 presents the location of those 3,090 structures, as of June 2016.

[7] An antenna structure must be registered with the FCC, if the antenna structure is taller than 200 feet above ground level or may interfere with the flight path of a nearby airport (FCC, 2016c).

Table 11.1.1-10: Number of Commercial Towers in North Carolina by Type

Constructed[a] Towers[b]		Constructed Monopole Towers	
100 ft. and over	470	100 ft. and over	0
75 ft. – 100 ft.	987	75 ft. – 100 ft.	6
50 ft. – 75 ft.	657	50 ft. – 75 ft.	122
25 ft. – 50 ft.	219	25 ft. – 50 ft.	52
25 ft. and below	36	25 ft. and below	3
Subtotal	2,369	Subtotal	183
Constructed Guyed Towers		**Buildings with Constructed Towers**	
100 ft. and over	68	100 ft. and over	1
75 ft. – 100 ft.	72	75 ft. – 100 ft.	3
50 ft. – 75 ft.	12	50 ft. – 75 ft.	3
25 ft. – 50 ft.	5	25 ft. – 50 ft.	3
25 ft. and below	1	25 ft. and below	0
Subtotal	158	Subtotal	10
Constructed Lattice Towers		**Multiple Constructed Structures[c]**	
100 ft. and over	30	100 ft. and over	2
75 ft. – 100 ft.	235	75 ft. – 100 ft.	0
50 ft. – 75 ft.	64	50 ft. – 75 ft.	1
25 ft. – 50 ft.	19	25 ft. – 50 ft.	0
25 ft. and below	1	25 ft. and below	0
Subtotal	349	Subtotal	3
Constructed Tanks[d]			
Tanks	18		
Subtotal	18		
Total All Tower Structures		**3,090**	

[a] Planned construction or modification has been completed. Results will return only those antenna structures that the FCC has been notified are physically built or planned modifications/alterations to a structure have been completed. (FCC, 2015a)
[b] Self standing or guyed (anchored) structure used for communication purposes. (FCC, 2012)
[c] Multiple constructed structures per antenna registration. (FCC, 2016c)
[d] Any type of tank – water, gas, etc. with a constructed antenna. (FCC, 2016c)
Source: (FCC, 2015a)

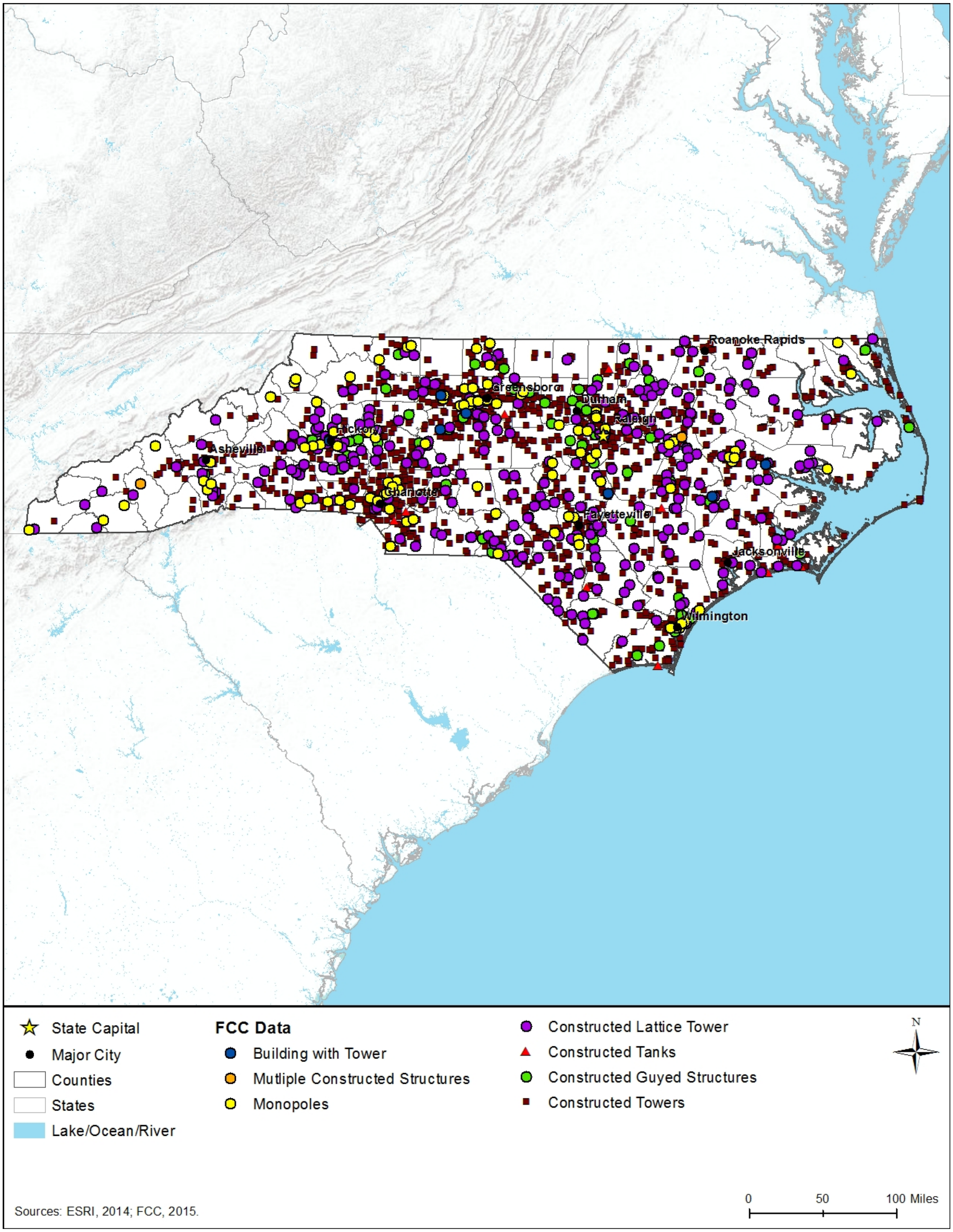


Figure 11.1.1-10: FCC Tower Structure Locations in North Carolina

Fiber Optic Plant (Cables)

Fiber optic plant, or cables, can be buried directly in the ground; pulled, blown, or floated into ducts, conduits, or innerduct (flexible plastic protective sleeves or tubes); placed under water; or installed aerially between poles, typically on utility rights-of-way. A fiber optic network includes an access network consisting of a central office, distribution and feeder plant (cables of various sizes directly leaving a central office and splitting to connect users to the network), and a user location, as shown in Figure 11.1.1-11. The network also may include a middle mile component (shorter distance cables linking the core network between central offices or network nodes across a region) and a long haul network component (longer distance cables linking central offices across regions). (FCC, 2000)

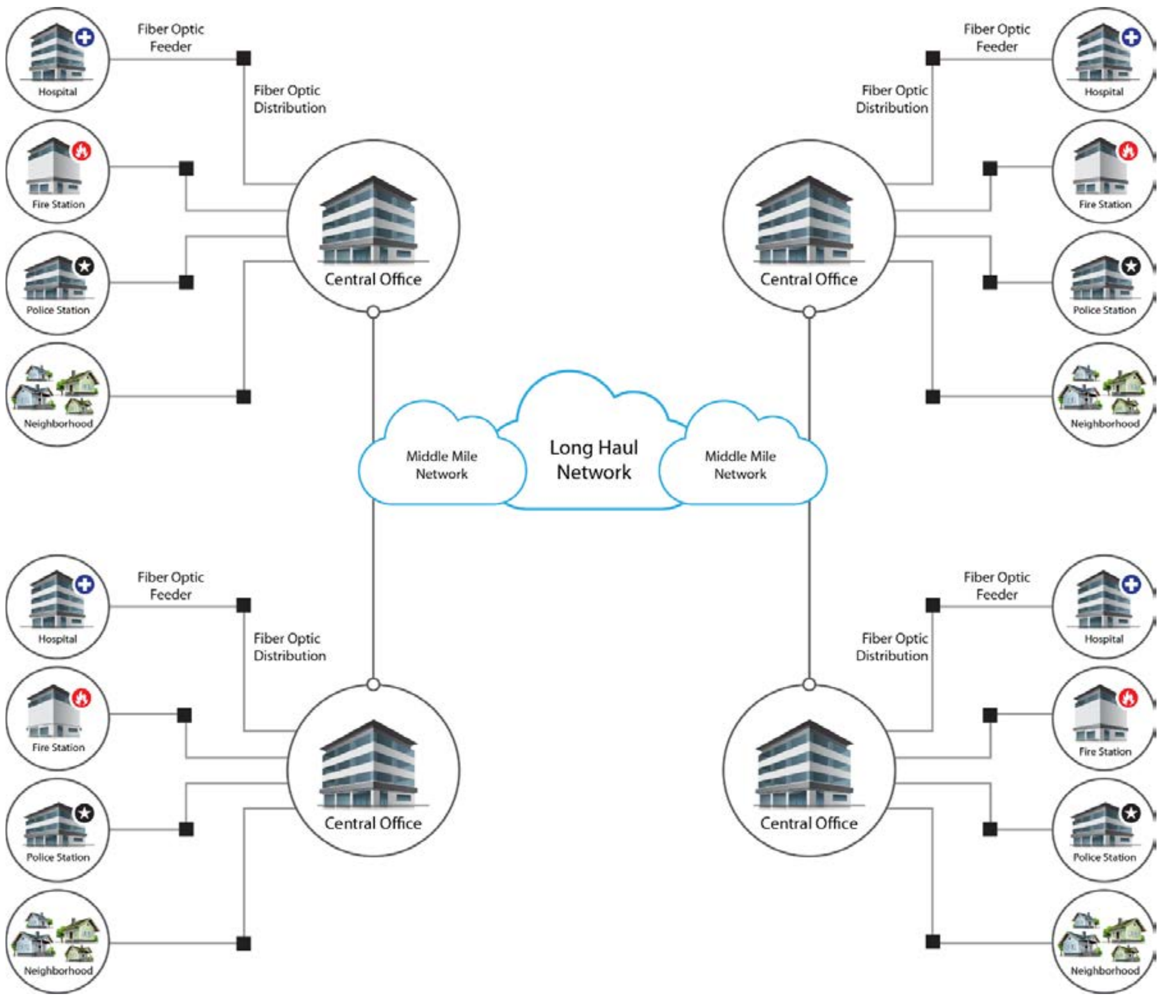


Figure 11.1.1-11: Typical Fiber Optic Network in North Carolina

Source: (ITU-T 2012)
Prepared by: Booz Allen Hamilton

Last Mile Fiber Assets

In North Carolina, fiber access networks are concentrated in the highest population centers as shown in the figures below. There are 46 fiber providers that offer service in the state, as listed in Table 11.1.1-11, and Figure 11.1.1-12 shows coverage for Time Warner Cable and CenturyLink, Figure 11.1.1-13 shows coverage for AT&T North Carolina and Charter Communications Inc., and Figure 11.1.1-14 shows coverage for all other providers with less than 5 percent coverage area, respectively.

Table 11.1.1-11: Fiber Provider Coverage

Fiber Provider	Coverage
Time Warner Cable	29.65%
CenturyLink	25.59%
AT&T North Carolina	14.73%
Charter Communications Inc.	10.78%
Other [a]	22.22%

[a] Other: Provider with less than 5% coverage area include: MegaPath Corporation; Windstream Corporation: Frontier Communications of the Carolinas, Inc.; Suddenlink Communications; Surry Telephone Membership Corporation; Skyline Telephone Membership Corporation; North State Communications; Yadtel; Star Telephone Membership Corporation; Wilkes Communications; ATMC; Morris Broadband LLC; Mediacom; Randolph Telephone Membership Corporation; Comporium Communications; TriCounty Telecom; Level 3 Communications, LLC; Ellerbe Telephone Company; Northland Communications; Country Cablevision; BRMEMC.net; Piedmont Communications; Comcast; MI-Connection; Zito Media; Greenlight; TDS Telecom; Carolina Mountain Cablevision; StarVision; CoMPAS Cable; MCNC; Cherokee Cablevision; Skybest Communications; Verizon; Reds Cable TV; Pineville Telephone Company; RST Fiber; Tele-Media; DukeNet Communications; Crystal Broadband Networks; Cogent Communications, Inc.; ERC Broadband.
Source: (NTIA, 2014)

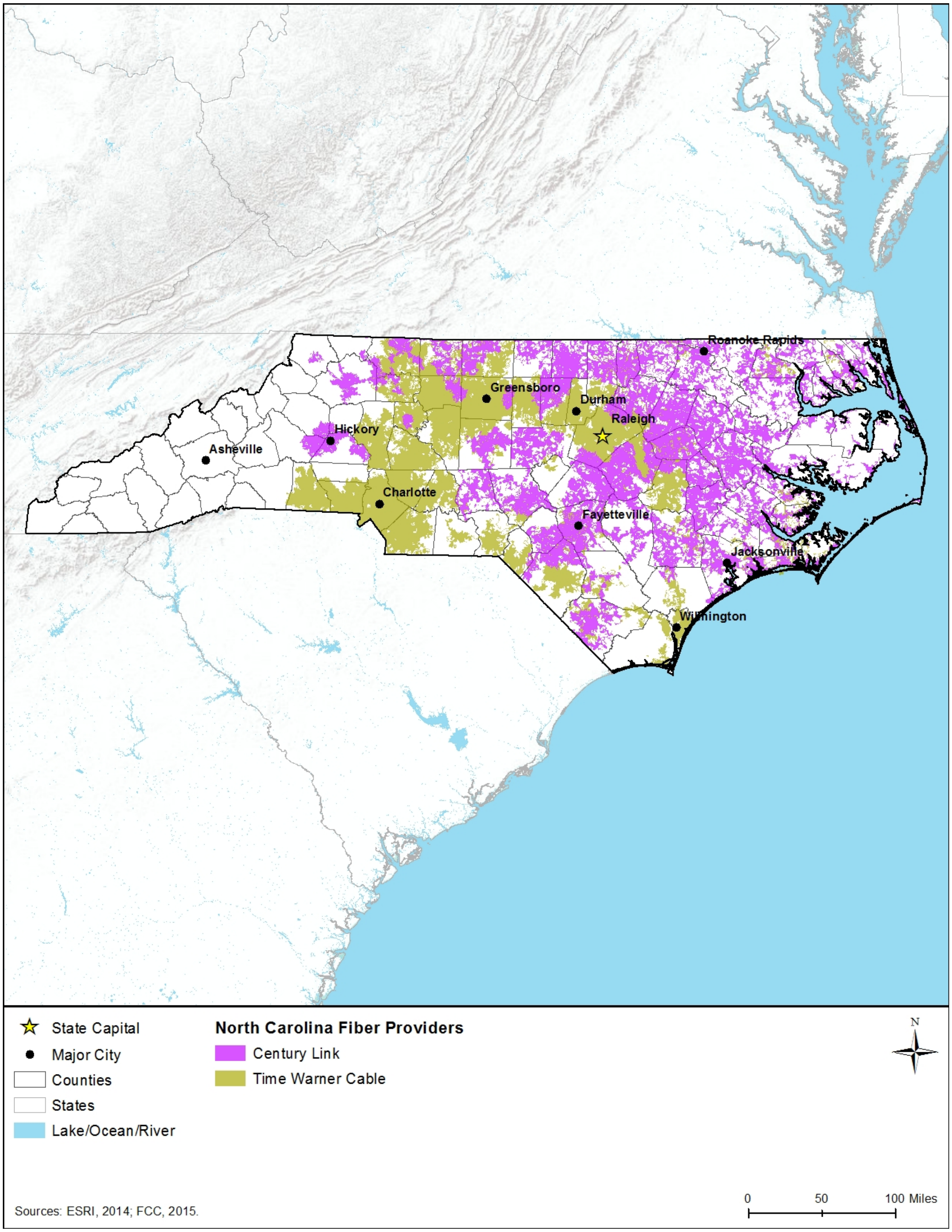


Figure 11.1.1-12: Fiber Availability in North Carolina for Time Warner Cable and CenturyLink

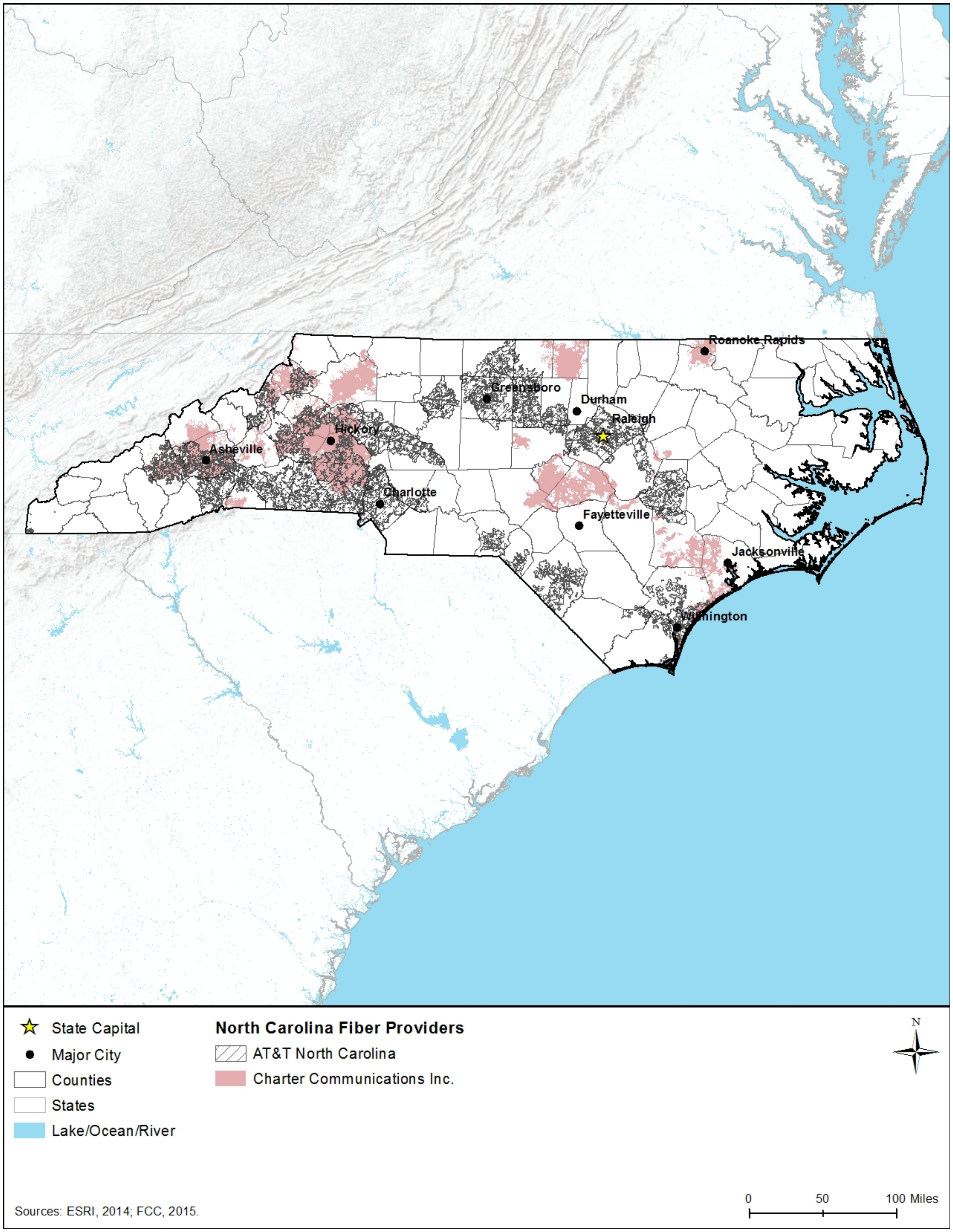


Figure 11.1.1-13: Charter Communication Inc.'s and AT&T's Fiber Availability in North Carolina

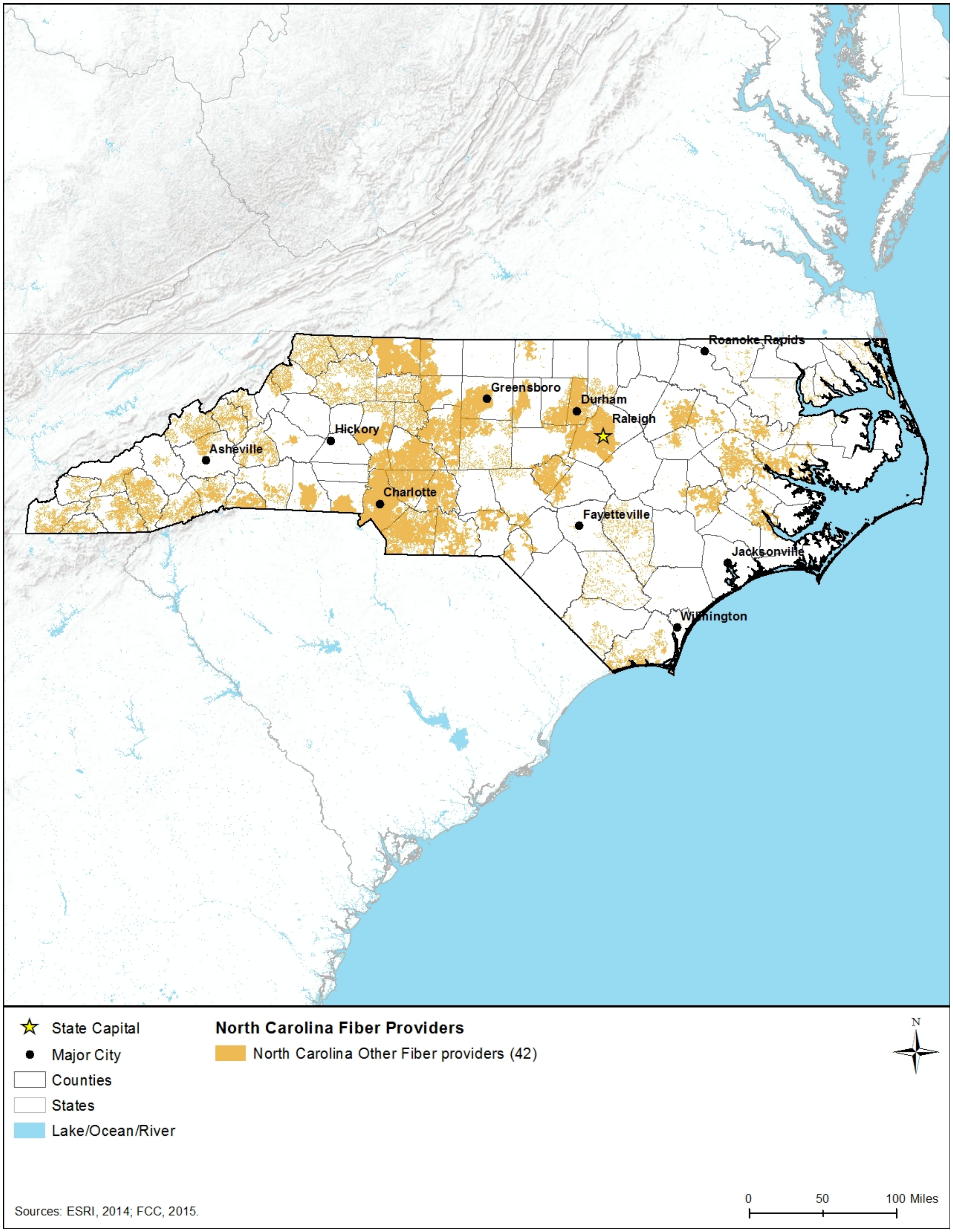


Figure 11.1.1-14: Other Provider's Fiber Availability in North Carolina

Data Centers

Data centers (also known as network access points, collocation facilities, hosting centers, carrier hotels, and Internet exchanges) are large telecommunications facilities that house routers, switches, servers, storage, and other telecommunications equipment. These data centers facilitate efficient network connectivity among and between telecommunications carriers and between carriers and their largest customers (CIO Council, 2015; GAO, 2013). These facilities also provide racks and cages for equipment, power and cooling, cabling, physical security, and 24x7 monitoring. Ownership of data centers may be public or private; comprehensive information regarding data centers may not be publicly available as some are related to secure facilities.

11.1.1.6. Utilities

Utilities are the essential systems that support daily operations in a community and cover a broad array of public services, such as electricity, water, wastewater, and solid waste. Section 11.1.4, Water Resources, describes the potable water sources in the state.

Electricity

In North Carolina, electric utilities are regulated by the North Carolina Utilities Commission (NCUS). Their authority includes the regulation of rates and service quality for several types of utilities (NCUC, 2015a). Both rates and services are regulated for investor owned utilities, of which North Carolina has three: Dominion North Carolina Power, Duke Energy Carolinas and Progress Energy Carolinas, Inc. For electric membership corporations and municipally owned electric utilities, the NCUC only regulates service quality but not rates charged to customers. There are 32 electric membership corporations and 76 municipally owned utilities (NCUC, 2015b). Most of the state's electricity comes from plants using coal or natural gas as a fuel, or from nuclear power plants. Together, these three sources account for 92.8 percent of the electricity generated in 2014 (EIA 2015a). Coal accounts for the largest portion of this, generating 49,238,197 megawatthours[8] of electricity (38.4 percent) out of the total 128,143,588 megawatthours produced. Nuclear power produced 40,967,020 megawatthours and natural gas produced 28,737,608 megawatthours, 31.9 percent and 22.4 percent of the total, respectively. The same year, the state was "ranked sixth in the nation in net electricity generation from nuclear power" and produced "5.1 percent of the nation's total [nuclear power]" (EIA, 2015b). Other sources of electricity included conventional hydroelectric plants, biomass, and solar power (EIA 2015a). About 6.6 percent of North Carolina's power came from renewable sources in 2014. The transportation sector of North Carolina uses approximately 28.3 percent of its electricity, the largest percentage of the four sectors measured by the U.S. Energy Information Administration (EIA). The residential sector uses approximately 27.4 percent of the power, and the industrial and commercial sectors use about 22 percent each. (EIA, 2015b)

[8] One megawatthour is defined as "one thousand kilowatthours or 1 million watthours." One watthour is "the electrical energy unit of measure equal to one watt of power supplied to, or taken from, an electric circuit steadily for one hour" (FCC, 2016b).

Water

Many aspects of the governance of North Carolina's drinking water fall to the Division of Water Resources (DWR), part of the North Carolina Department of Environmental Quality (NCDEQ). The DWR "evaluates environmental water quantity and quality, and carries out enforcement actions for violations of environmental regulations." Specifically, the Public Water Supply section is dedicated to the preservation of drinking water quality (DWR, 2015a). The Public Water Supply section regulates North Carolina's more than 6,000 public water systems; defined as "those which provide piped drinking water to at least 15 connections or 25 or more people 60 or more days per year" (DWR, 2015b). These systems are held to standards set forth by the federal Safe Drinking Water Act (SDWA). About 75 percent of North Carolina's citizens receive their water from a community water system (such as a town water system), as opposed to a non-community system (such as water systems in a school or park) (DWR, 2015b). The Source Water Protection Program exists to provide details on the source from which public water systems draw their water. The program also lists levels of contaminants detected in the water, and possible risks associated with said levels and contaminants. These are available for all water systems in the state (DWR, 2015c). Water utilities must complete and publicize a Consumer Confidence Report for their customers, which details information from the Source Water Protection Program, any contaminants in the water, and any other violations of environmental regulations (DWR, 2015d).

Wastewater

Many aspects of North Carolina's wastewater treatment fall under the jurisdiction of the DWR. As much of wastewater regulation is done through permitting, the 'NCDEQ Water Quality Permitting Section has multiple sections devoted to aspects of wastewater treatment. The Pretreatment Program "controls and documents the discharge of wastewater from Significant and Categorical Industrial Users to the Publicly Owned Treatment Works" (DWR, 2015e). These actions are directed towards industrial sources of wastewater that may require treatment before being treated at a more standard treatment facility alongside non-industrial wastewater. The Wastewater Branch handles "permitting and compliance in accordance with the federal National Pollutant Discharge Elimination System (NPDES) program for wastewater that discharges directly to waters of the state" (DWR, 2015e). The DWR maintains 1,795 active general NPDES permits and 1,180 individual NPDES permits (DWR, 2015f). The DWR also requires that operators of wastewater facilities be certified in order to protect both the citizens of the state and the "public investment in water pollution control systems" (DWR, 2006).

Solid Waste Management

North Carolina's solid waste is managed through the Division of Waste Management (DWM). This is accomplished "through guidance, technical assistance, regulations, permitting, environmental monitoring, compliance evaluation and enforcement" (DWM, 2015). Most of North Carolina's solid waste ends up in a landfill for either municipal solid waste or construction and demolition wastes. Between 2013 and 2014, 9,396,658 tons of waste was deposited in the 103 landfills that accept such materials. This number includes waste generated outside the state but landfilled in North Carolina (DWM, 2014). A report published by the Department of Environment and Natural Resources on waste management for FY 13-14 looked at data from 644 local government bodies and 350 solid waste facilities. It noted that 11,645,181 tons of NC-generated waste reached landfills, of which 76 percent went to either municipal landfills or construction and demolition landfills, and the remaining 24 percent went to industrial waste landfill sites. There remains 234 million tons of useable capacity left in municipal landfills. The report also states that curbside recycling has been an effective method of collection for cans, bottles, and paper products with a 0.4 percent increase in recycling of traditional recyclables and a 3.3 percent increase in recycling of container materials in 2014 (NCDEQ, 2014).

11.1.2. Soils

11.1.2.1. Definition of the Resource

The Soil Science Society of America defines soil as:

i. "The unconsolidated mineral or organic material on the immediate surface of the Earth that serves as a natural medium for the growth of land plants." (NRCS, 2015a)

ii. "The unconsolidated mineral or organic matter on the surface of the Earth that has been subjected to and shows effects of genetic and environmental factors of: climate (including water and temperature effects), and macro- and microorganisms, conditioned by relief, acting on parent material over a period of time. A product-soil differs from the material from which it is derived in many physical, chemical, biological, and morphological properties and characteristics." (NRCS, 2015a)

Five primary factors account for soil development patterns. A combination of the following variables contributes to the soil type in a particular area (University of Minnesota, 2001):

- *Parent Material*: The original geologic source material from the soil formed affects soil aspects, including color, texture, and ability to hold water.
- *Climate*: Chemical changes in parent material occur slowly in low temperatures. However, hot temperatures evaporate moisture, which also facilitates chemical reactions within soils. The highest degree of reaction within soils occurs in temperate, moist climates.
- *Topography*: Steeper slopes produce increased runoff, and, therefore, downslope movement of soils. Slope orientation also dictates the microclimate to which soils are exposed, because different slope faces receive more sunlight than others do.
- *Biology*: The presence/absence of vegetation in soils affects the quantity of organic content of the soil.
- *Time*: Soil properties are dependent on the period over which other processes act on them.

11.1.2.2. Specific Regulatory Considerations

The Proposed Action must meet the requirements of the (National Environmental Policy Act (NEPA) and other applicable laws and regulations. Applicable federal laws and regulations that apply for Soils, such as the Farmland Protection Policy Act of 1981, are in Appendix C, Environmental Laws and Regulations. A list of applicable state laws and regulations is included in Table 11.1.2-1 below.

Table 11.1.2-1: Relevant North Carolina Soil Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Sedimentation Pollution Control Act of 1973 (North Carolina General Statutes § 113A-50 to § 113A-69)	North Carolina Division of Energy, Minerals, and Land Resources	An approved Sedimentation and Erosion Control Plan is required before disturbing one acre or more.

11.1.2.3. Environmental Setting

North Carolina is composed of three Land Resource Region (LRR),[9] as defined by the National Resources Conservation Service (NRCS) (NRCS, 2006):

- Atlantic and Gulf Coast Lowland Forest and Crop Region;
- East and Central Farming and Forest Region; and
- South Atlantic and Gulf Slope Cash Crops, Forest, and Livestock Region.

Within and among North Carolina's three LRRs are six Major Land Resource Areas (MLRA),[10] which are characterized by patterns of soils, climate, water resources, land uses, and type of farming (NRCS, 2006). The locations and characteristics of North Carolina's MLRAs are presented in Figure 11.1.2-1 and Table 11.1.2-2, respectively.

Soil characteristics are an important consideration for FirstNet insomuch as soil properties could influence the suitability of sites for network deployment. Soil characteristics can differ over relatively short distances, reflecting differences in parent material, elevation, and position on the landscape, biota[11] such as bacteria, fungi, biological crusts, vegetation, animals, and climatic variables such as precipitation and temperature. For example, expansive soils[12] with wet and dry seasons alternately swell and shrink, which presents integrity risks to structural foundations (Rogers, Olshansky, & Rogers, 2004). Soils can also be affected by a variety of surface uses that loosen topsoil and damage or remove vegetation or other groundcover, which may result in accelerated erosion, compaction, and rutting[13] (discussed further in the subsections below).

[9] Land Resource Region: "A geographical area made up of an aggregation of Major Land Resource Areas (MLRA) with similar characteristics" (NRCS, 2006).
[10] Major Land Resource Area: "A geographic area, usually several thousand acres in extent, that is characterized by a particular pattern of soils, climate, water resources, land uses, and type of farming" (NRCS, 2006).
[11] All living organisms of an area. (USGS, 2013c)
[12] Expansive soils are characterized by "the presence of swelling clay minerals" that absorb water molecules when wet and expand in size or shrink when dry leaving "voids in the soil." (Rogers, Olshansky, & Rogers, 2004)
[13] Rutting is indentations in soil from operating equipment in moist conditions or soils with lower bearing strength. (USFS, 2009b)

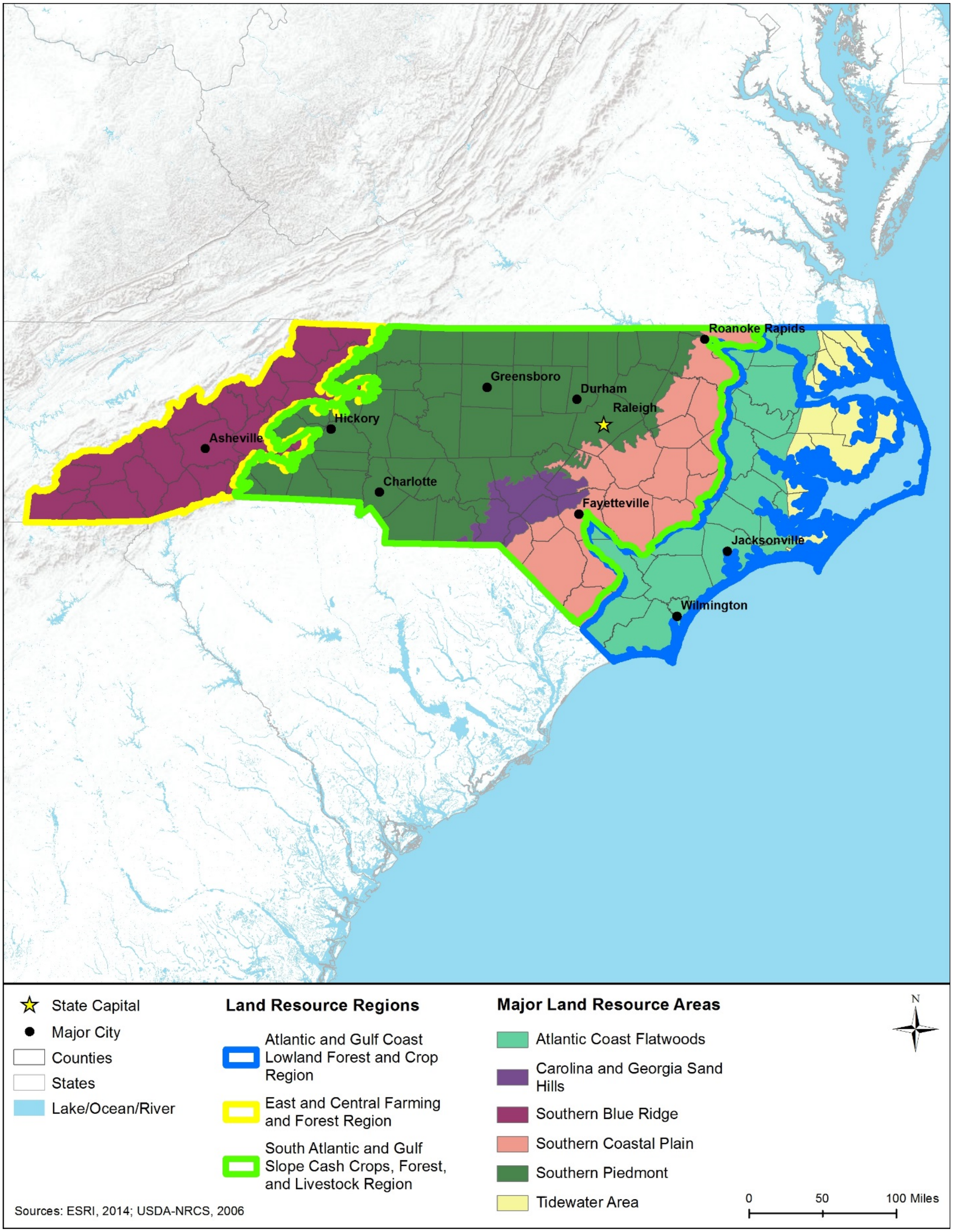


Figure 11.1.2-1: Locations of Major Land Resource Areas in North Carolina

Table 11.1.2-2: Characteristics of Major Land Resource Areas in North Carolina

MLRA Name	Region of State	Soil Characteristics
Atlantic Coast Flatwoods	Eastern North Carolina	Spodosols[a] and Ultisols[b] are the dominant soil orders. These clayey or loamy soils[c] range from well to poorly drained, and are very deep.
Carolina and Georgia Sand Hills	Central North Carolina	Entisols[d] and Ultisols are the dominant soil orders. These loamy or sandy soils range from well to excessively drained, and are very deep.
Southern Blue Ridge	Western North Carolina	Inceptisols[e] and Ultisols are the dominant soil orders. These clayey or loamy soils range from shallow to very deep.
Southern Coastal Plain	Eastern North Carolina	Entisols, Inceptisols, and Ultisols are the dominant soil orders. These loamy soils are typically very deep, and poorly to somewhat excessively drained.
Southern Piedmont	Western North Carolina	Alfisols,[f] Inceptisols, and Ultisols are the dominant soil orders. These loamy or clayey soils are well drained, and range from shallow to deep.
Tidewater Area	Northeastern North Carolina	Alfisols and Entisols are the dominant soil orders. These clayey or loamy soils are very deep with "restricted drainage".

[a] Spodosols: "Spodosols formed from weathering processes that strip organic matter combined with aluminum from the surface layer and deposit them in the subsoil. They commonly occur in areas of course-textured deposits under coniferous forests of humid regions, tend to be acid and infertile, and make up about 4% of the world's ice-free land surface" (NRCS, 2015e).
[b] Ultisols: "Soils found in humid environments that are formed from fairly intense weathering and leaching processes. This results in a clay-enriched subsoil dominated by minerals. They have nutrients concentrated in the upper few inches and make up 8% of the world's ice-free land surface" (NRCS, 2015e).
[c] Loamy Soil: "[A soil] that combines [sand, silt, and clay] in relatively equal amounts" (Purdue University Consumer Horticulture, 2006).
[d] Entisols: "Soils that show little to no pedogenic horizon development. They occur in areas of recently deposited parent materials or in dunes, steep slopes, or flood plains where erosion or deposition rates are faster than rate of soil development. They make up nearly 16% of the world's ice-free land surface" (NRCS, 2015e).
[e] Inceptisols: "Soils found in semiarid to humid environments that exhibit only moderate degrees of soil weathering and development. They have a wide range of characteristics, can occur in a wide variety of climates, and make up nearly 17% of the world's ice-free land surface" (NRCS, 2015e).
[f] Alfisols: "Soils found in semiarid to moist areas that are formed from weathering processes that leach clay minerals and other constituents out of the surface layer and into the subsoil. They are productive for most crop, are primarily formed under forest or mixed vegetative cover, and make up nearly 10% of the world's ice-free land surface" (NRCS, 2015e).

Source: (NRCS, 2006)

11.1.2.4. Soil Suborders

Soil suborders are part of the soil taxonomy.[14] There are 12 soil orders in the world, characterized by both observed and inferred[15] properties, such as texture, color, temperature, and moisture regime. Soil suborders are the next level, differentiated within an order by soil moisture and temperature regimes, as well as dominant physical and chemical properties (NRCS, 2015b). The STATSGO2[16] soil database identified 10 soil suborders in North Carolina (NRCS, 2015c). Figure 11.1.2-2 depicts the distribution of the soil suborders; Table 11.1.2-3 summarizes their major physical-chemical characteristics.

[14] "A formal representation of relationships between items in a hierarchical structure" (USEPA, 2013b).
[15] "Soil properties inferred from the combined data of soil science and other disciplines (e.g., soil temperature and moisture regimes inferred from soil science and meteorology)" (NRCS, 2015e).
[16] STATSGO2 is the Digital General Soil Map of the United States that shows general soil association units across the landscape of the nation. Developed by the National Cooperative Soil Survey, STATSGO2 supersedes the State Soil Geographic (STATSGO) dataset. (NRCS, 2015c)

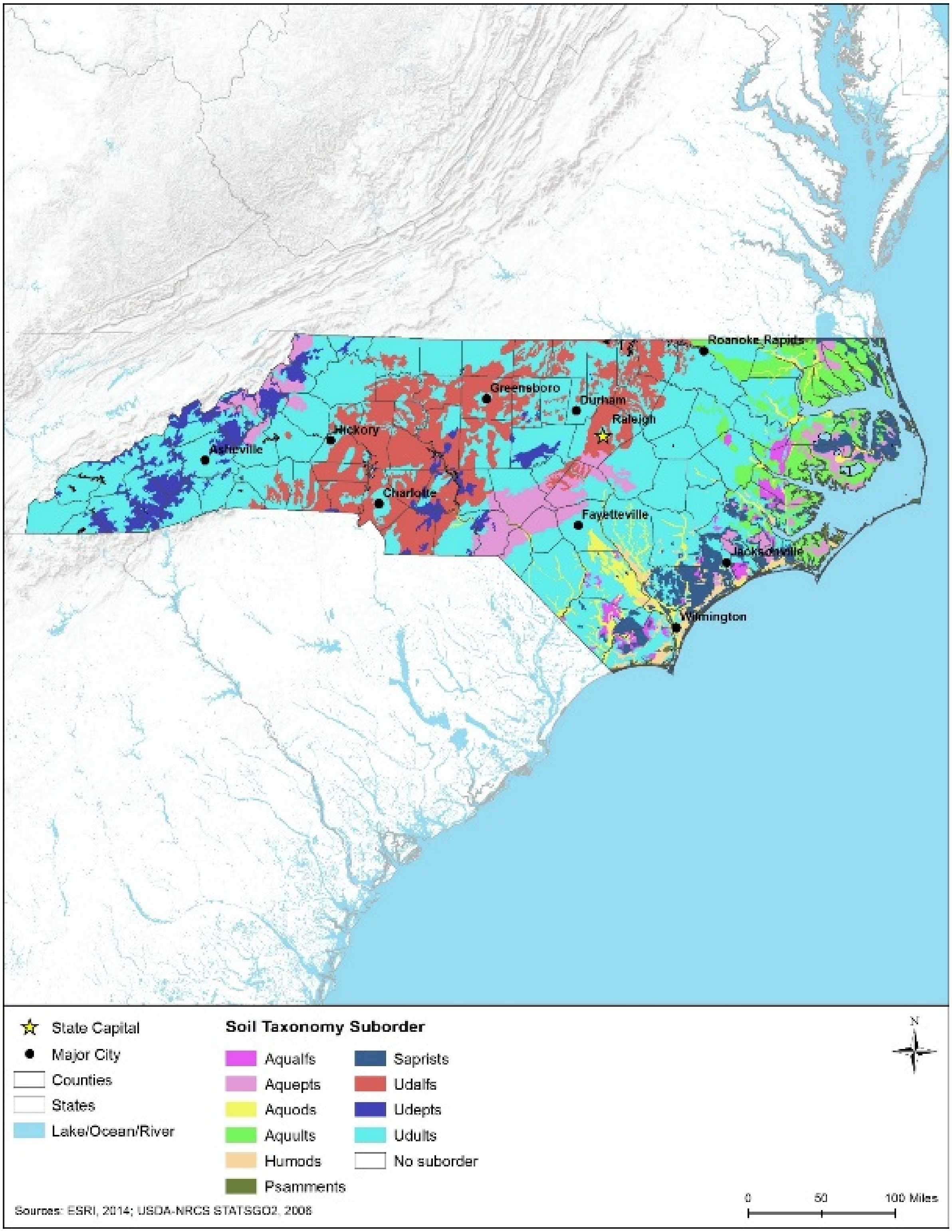


Figure 11.1.2-2: North Carolina Soil Taxonomy[17] Suborders

[17] Soil taxonomies are defined in Table 11.1.2-3.

Table 11.1.2-3: Major Characteristics of Soil Suborders[a] Found in North Carolina, as depicted in Figure 11.1.2-2

Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (%)	Drainage Class	Hydric Soil[b]	Hydrologic Group	Runoff Potential	Permeability[c]	Erosion Potential	Compaction and Rutting Potential
Alfisols	Aqualfs	Generally have warm and aquic (saturated with water long enough to cause oxygen depletion) conditions. Aqualfs are used as cropland for growing corn, soybeans, and rice and most have some artificial drainage or other water control. Nearly all Aqualfs have likely supported forest vegetation in the past.	Sandy clay, Sandy loam[d]	0-2	Poorly drained	Yes	D	High	Very Low	High	High, due to hydric soil and poor drainage conditions
Inceptisols	Aquepts	Aquepts have poor or very poor natural drainage. If these soils have not been artificially drained, groundwater is at or near the soil surface at some time during normal years (although not usually in all seasons). They are used primarily for pasture, cropland, forest, or wildlife habitat. Many Aquepts have formed under forest vegetation, but they can have almost any kind of vegetation.	Loam, Silt loam, Stratified sand to loamy sand	0-3	Very poorly drained	Yes	B, D	Medium, High	Moderate, Very Low	Medium to High, depending on slope	High, due to hydric soil and poor drainage conditions
Spodosols	Aquods	Aquods are characterized by a shallow fluctuating water table, with water-loving vegetation, ranging from moss, shrubs, and trees in cold areas to mixed forests and palms in the warmest areas. Although some Aquods have been cleared and are used as cropland or pasture, most are used as forest or wildlife habitat, as they are naturally infertile (but they can be highly responsive to good management).	Fine sand, Sand	0-3	Poorly drained	Yes	B, D	Medium, High	Moderate, Very Low	Medium to High, depending on slope	High, due to hydric soil and poor drainage conditions
Ultisols	Aquults	Aquults are found in wet areas where groundwater is very close to the surface during part of each year, usually in winter and spring. Their slopes are gentle, with many soils formerly and currently supporting forest vegetation.	Clay loam, Fine sandy loam, Sandy clay loam, Sandy loam, Silt loam	0-2	Very poorly drained to somewhat poorly drained	No, Yes	B, C, D	Medium, High	Moderate, Low, Very Low	Medium to High, depending on slope	High, due to hydric soil and poor drainage conditions
Spodosols	Humods	Humods are typically formed under coniferous forest vegetation, and utilized mostly as forest. They are relatively freely drained.	Fine sand	0-3	Somewhat poorly drained	No	A, D	Low, High	High, Very Low	Low to High, depending on slope	Low
Entisols	Psamments	Psamments are sandy in all layers. In some arid and semi-arid climates, they are among the most productive rangeland soils, and are primarily used as rangeland, pasture, or wildlife habitat. Those Psamments that are nearly bare are subject to wind erosion and drifting, and do provide good support for wheeled vehicles.	Fine sand, Sand	0-10	Excessively drained	No	A	Low	High	Low	Low
Histosols	Saprists	Saprists have organic materials are well decomposed, and many support natural vegetation and are used as woodland, rangeland, or wildlife habitat. Some Saprists, particularly those with a mesic or warmer temperature regime, have been cleared, drained, and used as cropland.	Muck, Sand, Variable	0-2	Very poorly drained	Yes	D	High	Very Low	High	High, due to hydric soil and poor drainage conditions
Alfisols	Udalfs	Udalfs have an udic (humid or subhumid climate) moisture regime, and are believed to have supported forest vegetation at some time during development.	Fine sandy loam, Loam, Variable, Weathered bedrock	2-45	Moderately well drained to well drained	No	B, C, D	Medium, High	Moderate, Low, Very Low	Medium to High, depending on slope	Low

Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (%)	Drainage Class	Hydric Soil[b]	Hydrologic Group	Runoff Potential	Permeability[c]	Erosion Potential	Compaction and Rutting Potential
Inceptisols	Udepts	Udepts have an udic or perudic (saturated with water long enough to cause oxygen depletion) moisture regime, and are mainly freely drained. Most of these soils currently support or formerly supported forest vegetation, with mostly coniferous forest in the Northwest and mixed or hardwood forest in the east. Some also support shrub or grass vegetation, and in addition to being used as forest, some have been cleared and are used as cropland or pasture.	Channery[e] silty clay loam, Cobbly sandy loam, Fine sandy loam, Gravelly fine sandy loam, Loam	0-80	Moderately well drained to somewhat excessively drained	No	B, C	Medium	Moderate, Low	Medium	Low
Ultisols	Udults	Udults are more or less freely drained, relatively humus poor, and have an udic moisture regime. Most of these soils currently support or formerly supported mixed forest vegetation, and many have been cleared and used as cropland (mostly with the use of soil amendments).	Channery loam, Clay, Clay loam, Fine sandy loam, Loam, Loamy sand, Sandy clay, Sandy clay loam, Sandy loam, Silt loam, Stratified sand to fine sandy loam, Variable	0-50	Moderately well drained to somewhat excessively drained	No	A, B, C	Low, Medium	High, Moderate, Low	Low to Medium, depending on slope	Low

[a] Soil suborders constitute a broad range of soil types. Within each suborder, the range of soil types may have a range of properties across the state, which result in multiple values being displayed in the table for that suborder.
[b] Hydric Soil: A soil that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part" (NRCS, 2015c). Soil suborders constitute a broad range of soil types. Within each soil suborder, some specific soil types are hydric while others are not.
[c] Based on Infiltration Characteristics.
[d] Loam: Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles. (University of Delaware, 2016)
[e] Channery: An accumulation of thin, flat, course fragments of sandstone, limestone of schist up to 6 inches. (University of Delaware, 2016)
Sources: (NRCS, 2015c) (NRCS, 1999)

11.1.2.5. Runoff Potential

The National Resources Conservation Service (NRCS) uses four Hydrologic Soil Groups (A, B, C, and D) that are based on a soil's runoff potential.[18] Group A generally has the smaller runoff potential, whereas Group D generally has the greatest (Purdue University, 2015). Table 11.1.2-3 provides a summary of the runoff potential for each soil suborder in North Carolina.

Group A. **Sand, loamy sand or sandy loam soils.** This group of soils has "low runoff potential and high infiltration rates[19] even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sands or gravels and have a high rate of water transmission" (Purdue University, 2015). Humods, Psamments, and Udults fall into this category in North Carolina.

Group B. **Silt loam or loam soils.** This group of soils has a "moderate infiltration rate when thoroughly wetted and consists chiefly or moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures" (Purdue University, 2015). This group has medium runoff potential. Aquepts, Aquods, Aquults, Udalfs, Udepts, and Udults fall into this category in North Carolina.

Group C. **Sandy clay loam soils.** This group of soils has "low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine structure" (Purdue University, 2015). This group has medium runoff potential. Aquults, Udalfs, Udepts, and Udults fall into this category in North Carolina.

Group D. **Clay loam, silty clay loam, sandy clay, silty clay, or clay soils.** This group of soils "has the highest runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface and shallow soils over nearly impervious material" (Purdue University, 2015). Aqualfs, Aquepts, Aquods, Aquults, Humods, Saprists, and Udalfs fall into this category in North Carolina.

11.1.2.6. Soil Erosion

"Soil erosion involves the breakdown, detachment, transport, and redistribution of soil particles by forces of water, wind, or gravity" (NRCS, 2015d). Water-induced erosion can transport soil into streams, rivers, and lakes, degrading water quality and aquatic habitat. When topsoil is eroded, organic material is depleted, creating loss of nutrients available for plant growth. Soil particles displaced by wind can cause human health problems and reduced visibility, creating a

[18] Classifying soils is highly generalized and it is challenging to differentiate orders as soil properties can change with distance or physical properties. The soil suborders are at a high level, therefore soil groups may be found in multiple hydrologic groups within a state, as composition, topography, etc. varies in different areas.
[19] Infiltration Rate: "The rate at which a soil under specified conditions absorbs falling rain, melting snow, or surface water expressed in depth of water per unit time" (FEMA, 2010).

public safety hazard (NRCS, 1996a). Table 11.1.2-3 provides a summary of the erosion potential for each soil suborder in North Carolina. Soils with medium to high erosion potential in North Carolina include those in the Aqualfs, Aquepts, Aquods, Aquults, Humods, Saprists, Udalfs, Udepts, and Udults suborders, which are found throughout most of the state (Figure 11.1.2-2).

11.1.2.7. Soil Compaction and Rutting

Soil compaction and rutting occurs when soil layers are compressed by machinery or animals, which decreases both open spaces in the soil, as well as water infiltration rates (NRCS, 1996b). Moist soils with high soil water content are most susceptible to compaction and rutting, as they lack the strength to resist deformation caused by pressure. When rutting occurs, channels form and result in downslope erosion (USFWS, 2009). Other characteristics that factor into compaction and rutting risk include soil composition (i.e., low organic soil is at increased risk of compaction), amount of pressure exerted on the soil, and repeatability (i.e., the number of times the pressure is exerted on the soil). Machinery and vehicles that have axle loads greater than 10 tons can cause soil compaction of greater than 12 inches depth (NRCS, 1996b), (NRCS, 2003).

Loam, sandy loam, and sandy clay loam soils are most susceptible to compaction and rutting; silt, silty clay, silt loam, silty clay loam, and clay soils are more resistant to compaction and rutting (NRCS, 1996b). Table 11.1.2-3 provides a summary of the compaction and rutting potential for each soil suborder in North Carolina. Soils with the highest potential for compaction and rutting in North Carolina include those in the Aqualfs, Aquepts, Aquods, Aquults, and Saprists suborders, which are found primarily in the far eastern part of the state, although Aquepts are found in central and western North Carolina as well (Figure 11.1.2-2).

11.1.3. Geology

11.1.3.1. Definition of the Resource

The U.S. Geological Survey (USGS) is the primary government organization responsible for the nation's geological resources. USGS defines geology as an interdisciplinary science with a focus on the following aspects of earth sciences: geologic hazards and disasters, climate variability and change, energy and mineral resources, ecosystem and human health, and groundwater availability. Several of these elements are discussed in other sections of this PEIS, including Water Resources (Section 11.1.4), Human Health and Safety (Section 11.1.15), and Climate Change (11.1.14).

This section covers the six aspects of geology most relevant to the Proposed Action and Alternatives:

- Section 11.1.3.3, Environmental Setting: Physiographic Regions[20]and Provinces;[21]
- Section 11.1.3.4, Surface Geology;

[20] Physiographic regions: Areas of the United States that share commonalities based on topography, geography, and geology (Fenneman, 1916).
[21] Physiographic provinces: Subsets within physiographic regions (Fenneman, 1916).

- Section 11.1.3.5, Bedrock Geology;[22]
- Section 11.1.3.6, Paleontological Resources;[23]
- Section 11.1.3.7, Fossil Fuel and Mineral Resources; and
- Section 11.1.3.8, Potential Geologic Hazards.[24]

11.1.3.2. Specific Regulatory Considerations

The Proposed Action must meet the requirements of NEPA and other applicable laws and regulations. A list of applicable state laws and regulations is included in Table 11.1.3-1.

Table 11.1.3-1: Relevant North Carolina Geology Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
North Carolina Building Code	North Carolina State Building Code Council	Guidelines for seismic design.

11.1.3.3. Environmental Setting: Physiographic Regions and Provinces

The concept of physiographic regions was created in 1916 by geologist Nevin Fenneman as a way to describe areas of the United States based on common landforms (i.e., not climate or vegetation). Physiographic regions are areas of distinctive topography, geography, and geology. “Important physiographic differences between adjacent areas are, in a large proportion of cases, due to differences in the nature or structure of the underlying rocks.” There are eight distinct physiographic regions in the continental United States: 1) Atlantic Plain, 2) Appalachian Highlands, 3) Interior Plains, 4) Interior Highlands, 5) Laurentian Upland, 6) Rocky Mountain System, 7) Intermontane Plateaus, and 8) Pacific Mountain System. Regions are further sub-divided into physiographic provinces based on differences observed on a more local scale. (Fenneman, 1916)

North Carolina is within the Atlantic Plain (Coastal Plain Province) and Appalachian Highlands (Piedmont and Blue Ridge Provinces) physiographic regions (USGS, 2003b) (Figure 11.1.3-1). The general characteristics of these regions and their respective provinces are summarized in the following subsections.

[22] Bedrock: Solid rock beneath the soil and superficial rock (USGS, 2015l).
[23] Paleontology: “Study of life in past geologic time based on fossil plants and animals” (Merriam Webster Dictionary, 2015c).
[24] Geologic Hazards: Any geological or hydrological process that poses a threat to people and/or their property, which includes but is not limited to volcanic eruptions, earthquakes, landslides, sinkholes, mudflows, flooding, and shoreline movements (NPS, 2013).

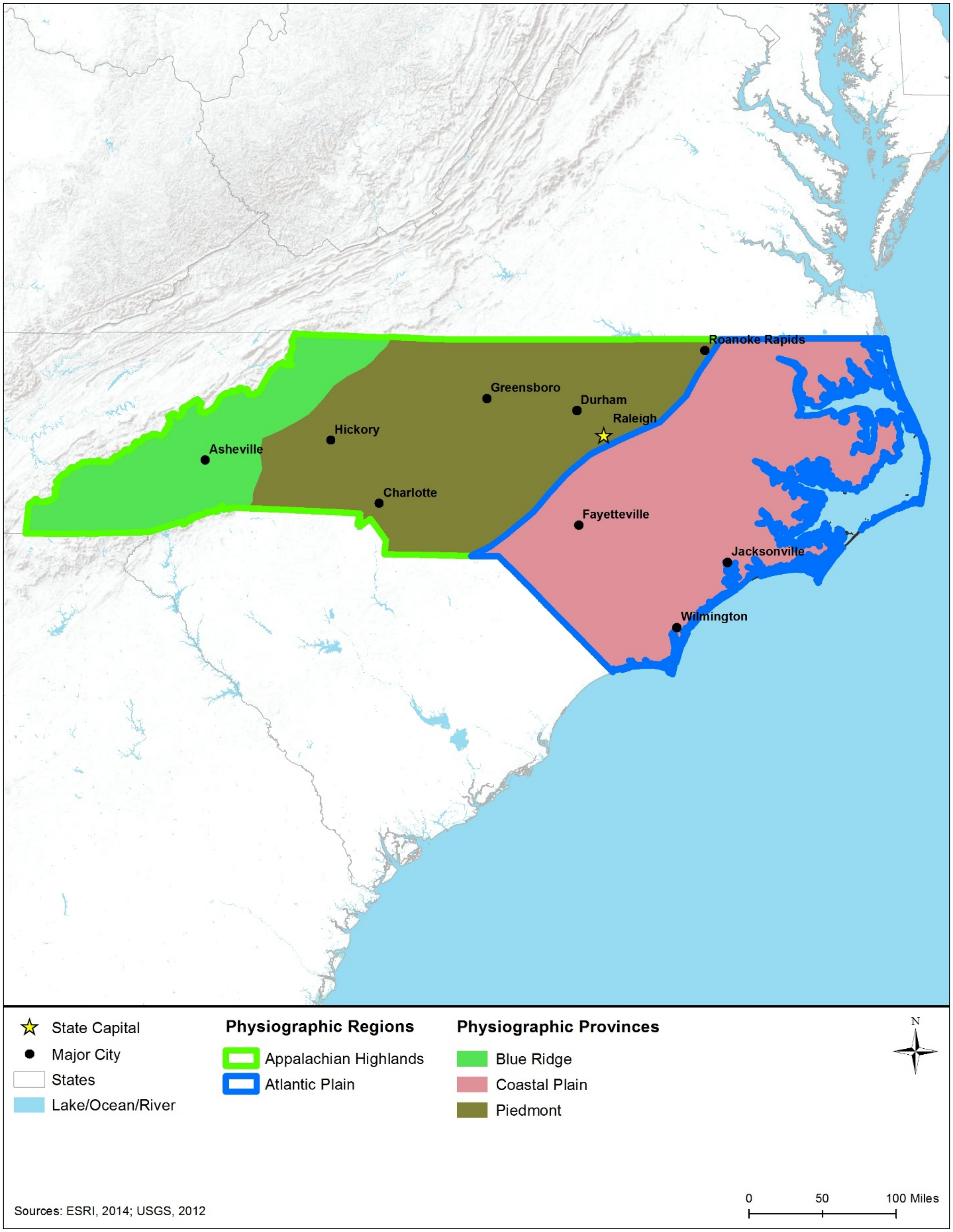


Figure 11.1.3-1: Physiographic Regions and Provinces of North Carolina

Atlantic Plain Region

The Atlantic Plain Region includes the Continental Shelf and the Gulf and Atlantic Coast plains stretching from New York south to Florida and west to Texas. The Atlantic Plain Region formed through the repetitive rise and fall of the oceans over the last 150 million years. Sedimentary[25] strata become thinner moving westward through the region, and thicken to several thousand feet thick along the coastline. Erosion from the Appalachian Mountains, which began to form 480 to 440 million years ago (MYA), dislodged sediments, which were subsequently deposited by rivers to form the Atlantic Plain.[26] The area is characterized by gentle topography and a transition zone between the land and sea often having marshes, lagoons, swamps, sand bars, and reefs. Deposits of coastal marine life over millions of years form the basis for rich fossil fuel reserves in the region. (NPS, 2015a)

As reported above, the Atlantic Plain Region within North Carolina is composed of one physiographic province, the Coastal Plain Province (USGS, 2003b).

<u>Coastal Plain Province</u> – The Coastal Plain Province includes roughly 25,000 square miles of North Carolina (i.e., about 47 percent of the state's total land area) southeast of the Fall Line[27] boundary with the Piedmont Province (discussed below). The Fall Line trends northeast/southwest throughout the state, and passes just to the southeast of Raleigh and Roanoke Rapids, and to the northwest of Fayetteville. Within North Carolina, the Coastal Plain Province can be further sub-divided into the Outer Coastal Plain and the Inner Coastal Plain. The Outer Coastal Plain includes areas of coastal North Carolina, including the Outer Banks, "where large streams and many of their tributaries are affected by oceanic tides." Topography along the North Carolina coast is generally flat, with elevations not exceeding 50 feet above sea level (ASL). The Inner Coastal Plain extends westward from its border with the Outer Coastal Plain to the Fall Line. This area is marked by a rolling topography with elevations spanning 50 to 700 feet ASL. (Winner & Coble, 1996)

Appalachian Highlands Region

The Appalachian Highlands Region extends from Canada to Alabama. This region is composed of layers of folded sedimentary rock, created when the North American plates collided with the Eurasian and African plates more than 500 MYA. Once similar in height to the present-day Rocky Mountains,[28] the Appalachian Highlands have eroded considerably, and most peaks are now under 5,000 feet ASL. The current Appalachian Highlands Region is characterized by prime and unique farmlands and is rich in mineral resources. (USGS, 2003b)

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[25] Sedimentary Rock: "Rocks that formed from pre-existing rocks or pieces of once-living organisms. They form from deposits that accumulate on the Earth's surface. Sedimentary rocks often have distinctive layering or bedding" (USGS, 2014e).
[26] For consistency, this PEIS uses the University of California Berkeley Geologic Time Scale for all of the FirstNet PEIS state documents. Time scales differ among universities and researchers; FirstNet utilized a consistent time scale throughout, which may differ slightly from other sources. (University of California Museum of Paleontology, 2011)
[27] Fall Line: "A somewhat indefinite line which derives its name from the falls or rapids in the rivers at the places where they pass from the Piedmont crystalline rocks to the softer and less resistant rocks of the Coastal Plain" (Geological Survey of Georgia, 1911).
[28] The Rocky Mountains exceed 14,000 feet above sea level (NPS, 2004b).

As reported above, the Appalachian Highlands Region within North Carolina is composed of two physiographic provinces: the Piedmont and Blue Ridge Provinces. (USGS, 2003b)

Piedmont Province – North Carolina's Piedmont Province spans the area between the Fall Line in the east and the Blue Ridge Province to the west. The Piedmont is comprised of approximately 40 percent of the total land area within North Carolina. Elevations rise from between 400 and 600 feet ASL at the Fall Line, to nearly 2,000 feet ASL at the intersection with the Blue Ridge Province. "The topography consists of rounded hills and long, rounded ridges with a northeast-southwest trend. The bedrock formations underlying the area also have a northeast-southwest trend." (Putnam, 1972)

Blue Ridge Province – North Carolina's Blue Ridge Province includes the area west of the Piedmont Province in the western portion of the state. Elevations are about 1,500 ASL near the North Carolina-Virginia border, but rise to over 6,000 feet ASL further to the south (USGS, 2015b). Mount Mitchell (in the western portion of the state about 20 miles northeast of Asheville) is the highest point within North Carolina and the United States east of the Mississippi River (North Carolina Division of Parks and Recreation, 2015a). In general, intrusive[29] igneous[30] rocks dominate the Blue Ridge Province in North Carolina, "sedimentary rocks (limestone, dolomite,[31] conglomerate,[32] sandstone,[33] and shale[34]) also are included in the province" (USGS, 2015b).

11.1.3.4. Surface Geology

Surficial geology is characterized by materials such as till,[35] sand and gravel, or clays that overlie bedrock. The surface terrain, which can include bedrock outcrops, provides information on the rock compositions and structural characteristics of the underlying geology. Because surface materials are exposed, they are subject to physical and chemical changes due to weathering from precipitation (rain and snow), wind and other weather events, and human-caused interference. Depending on the structural characteristics and chemical compositions of the surface materials, heavy precipitation can cause slope failures,[36] subsidence,[37] and erosion. (Thompson, 2015)

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[29] Intrusive Rock: "Igneous rock that cools and solidifies beneath the Earth's surface" (USGS, 2015n).
[30] Igneous Rock: "Rock formed when molten rock (magma) that has cooled and solidified (crystallized)" (USGS, 2015n).
[31] Dolomite: "A magnesium-rich carbonate sedimentary rock. Also, a magnesium-rich carbonate mineral ($CaMgCO_3$)" (USGS, 2015n).
[32] Conglomerate: "A sedimentary rock made of rounded rock fragments, such as pebbles, cobbles, and boulders, in a finer-grained matrix. To call the rock a conglomerate, some of the constituent pebbles must be at least 2 mm (about 1/13th of an inch) across" (USGS, 2015n).
[33] Sandstone: "Sedimentary rock made mostly of sand-sized grains" (USGS, 2015n).
[34] Shale: "Sedimentary rock derived from mud. Commonly finely laminated (bedded). Particles in shale are commonly clay minerals mixed with tiny grains of quartz eroded from pre-existing rocks" (USGS, 2015n).
[35] Till: "An unsorted and unstratified accumulation of glacial sediment, deposited directly by glacier ice. Till is a heterogeneous mixture of different sized material deposited by moving ice (lodgement till) or by the melting in-place of stagnant ice (ablation till). After deposition, some tills are reworked by water" (USGS, 2013b).
[36] Slope failure: "Slope failure, also referred to as mass wasting, is the downslope movement of rock debris and soil in response to gravitational stresses" (Idaho State University 2000).
[37] Subsidence: "Gradual settling or sudden sinking of the Earth's surface owing to subsurface movement of earth materials" (USGS, 2000).

Surface deposits in North Carolina overlie the Coastal Plain Province in the eastern half of the state. Coastal Plain deposits are classified as "mostly clastic rocks ranging from clay to gravel, with lesser amounts of marine limestone,[38] all resting on a foundation of crystalline basement rocks." The sediments thicken moving east from the Fall Line, and may extend to nearly 10,000 feet below the ground surface (bgs). Alternating marine and non-marine sediments reveal the transgressions and regressions of the ocean over the last 200 MYA (i.e., from the Jurassic Period to the present) (Winner & Coble, 1996). Glacial deposits coming from the Pleistocene glaciation are not present in North Carolina, as the terminal extent of the glaciers did not reach North Carolina during that time (Ray, 1992). Figure 11.1.3-2 depicts a generalized illustration of the surface geology for North Carolina. These also include river deposits in localized areas throughout the state.

11.1.3.5. Bedrock Geology

Bedrock geology analysis, and "the study of distribution, position, shape, and internal structure of rocks" (USGS, 2015c) reveals important information about a region's surface and subsurface characteristics (i.e., 3-dimensional geometry), including dip (slope of the formation),[39] rock composition, and regional tectonism.[40] These structural aspects of bedrock geology are often indicative of regional stability, as it relates to geologic hazards such as landslides, subsidence, earthquakes, and erosion (New Hampshire Department of Environmental Services, 2014).

North Carolina's bedrock geology follows the same delineations as the physiographic regions and provinces discussed in Section 11.1.3.3. The Coastal Plain Province is underlain by sediments (including silt, clay, and sand, with some gravel and lignite), as well as limestone and sandstone, that date from the Jurassic Period (200 MYA) through the present. To the west is the Piedmont Province, which is underlain by igneous and metamorphic rocks that date to the Precambrian (older than 542 MYA) and Paleozoic (542 to 251 MYA) Eras. "Included in this province, however, are sedimentary basins that formed along rifts in the Earth's crust and contain shale, sandstone, and conglomerate[41] of early Mesozoic age, interbedded locally with basaltic[42] lava flows and minor coal beds." The Blue Ridge Province lies in western North Carolina and is characterized by igneous and metamorphic rocks of the late Precambrian and Early Cambrian age (USGS, 2015d). Figure 11.1.3-3 displays the generalized illustration of bedrock geology for North Carolina.

[38] Limestone: "A sedimentary rock made mostly of the mineral calcite (calcium carbonate). Limestone is usually formed from shells of once-living organisms or other organic processes, but may also form by inorganic precipitation" (USGS, 2015n).
[39] Dip: "A measure of the angle between the flat horizon and the slope of a sedimentary layer, fault plane, metamorphic foliation, or other geologic structure" (NPS, 2000).
[40] Tectonism: "Structure forces affecting the deformation, uplift, and movement of the earth's crust" (USGS, 2015o).
[41] Conglomerate: "A sedimentary rock made of rounded rock fragments, such as pebbles, cobbles, and boulders, in a finer-grained matrix. To call the rock a conglomerate, some of the constituent pebbles must be at least 2 mm (about 1/13th of an inch) across" (USGS, 2015n).
[42] Basalt: "A dark, fine-grained, extrusive (volcanic) igneous rock with a low silica content (40% to 50%), but rich in iron, magnesium and calcium" (USGS, 2015n).

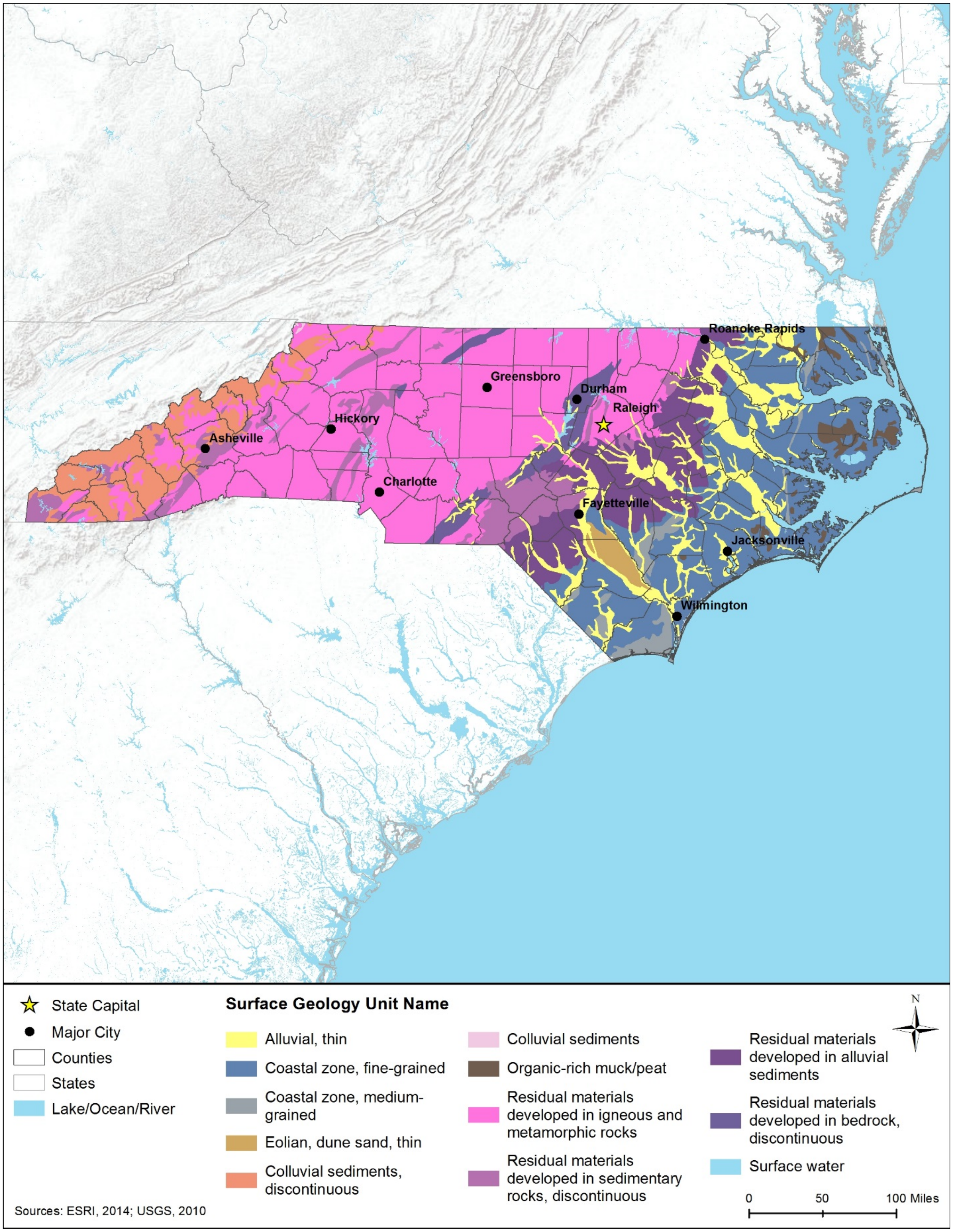

Figure 11.1.3-2: Generalized Surface Geology for North Carolina

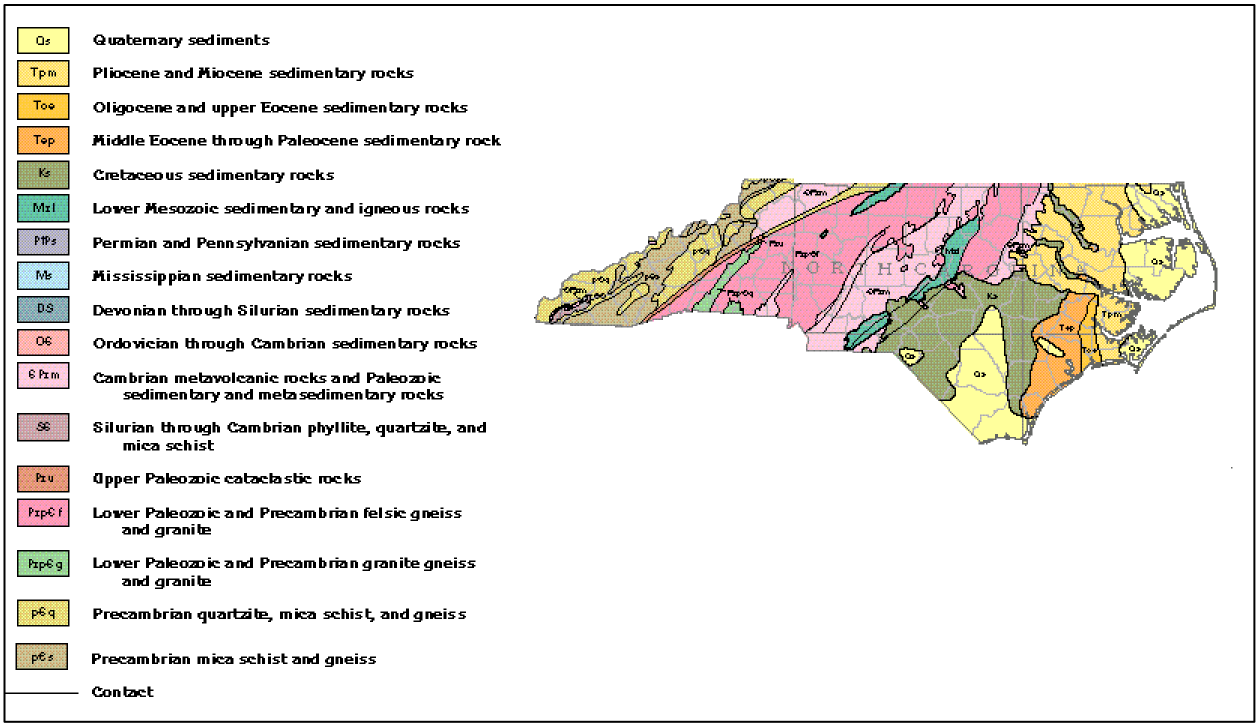

Figure 11.1.3-3: Generalized Bedrock Geology for North Carolina

11.1.3.6. Paleontological Resources

The oldest fossils in North Carolina date from the Precambrian Era (older than 542 MYA), including four fossils from an organism called *Pteridinium carolinaense* which were recovered in the central part of the state. North Carolina was under a marine sea for portions of the Precambrian Era. No Paleozoic fossils have been documented in North Carolina. During the Triassic Period (251 to 200 MYA), as the supercontinent Pangea was breaking apart, deep basins formed in the state, creating lakes and rivers. Fossils of lakeshore plants (e.g., conifers and cycads), fish, crustaceans, marine clams, terrestrial mammals, and reptiles have been recovered. Oyster, mollusk, and dinosaur fossils from the Cretaceous Period (146 to 66 MYA) have also been recorded. During the Cenozoic Era (66 MYA to present), fluctuating sea levels in the eastern part of the state left sedimentary deposits abundant with bryozoans,[43] sea urchins, mollusks, whale bones, and shark teeth (Paleontology Portal, 2015). The state fossil of North Carolina is the fossilized teeth from Cenozoic *Megalodon* sharks (General Assembly of North Carolina, 2013). Sea levels have

***Megalodon* Teeth**

Source: (North Carolina Secretary of State, 2015)

[43] Bryozoan: "Common name for any member of the phylum Bryozoa. Bryozoans are invertebrate aquatic organisms most commonly found in large colonies." (Smithsonian Institution, 2016)

fluctuated through the Quaternary Period (2.6 MYA to present), with marine fossils found in the eastern part of the state. Fossils from horses, giant ground sloths, mastodons, and other mammals are recorded in western parts of North Carolina (Paleontology Portal, 2015).

11.1.3.7. Fossil Fuel and Mineral Resources

Oil and Gas

North Carolina does not produce crude oil or natural gas and relies on imports of both resources into the state. (EIA, 2015c)

Minerals

As of 2015, North Carolina's total non-fuel mineral production value of $943M, which ranked 20th nationwide (in terms of dollar value). This level of production accounted for 1.21 percent of the total nationwide mineral production. As of 2015, North Carolina's leading non-fuel minerals were crushed stone, phosphate rock, construction sand and gravel, industrial sand and gravel, and dimension stone[44] (USGS, 2016a). Crushed stone accounted for 70 percent of North Carolina's total non-fuel mineral production value in 2011. North Carolina is the only state that produces andalusite and pyrophillite, and ranks first in feldspar and olivine production. Other minerals produced in North Carolina are common clay and shale, gemstones, mica, perlite, and kaolin clay (USGS, 2016a).

11.1.3.8. Potential Geologic Hazards

The three major geologic hazards of concern in North Carolina are earthquakes, landslides, and subsidence. Volcanoes do not occur in North Carolina and therefore do not present a hazard to the state (USGS, 2015e). The subsections below summarize current geologic hazards in North Carolina.

Earthquakes

Between 1973 and March 2012, there were four earthquakes of a magnitude 3.5 (on the Richter scale[45]) or greater in North Carolina (USGS, 2014a). Earthquakes are the result of large masses of rock moving against each other along fractures called faults. Earthquakes occur when landmasses on opposite sides of a fault suddenly slip past each other; the grinding motion of each landmass sends out shock waves. The vibrations travel through the Earth and, if they are strong enough, they can damage manmade structures on the surface (USGS, 2012a).

The shaking due to earthquakes can be significant many miles from its point of origin depending on the type of earthquake and the type of rock and soils beneath a given location. Crustal earthquakes, the most common and the kind that occur in North Carolina, typically occur at depths of 6 to 12 miles; these earthquakes typically do not reach magnitudes higher than 6.0 on

[44] Dimension stone: "Natural rock material quarried for the purpose of obtaining blocks or slabs that meet specifications as to size (width, length, and thickness) and shape" (USGS, 2016b).
[45] The Richter scale is a numerical scale for expressing the magnitude of an earthquake on the basis of seismograph oscillations. The more destructive earthquakes typically have magnitudes between about 5.5 and 8.9; the scale is logarithmic and a difference of one represents an approximate thirtyfold difference in magnitude. (USGS, 2014f)

the Richter scale. Subduction zone earthquakes happen where tectonic plates converge. "When these plates collide, one plate slides (subducts) beneath the other, where it is reabsorbed into the mantle of the earth" (Oregon Department of Geology, 2015). Subduction zones are found off the coast of Washington, Oregon, and Alaska (USGS, 2014). Convergence boundaries between two tectonic plates can result in earthquakes with magnitudes that exceed 8.0 on the Richter scale. (Oregon Department of Geology, 2015)

Figure 11.1.3-4 depicts the seismic risk throughout North Carolina; the box surrounding the range of colors shows the seismic hazards in the state. The map indicates levels of horizontal shaking (measured in Peak Ground Acceleration [PGA]) that have a 2 percent chance of being exceeded in a 50-year period. Units on the map are measured in terms of acceleration due to gravity (% g). Most pre-1965 buildings are likely to experience damage with exceedances of 10% g. Post-1985 buildings (in California) have experienced only minor damage with shaking of 60% g. (USGS, 2010a)

Areas of greatest seismicity in North Carolina are concentrated in the western portions of the state (USGS, 2014b). The largest earthquake recorded in North Carolina occurred in the town of Waynesville (just over 20 miles west of Asheville in the western portion of the state) in February 1916, and measured 5.5 on the Richter scale (USGS, 2012b). "Since 1735, 22 earthquakes have caused damage in North Carolina; only seven were located in the state. Four earthquake zones could generate ground shaking strong enough to cause damage in North Carolina: 1) Eastern Tennessee Seismic Zone, 2) Southern Appalachian Seismic Zone; 3) Charleston, S.C. Seismic Zone; and 4) Giles County, Va. Seismic Zone" (NCDPS, 2012).

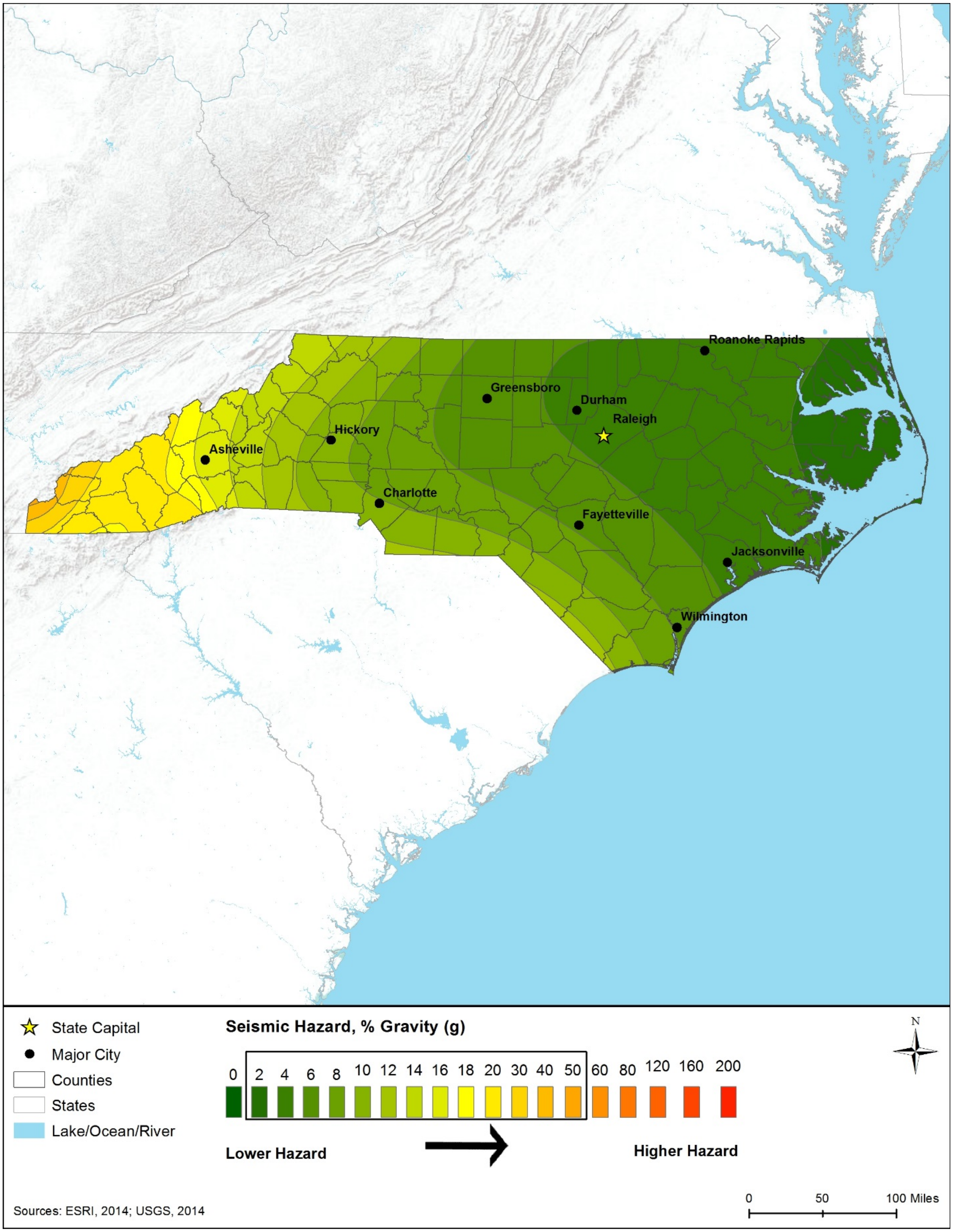

Figure 11.1.3-4: North Carolina 2014 Seismic Hazard Map

Landslides

The potential for landslides in North Carolina is greatest in the Blue Ridge Province in areas with steep slopes. Landslides may also occur along road cuts in the Piedmont and Coastal Plain Provinces where the ground surface has been disturbed. (NCDEQ, 2015a)

"The term 'landslide' describes many types of downhill earth movements, ranging from rapidly moving catastrophic rock avalanches and debris flows in mountainous regions to more slowly moving earth slides and other ground failures" (USGS, 2003a). Geologists use the term "mass movement" to describe a great variety of processes such as rock fall, creep, slump, mudflow, earth flow, debris flow, and debris avalanche regardless of the time scale (USGS, 2003a).

Landslides can be triggered by a single severe storm or earthquake, causing widespread damage in a short period. Most landslide events are triggered by water infiltration that decomposes and loosens rock and soil, lubricates frictional surfaces, adds weight to an incipient landslide, and imparts buoyancy to the individual particles. Intense rainfall, rapid snowmelt, freeze/thaw cycles, earthquakes, volcanic eruptions, and human alterations to the natural landscape can trigger mass land movements. Large landslides can dam rivers or streams, and cause both upstream and downstream flooding. (USGS, 2003a)

Landslide Debris in Macon County Resulting from Hurricanes Frances and Ivan

Source: (NCDEQ, 2015b)

Landslides have been recorded in several counties in North Carolina's Blue Ridge Province, including Macon, Watauga, Buncombe, and Henderson. Landslides in North Carolina are typically related to significant precipitation events (e.g., hurricanes), freeze-thaw processes, and human activities. For example, in September 2004, when Hurricanes Frances and Ivan delivered 10 to 16 inches of rain to western North Carolina over a two-week period, a significant landslide event was triggered in Macon County. "Tons of water, mud, rocks, trees, and other debris traveled for more than two miles. The debris flow was 30 feet deep and 250 feet wide at some points and traveled downhill as fast as 33 miles per hour" (NCDEQ, 2015a). Figure 11.1.3-5 shows landslide incidence and susceptibility throughout North Carolina.

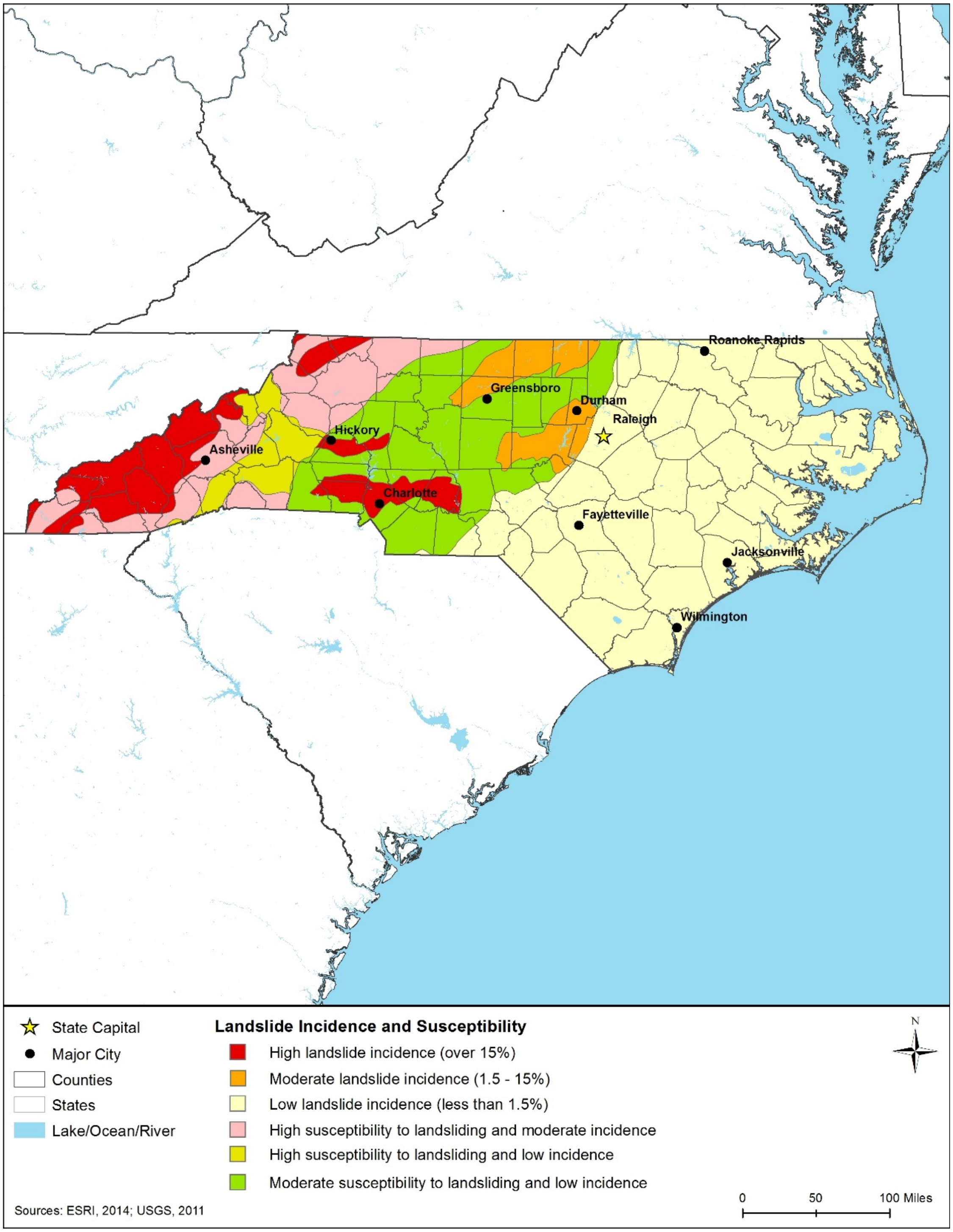

Figure 11.1.3-5: North Carolina Landslide Incidence and Susceptibility Hazard Map[46]

[46] Susceptibility hazards not indicated in Figure 11.1.3-5 where same or lower than incidence. Susceptibility to landslides is defined as the probable degree of response of areal rocks and soils to natural or artificial cutting or loading of slopes, or to anomalously high precipitation. High, moderate, and low susceptibility are delimited by the same percentages used in classifying the incidence of landslides. Some generalization was necessary at this scale, and several small areas of high incidence and susceptibility were slightly exaggerated. (USGS, 2014g)

Land Subsidence

Land subsidence is a "gradual settling or sudden sinking of the Earth's surface owing to subsurface movement of earth materials." Land subsidence has been observed in portions of North Carolina in the Coastal Plain Province (NCDEQ Division of Water Resources, 2015). The main triggers of land subsidence can be aquifer compaction, drainage of organic soils, mining, sinkholes, and thawing permafrost. More than 80 percent of subsidence in the United States is due to over-withdrawal of groundwater. In many aquifers, which are subsurface soil layers through which groundwater moves, water is pumped from pore spaces between sand and gravel grains (USGS, 2013a). If an aquifer is confined by layers of silt or clay, which do not transport groundwater, the lowered water pressure in the sand and gravel can cause ground layers to collapse on one another. Compression permanently lowers the land surface elevation (USGS, 2000).

Land subsidence can result in altered stream elevations and slopes; detrimental effects to infrastructure and buildings; and collapse of wells due to compaction of aquifer sediments. Subsided areas can become more susceptible to inundation, both during storm events and non-events. Lowered terrain is more susceptible to inundation during high tides. Additionally, land subsidence can affect vegetation and land use. (U.S. Geological Survey, 2013b)

Land subsidence has been observed in the Coastal Plain due to aquifer compaction and overuse of groundwater (USGS, 2015f). Subsidence over the past 2,000 years may exceed 1 millimeter per year (Kemp, et al., 2011). Sinkholes pose an additional subsidence threat within eastern portions of the Coastal Plain Province that are underlain by limestone. "Most NC sinkholes become flooded and appear as small to medium sized circular lakes" (NCDEQ Division of Water Resources, 2015). Figure 11.1.3-6 displays the areas of North Carolina that are susceptible to land subsidence due to karst topography. "Karst" is a distinctive topography in which the landscape is largely shaped by the dissolving action of water on soluble, carbonate bedrock (usually limestone, dolomite, or marble)" (Talley, 1981). Isolated portions of eastern North Carolina may also be sinking due to drainage of organic soils (USGS, 2000).

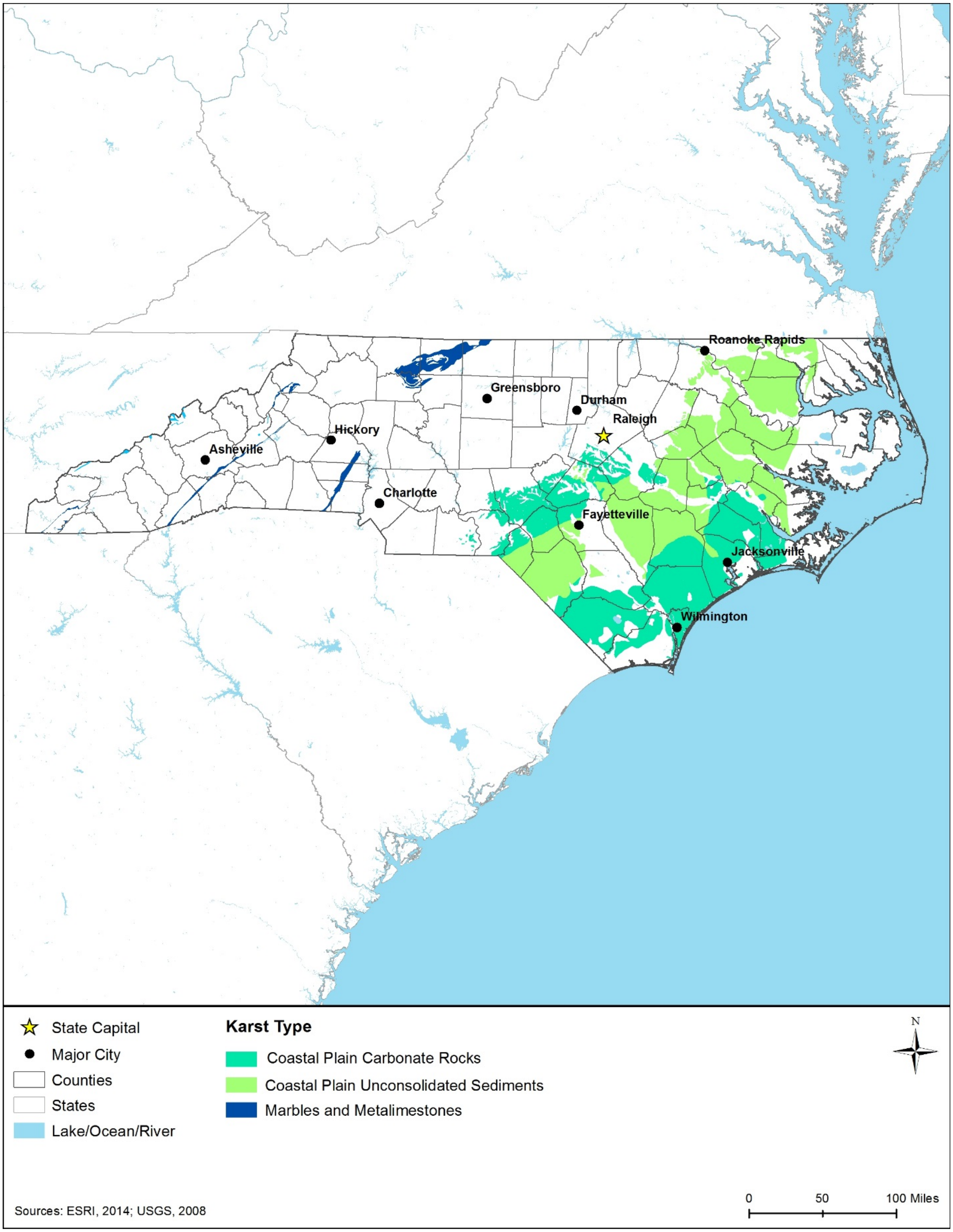

Figure 11.1.3-6: Karst Topography in North Carolina

11.1.4. Water Resources

11.1.4.1. Definition of the Resource

Water resources are defined as all surface water bodies and groundwater systems including streams, rivers, lakes, estuarine waters, floodplains, aquifers, and other aquatic habitats (wetlands are discussed separately in Section 11.1.5). These resources can be grouped into watersheds, which are defined as areas of land whose flowing water resources (including runoff from rainfall) drain to a common outlet such as a river or ocean. The value and use of water resources are influenced by the quantity and quality of water available for use and the demand for available water. Water resources are used for drinking, irrigation, industry, recreation, and as habitat for wildlife. Some water resources that are particularly pristine, sensitive, or of great economic value enjoy special protections under federal and state laws. An adequate supply of water is essential for human health, economic wellbeing, and ecological health (USGS, 2014c).

11.1.4.2. Specific Regulatory Considerations

Federal laws relevant to protecting the quality and use of water resources are summarized in Appendix C, and Section 1.8, Overview of Relevant Federal Laws and Executive Orders. Multiple North Carolina laws and regulations pertain to the state's public utility and transportation infrastructure and its public safety community. Table 11.1.4-1 summarizes the relevant laws and regulations for water resources in North Carolina.

Table 11.1.4-1: Relevant North Carolina Water Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
North Carolina NPDES	NCDEQ	All construction projects that disturb one or more acre of surface soil. An Erosion and Sedimentation Control Plan must also be submitted. (NCDEQ, 2011)
North Carolina water permitting laws and regulations	NCDEQ, Division of Water Resources	Defines general North Carolina water permitting laws and regulations.
Stormwater Program Permit	NCDEQ	Any project that requires a Coastal Area Management Act (CAMA) major development permit and meets one of the following criteria: 1) located in 1 of 20 coastal counties, 2) project discharges stormwater to a designated Outstanding Resource Water, or 3) project discharges stormwater to a High Quality Water (NCDEQ, 1995).
Isolated Wetlands and Waters Rule	NCDEQ	Dredge and fill activities in waters and wetlands that are not regulated under Section 404 of the Clean Water Act (CWA) (NCDEQ, 2003a).
CAMA	NCDEQ	Construction and development projects that take place in 1 of 20 coastal counties and involve dredge and fill activities in coastal waters, or construction of coastal structures and roads (NCDEQ, 2015c).
CWA Section 404 permit, Nationwide Permit (NWP)	U.S. Army Corps of Engineers (USACE), Wilmington District	NWPs cannot be used in the following waters without preconstruction notification: anadromous fish spawning areas from February 15 to June 30; any of the 25 designated trout counties between October 15 and April 15; and sturgeon spawning areas between February 1 and June 30 (USACE, 2012a).

State Law/Regulation	Regulatory Agency	Applicability
		Other considerations: projects covered under NWP 12. Utility Line Activities must use directional boring. Justification is required for work corridors wider than 40 ft. Sub-aqueous utility lines must be buried at least 2 ft, except for in federally maintained channels where they must be buried 6 ft. (USACE, 2012a)
CWA Section 401 permit	NCDEQ	In accordance with CWA Section 401, activities that may result in a discharge to waters of the U.S. require a Water Quality Certification from NCDEQ indicating that the proposed activity will not violate water quality standards (NCDEQ, 2015d).

11.1.4.3. Environmental Setting: Surface Water

Surface water resources are lakes, ponds, rivers, and streams, as well as estuarine[47] and coastal waters. North Carolina has approximately 38,205 miles of rivers and streams, and approximately 311,236 of lakes, reservoirs, and ponds (USEPA, 2014a). The state also has approximately 3,324 square miles of estuaries and bays with more than 300 miles of coastline (USEPA, 2014a) (State of North Carolina, 2015). Surface water uses include public supply, agriculture, aquatic life, domestic, industrial, mining, and thermoelectric power (USGS, 2010b).

Watersheds

Watersheds, or drainage areas, consist of surface water and all underlying groundwater, and encompass an area of land that drains streams and rainfall to a common outlet (e.g., reservoir, bay). North Carolina's waters (lakes, rivers, and streams) are divided into 17 major watersheds, or drainage basins Figure 11.1.4-1. To describe water at a state-level, this PEIS uses the basin level. (NCDEQ, 2015e)

The Hiwassee, Savannah, Little Tennessee, and French Broad river basins encompass the far western corner of North Carolina. East of these river basins lies the Broad, Watauga, New, and Catawba River basins. The Yadkin River Basin is in west central North Carolina and covers approximately 7,400 square miles (NCSU, 2015a). The Roanoke and Chowan river basins extend along most of the northern border of North Carolina. Cape Fear River Basin is the largest basin in the state and extends from northcentral North Carolina to the southeastern coast. To the south of Cape Fear River Basin lies the Lumber River Basin. The White Oak River Basin extends along the southeast North Carolina coast with the Neuse River Basin bordering to the north. The remaining coastal basins include Tar-Pamlico Basin, which extends from the southeast coast to northcentral North Carolina, and the Pasquotank River Basin in the northeastern corner of the state. The Pasquotank River Basin drains approximately 3,635 square miles with 464 stream miles and 1,384 square miles of saltwater (NCSU, 2015b).

[47] Estuarine: related to an estuary, or a "partially enclosed body of water where fresh water from rivers and streams mixes with salt water from the ocean. It is an area of transition from land to sea" (USEPA, 2015a).

Freshwater

As shown in Figure 11.1.4-1, there are 11 major rivers in North Carolina: French Broad, Deep River, Pee Dee River, Lumber River, Northeast Cape Fear River, Cape Fear River, Neuse River, Tar River, Roanoke River, Chowan River, and Haw River. The French Broad River flows through western North Carolina. The Chowan River originates on the North Carolina-Virginia border and flows southeast for approximately 50 miles. The river's waters are home to many species of fish (NCDEQ, 2015f). The Deep, Pee Dee, and Cape Fear rivers flow through central North Carolina. The Neuse River is the longest river in the state and stretches approximately 248 miles from northcentral North Carolina to the southeast coast (NCDEQ, 2015g).

Major lakes and reservoirs in North Carolina include (Figure 11.1.4-1) Fontana Lake, Lake Norman, B. Everett Jordan Lake, Lake Gaston, and Lake Mattamuskeet, W. Kerr Scott Reservoir, and John H. Kerr Reservoir. The largest manmade lake is Lake Norman, located within the Catawba River Basin in western North Carolina (NCDPR, 2015). The W. Kerr Scott Reservoir is located within the Roanoke River Basin along the state's northern border. The reservoir is approximately 1,475 acres and is often used for boating, swimming, and fishing (USACE, 2015a). The Mattamuskeet Lake is in eastern North Carolina within the Tar-Pamlico Basin. The lake is approximately 40,000 acres and the largest natural lake in North Carolina (USFWS, 2013a).

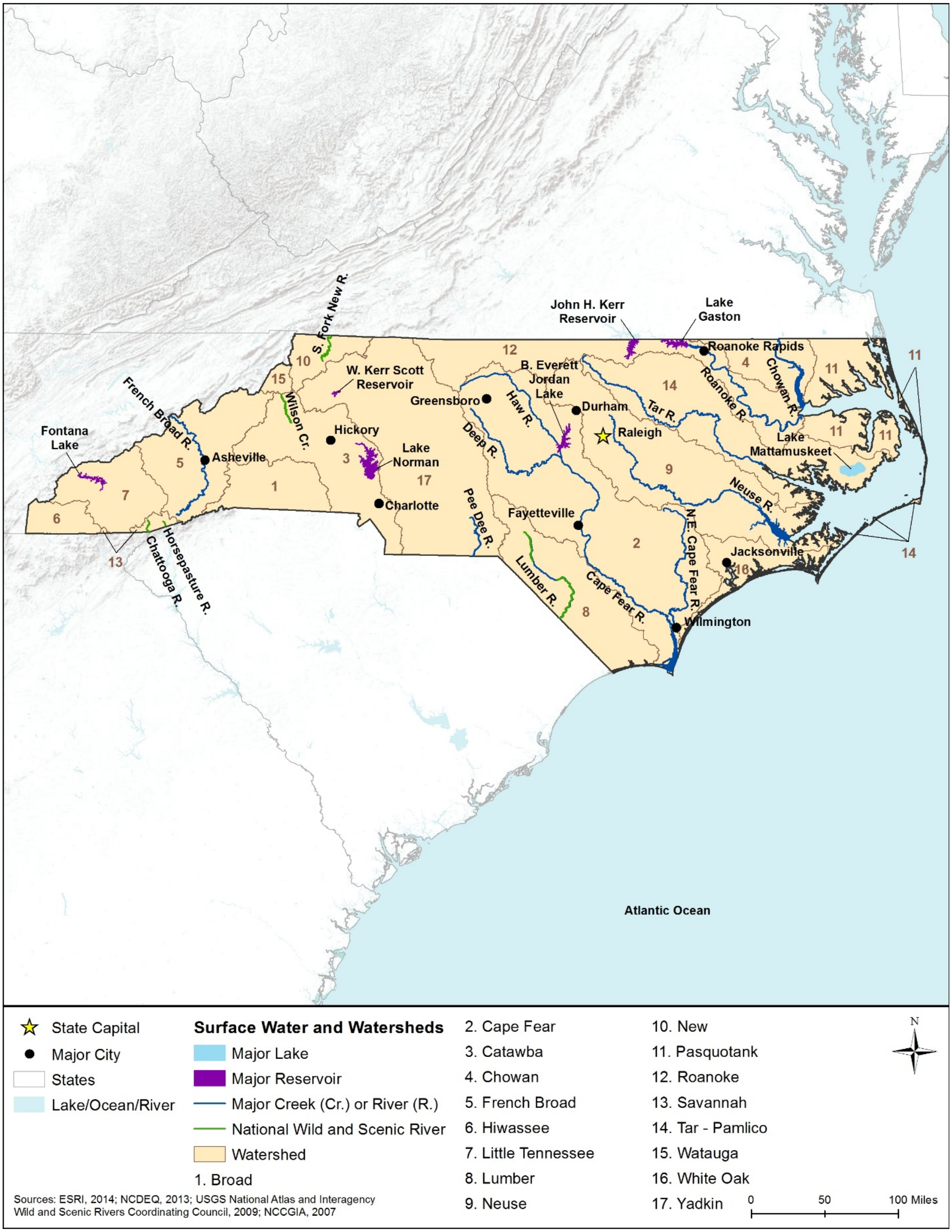

Figure 11.1.4-1: Major North Carolina Watersheds and Surface Waterbodies

Estuarine and Coastal Waters

Estuaries (including bays and tidal rivers) are bodies of water that provide transition zones between fresh river water and saline ocean water. Barrier islands, sand bars, and other landmasses protect estuaries, including those in North Carolina, from ocean waves and storms. North Carolina's estuarine environments support a variety of habitats, including tidal wetlands, mudflats, rocky shores, oyster reefs, freshwater wetlands, sandy beaches, and eelgrass beds, and are a critical part of the lifecycle of many different plant and animal species. (USEPA, 2012a)

Source: (NCDEQ, 2015h)

In 1987, the USEPA's National Estuary Program (NEP) identified Albemarle-Pamlico Estuary as an Estuary of National Significance in North Carolina Figure 11.1.4-2. The estuary is located along the northeast coast of North Carolina and includes more than 3,000 square miles of open water. Two major sounds, the Albemarle and the Pamlico, and several smaller sounds are included in the estuary. The Albemarle-Pamlico Estuary has a watershed area of approximately 31,000 square miles and is drained by several prominent rivers including the Roanoke, Chowan, Pasquotank, Tar-Pamlico, Neuse, and White Oak. (NCDEQ, 2015h)

The North Carolina National Estuarine Research Reserve was designated in 1985 and includes approximately 10,568 acres of protected estuarine habitats along the coast of North Carolina. (NOAA, 2015a) The research reserve is managed by the National Oceanic Atmospheric Administration (NOAA) and the NCDEQ for the purposes of research and education. The reserve is comprised of four components representing diverse estuarine habitats. These include the 965-acre Currituck Banks, the 2,675-acre Rachel Carson, the 5,653-acre Masonboro Island, and the 1,635-acre Zeke's Island (Figure 11.1.4-2). (NOAA, 2015c)

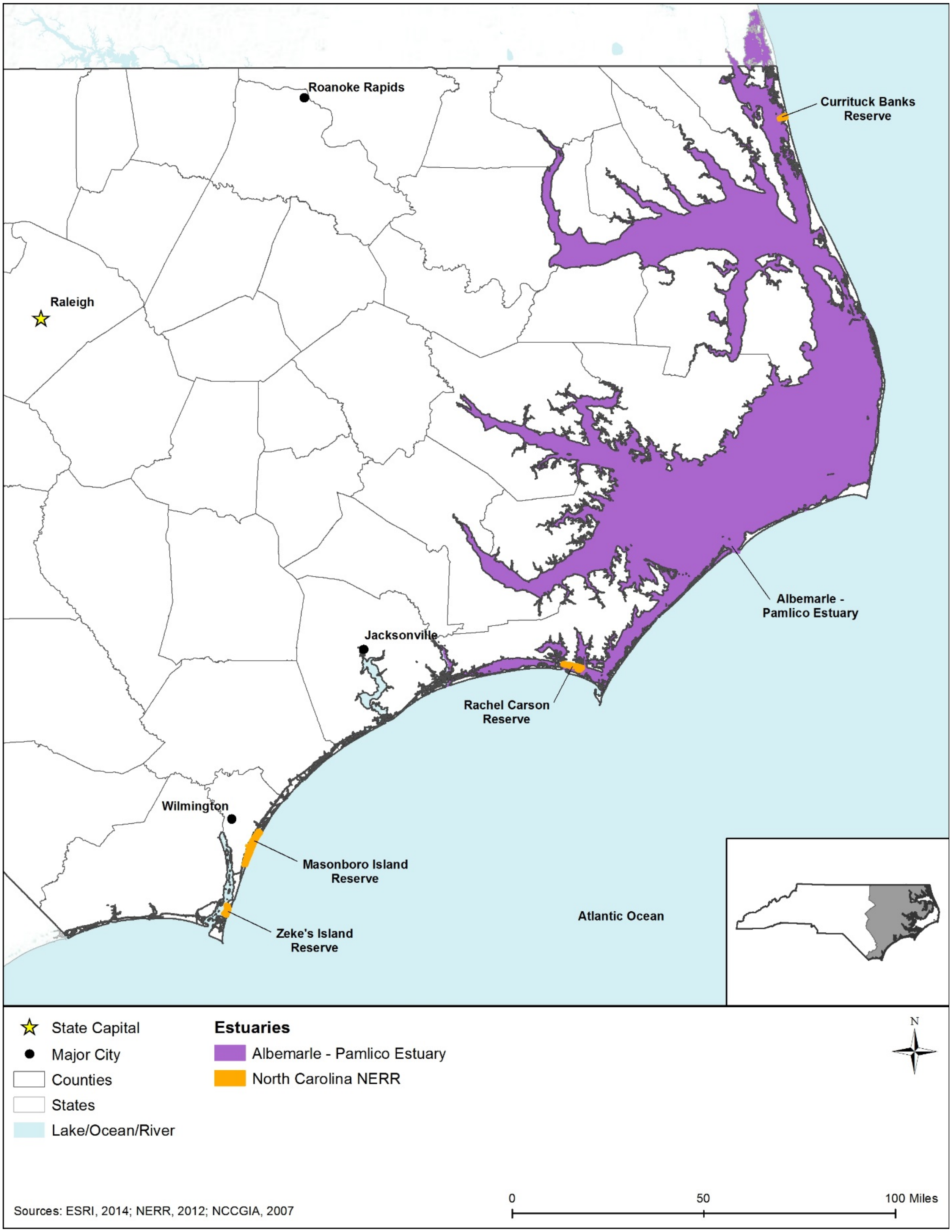

Figure 11.1.4-2: North Carolina's Estuaries and Critical Resource Waters

11.1.4.4. Sensitive or Protected Waterbodies

Wild and Scenic Rivers

Five rivers within North Carolina that are federally designated as National Wild and Scenic Rivers. These rivers include the Chattooga River, Horsepasture River, New River, South Fork, Lumber River, and Wilson Creek (Figure 11.1.4-1).

- Chattooga River, in southwest North Carolina, includes a 41.6 miles of wild river, 2.5 miles of scenic river, and 14.6 miles of recreational river (National Wild and Scenic Rivers System, 2015a).
- Horsepasture River, in southwest North Carolina, includes 3.6 miles of scenic river and 0.6 miles of recreational river (National Wild and Scenic Rivers System, 2015b).
- New River (South Fork), in northwest North Carolina, includes 26.5 miles designated as scenic (National Wild and Scenic Rivers System, 2015c).
- Lumber River, in southcentral North Carolina, includes 60 miles of scenic river and 21 miles of recreational river (National Wild and Scenic Rivers System, 2015d).
- Wilson Creek, in northwest North Carolina, includes 4.6 miles of wild river, 2.9 miles of scenic river, and 15.8 miles of recreational river (National Wild and Scenic Rivers System, 2015e).

State Designated Critical Resource Waters

North Carolina has established rules to protect and maintain waters classified by the state as Critical Water Supply Watersheds. Randleman Lake (Deep River) water supply watershed is designated by the Environmental Management Commission as a Critical Water Supply Watershed. The drainage area upstream of the Randleman Lake Dam is protected from wastewater discharges, destruction of riparian areas, and urban storm water. (NCDEQ, 2015i)

High Quality Waters (HQWs) within North Carolina are waters rated excellent based on biological and physical/chemical characteristics, including commercial shell fishing areas, Outstanding Resource Waters (ORWs), and primary nursery areas (NCDEQ, 2015j). Currently, HQWs with specific actions include Thorpe Reservoir (Little Tennessee River Basin) and all of its tributaries (NCDEQ, 2015k). Additionally, a subset of HQWs in North Carolina are ORWs, which exhibit “exceptional state or national recreational or ecological significance” and “exceptional water quality.” A list of these waters can be found be found at www.ncrules.state.nc.us/environmentalmanagement/subchapter.pdf (NCDEQ, 2009).

North Carolina also designates waters as Nutrient Sensitive Waters if they need additional nutrient management to provide protections from excessive growth of vegetation. Currently, waters within the Tar-Pamlico River Basin and Neuse River Basin have this classification. (NCDEQ, 2015l)

11.1.4.5. Impaired Waterbodies

Water quality is evaluated by several constituents and attributes, including temperature, dissolved oxygen, suspended sediment, nutrients, metals, oils, pesticides water color, condition of stream banks and lake shores; observations of aquatic wildlife communities; and sampling of fish tissue or sediment. Under Section 303(d) of the CWA, states are required to assess water quality and report a listing of impaired waters,[48] the causes of impairment, and probable sources. Table 11.1.4-2 summarizes the water quality of North Carolina's assessed major waterbodies by category, percent impaired, designated use,[49] cause, and probable sources. Figure 11.1.4-3 shows the Section 303(d) waters in North Carolina, as of 2014.

As shown in Table 11.1.4-2, various sources affect North Carolina's waterbodies, causing impairments. In North Carolina, the designated uses of all statewide waterbodies are considered impaired for fish consumption due to a statewide fish consumption advisory that is in effect because of elevated mercury levels in fish tissue. If the statewide mercury fish consumption advisory is excluded, the number of impaired waters within the state is significantly less (USEPA, 2014a). Further, metals and polychlorinated biphenyls are sources of impairment for North Carolina's waterbodies. For example, Lake Norman currently has a fish consumption advisory in place due to elevated levels of polychlorinated biphenyls and mercury in several species of bass. Additionally, consumption of carp and catfish in the Neuse River is limited due to polychlorinated biphenyls levels (NCPH, 2015).

Table 11.1.4-2: Section 303(d) Impaired Waters of North Carolina, 2014

Water Type[a]	Amount of Waters Assessed[b] (Percent)	Amount Impaired (Percent)	Designated Uses of Impaired Waters	Top Causes of Impairment	Top Probable Sources for Impairment
Rivers and Streams	100%	100%	Aquatic life, fish consumption, recreation, water supply	Mercury, metals, pathogens[c]	No sources reported
Lakes, Reservoirs, and Ponds	80.3%	100%	Aquatic life, fish consumption, recreation, water supply	Mercury, algal growth, polychlorinated biphenyls	No sources reported
Estuaries and Bays	100%	100%	Aquatic life, fish consumption, recreation, shellfish harvesting	Mercury, metals, pathogens	No sources reported
Coastal Shoreline	NA	100%	Aquatic life, fish consumption, recreation	Mercury	No sources reported

[a] Some waters may be considered for more than one water type.
[b] North Carolina has not assessed all waterbodies within the state.
[c] Pathogen: a bacterium, virus, or other microorganism that can cause disease (USEPA, 2015a).

Source: (USEPA, 2015b)

Pathogens are a source of impairment in North Carolina's estuaries, bays, rivers, and streams. For example, pathogens threaten the Albemarle-Pamlico Estuary along North Carolina's eastern coastline. USEPA and the state are working to minimize the introduction of these pathogens

[48] Impaired waters: waterways that do not meet state water quality standards. Under the CWA, Section 303(d), states, territories, and authorized tribes are required to develop prioritized lists of impaired waters (USEPA, 2015a)
[49] Designated Use: an appropriate intended use by humans and/or aquatic life for a waterbody. Designated uses may include recreation, shell fishing, or drinking water supply (USEPA, 2015a)

from various sources, including aging infrastructure and rising sea levels. North Carolina plans to upgrade wastewater treatment facilities and implement best management practices in targeted waterbodies to reduce overall pathogen levels. (NCDEQ, 2015m)

The North Carolina Division of Water Resources (NCDWR) monitors and manages water quality throughout the state. The eight branches of the NCDWR Water Sciences Division evaluate the state's water resources through use of various biological, chemical, and physical techniques. For example, aquatic life is the primary designated use for impaired waters within North Carolina. The Ecosystems Branch is responsible for algal and aquatic plant assessments for North Carolina's Ambient Monitoring System. Sample are collected in response to specific events, such as fish kills and algal growth, and on a routine basis, particularly in estuarine systems (NCDEQ, 2015n). Additionally, the Aquatic Toxicology Branch monitors toxicity of aquatic species in North Carolina's waterbodies, and supports the USEPA mandated NPDES program to verify data quality and ensure compliance with established permits (NCDEQ, 2015o).

NCDWR also includes the Intensive Survey Branch, which supports the state's Ambient Lake Monitoring Program. Top sources of impairment for North Carolina's lakes, reservoirs, and ponds include mercury, polychlorinated biphenyls, and algal growth. For example, Lake Jordan in the Cape Fear River Basin exhibits excess nutrient and sediment levels, and are therefore closely monitored by this program to prevent and control future pollution (NCDEQ, 2015p).

11.1.4.6. Floodplains

The Federal Emergency Management Agency (FEMA) defines a floodplain or flood-prone area as "any land area susceptible to being inundated by water from any source" (44 Code of Federal Regulations [CFR] 59.1) (FEMA, 2000).[50] Through FEMA's flood hazard mapping program, the agency identifies flood hazards and risks associated with the 100-year flood, which is defined as "a flood that has a 1 percent chance of occurring in any given year," to allow communities to prepare and protect against flood events (FEMA, 2013).

Floodplains provide suitable and sometimes unique habitat for a wide variety of plants and animals, and are typically more biologically diverse than upland areas due to the combination of both terrestrial and aquatic ecosystems. Vegetation along stream banks provides shade, which helps to regulate water temperature for aquatic species. During flood events, sediment and debris settle out and collect on the floodplain, enriching the soil with additional nutrients. Pollutants from floodwater runoff are also filtered by floodplain vegetation and soils; thereby improving water quality. Furthermore, floodplains protect natural and built infrastructure by providing floodwater storage, erosion control, water quality maintenance, and groundwater recharge. Historically, floodplains have been favorable locations for agriculture, aquaculture, and forest production due to the relatively flat topography and nearby water supply. Floodplains can also offer recreational activities, such as boating, swimming, and fishing, as well as hiking and camping (FEMA, 2014a).

[50] To search for and locate CFR records, see the Electronic Code of Federal Regulations (e-CFR): www.ecfr.gov.

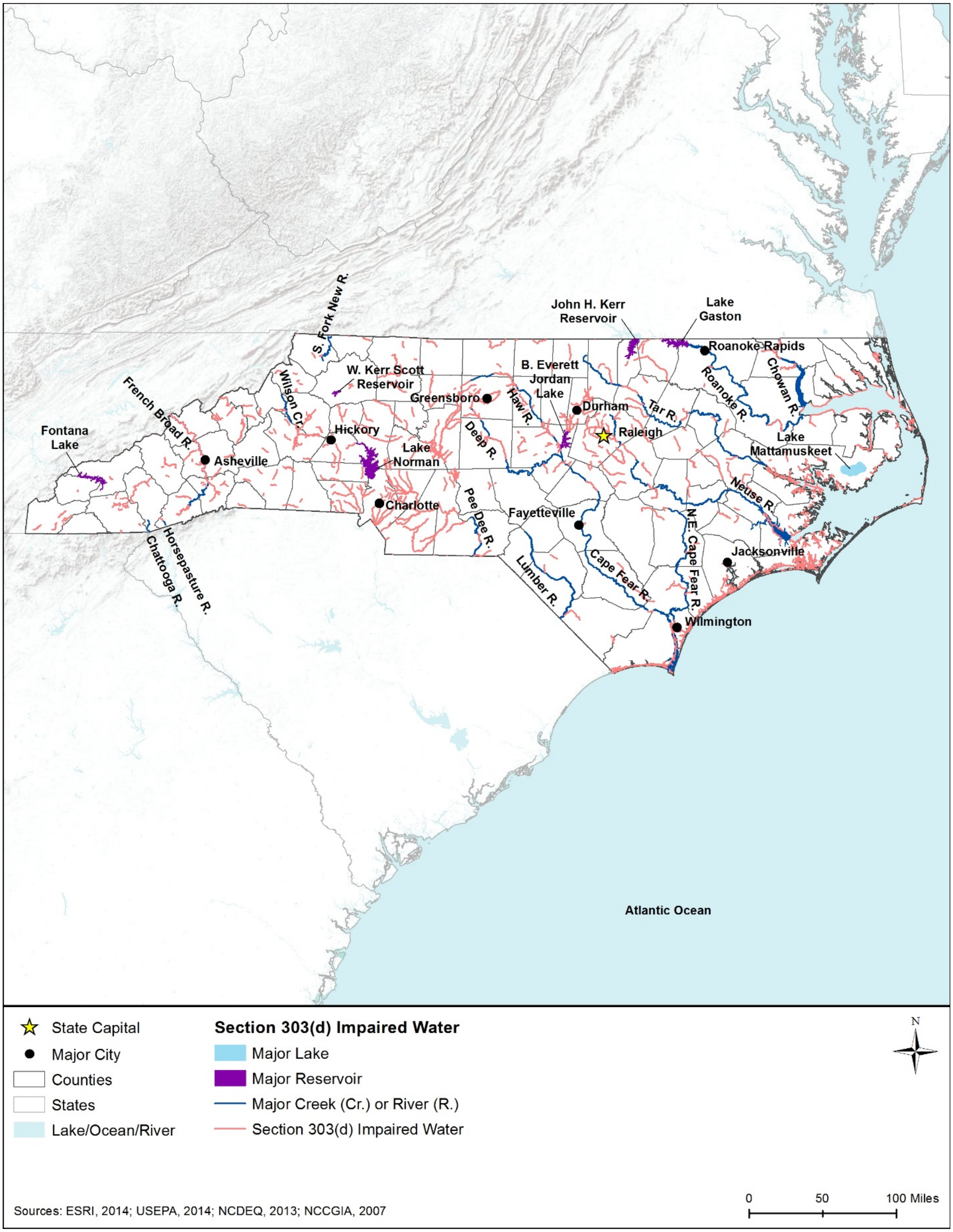

Figure 11.1.4-3: Section 303(d) Impaired Waters of North Carolina, 2014

There are two primary types of floodplains in North Carolina:

- **Riverine and lake floodplains** occur along rivers, streams, or lakes where overbank flooding may occur, inundating adjacent land areas. In steep river valleys found in hilly or mountainous areas, floodwaters can build and recede quickly, with fast moving and deep water. Flooding in these areas can cause greater damage than typical riverine flooding due to the high velocity of water flow, the amount of debris carried, and the broad area affected by floodwaters. Whereas, flatter floodplains may remain inundated for days or weeks, covered by slow-moving and shallow water (FEMA, 2014b).
- **Coastal floodplains** occur in North Carolina's watersheds along the Atlantic Ocean coastline, particularly the Pasquotank River, Tar-Pamlico, and White Oak River basins. Coastal flooding can occur when strong wind and storms, usually nor'easters and hurricanes, increase water levels on the adjacent shorelines (FEMA, 2013).

Flooding is the leading cause for disaster declaration by the President in the U.S. and results in significant damage throughout the state annually (NOAA, 2015d). There are several causes of flooding in North Carolina, often resulting in loss of life and damage to property, infrastructure, agriculture, and the environment. These include hurricanes, excessive rainfall or snowmelt, dam and levee failure, and insufficient drainage in developed areas (NCDEM, 2011).

Although some areas, such as floodplains, are more prone to flooding than others, no area in the state is exempt from flood hazards. In 2004, North Carolina was hit by four hurricanes resulting in disaster declaration for 95 out of the 100 counties in the state. In response to significant flooding from Hurricane Floyd in September 1999, North Carolina developed the Inundation Mapping and Alert Network to provide real-time flood forecast maps. (NCDEM, 2011)

Local communities often have floodplain management or zoning ordinances that restrict development within the floodplain. FEMA provides floodplain management assistance, including mapping of 100-year floodplain limits, to approximately 576 communities in North Carolina through the National Flood Insurance Program (NFIP) (FEMA, 2014c). Established to reduce the economic and social cost of flood damage, by subsidizing insurance payments, the NFIP encourages communities "to adopt and enforce floodplain management regulations and to implement broader floodplain management programs" and allows property owners in participating communities to purchase insurance protection against losses from flooding (FEMA, 2015). As an incentive, communities can voluntarily participate in the NFIP Community Rating System (CRS), which is a program that rewards communities by reducing flood insurance premiums in exchange for doing more than the minimum NFIP requirements for floodplain management. As of May 2014, North Carolina had 89 communities participating in the CRS (FEMA, 2014d).[51]

[51] A list of the 89 CRS communities can be found in the most recent FEMA CRS report dated May 1, 2014 (FEMA, 2014d) and additional program information is available from FEMA's NFIP CRS website (www.fema.gov/national-flood-insurance-program-community-rating-system).

11.1.4.7. Groundwater

Groundwater systems are sources of water that result from precipitation infiltrating the ground surface, and includes underground water that occupies pore spaces between sand, clay, or rock particles. An aquifer is a permeable geological formation that stores or transmits water to wells and springs. Groundwater is contained in either confined (bound by clays or nonporous bedrock) or unconfined (no layer to restrict the vertical movement of groundwater) aquifers (USGS, 1999). When the water table reaches the ground surface, groundwater will reappear as either streams, surface bodies of water, or wetlands. This exchange between surface water and groundwater is an important feature of the hydrologic (water) cycle.

North Carolina's principal aquifers consist of carbonate-rock[52] and sandstone aquifers.[53] More than 50 percent of state residents obtain drinking water from groundwater sources (NCDEQ, 2015q). Generally, the water quality of the state's aquifers is adequate for existing uses. Threats to groundwater quality include pollution from surface activities conducted by industry, agriculture, government, and individuals. Historically, approximately 70 percent of groundwater contamination has resulted from underground storage tank leaks (NCDENR, 1999).

Table 11.1.4-3 provides details on aquifer characteristics in the state and Figure 11.1.4-4 shows North Carolina's principal aquifers. There are no sole source aquifers in North Carolina. The Piedmont and Blue Ridge carbonate-rock aquifers, Early Mesozoic basin aquifer, Valley and Ridge crystalline aquifers, and Southeastern Coastal Plain aquifer system exist in small parts within North Carolina and are therefore not discussed in detail.

Table 11.1.4-3: Description of North Carolina's Principal Aquifers

Aquifer Type and Name	Location in State	Groundwater Quality
Castle Hayne Aquifer Consist of limestone, sandy limestone, and sand.	Southeast North Carolina	Suitable for most uses and is the most productive aquifer in the state.
Northern Atlantic Coastal Plain Aquifer System Consists of sand, gravel, silt, and minor clay.	Extends from southcentral to eastern coast	Suitable for most uses. Generally produces high-yielding wells for coastal communities.
Surficial Aquifer System Consists of unconsolidated sand and gravel deposits.	Southcentral North Carolina	Suitable for most uses. Water is generally hard and of the calcium bicarbonate type. Aquifer is shallow and susceptible to contamination from septic tanks and other pollution sources.
Piedmont and Blue Ridge Aquifer Consists of dense, almost impermeable bedrock.	Covers the majority of western and central North Carolina	Suitable for drinking and other uses, but iron, manganese, and sulfate concentrations occur in some areas.

Sources: (USGS, 2015g), (USGS, 2015h), (USGS, 2015i), (USGS, 2015j), (NCDEQ, 2015r)

[52] Carbonate-rock aquifers typically consist of limestone with highly variable water-yielding properties (some yield almost no water and others are highly productive aquifers) (Olcott, 1995a).
[53] Sandstone aquifers form from the conversion of sand grains into rock caused by the weight of overlying soil/rock. The sand grains are rearranged and tightly packed, thereby reducing or eliminating the volume of pore space, which results in low-permeability rocks such as shale or siltstone. These aquifer types are highly productive in many places and provide large volumes of water. (Olcott, 1995b)

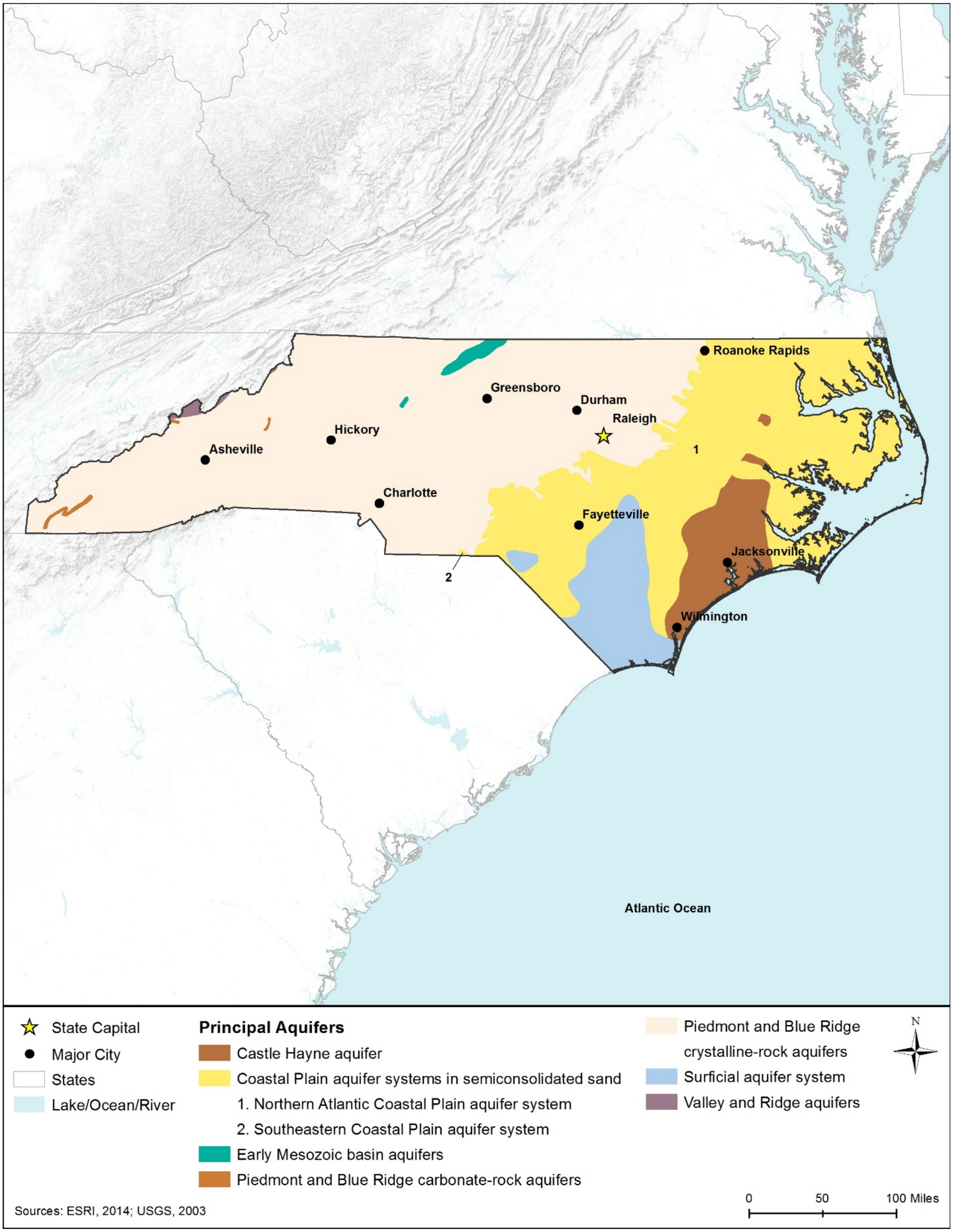

Figure 11.1.4-4: Principal Aquifers of North Carolina

11.1.5. Wetlands

11.1.5.1. Definition of the Resource

The CWA defines wetlands as "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas" (40 CFR 230.3(t), 1993).

The USEPA estimates that "more than one-third of the United States' threatened and endangered species live only in wetlands, and nearly half of such species use wetlands at some point in their lives" (USEPA, 1995). In addition to providing habitat for many plants and animals, wetlands also provide benefits to human communities. Wetlands store water during flood events, improve water quality by filtering polluted runoff, help control erosion by slowing water velocity and filtering sediments, serve as points of groundwater recharge, and help maintain base flow in streams and rivers. Additionally, wetlands provide recreation opportunities for people, such as hiking, bird watching, and photography. (USEPA, 1995)

11.1.5.2. Specific Regulatory Considerations

Appendix C describes the pertinent federal laws protecting wetlands in detail. Table 11.1.5-1 summarizes the major North Carolina state laws and permitting requirements relevant to the state's wetlands.

Table 11.1.5-1: Relevant North Carolina Wetlands Laws and Regulations

State Law/Regulation	Regulatory Authority	Permit Requirements
CWA Section 404 permit, NWP	USACE, Wilmington District	Preconstruction notification is required for activities covered by any NWP in wetlands classified as bogs[54] by the North Carolina Wetland Assessment Methodology. NWPs may not be used to authorize discharges of dredged or fill materials into waters of the U.S., including wetlands adjacent to those identified or designated by the state as Outstanding Resource Waters, High Quality Waters, or Coastal Wetlands as defined by CAMA.
CWA Section 401 permit	NCDEQ	Under CWA Section 401, a Water Quality Certification from NCDEQ is required for a 404 permit to discharge fill material into wetlands.
State wetlands rules	NCDEQ	Regulates all wetlands, not just those under federal jurisdiction, due to the ecological importance of remaining wetlands.

[54] Bogs: "Peat-accumulating wetland that has no major inflows or outflows and supports acid-loving mosses, particularly sphagnum" (USACE, 2015b).

State Law/Regulation	Regulatory Authority	Permit Requirements
CAMA	NCDEQ	Major Development Permit required if project involves development in an Area of Environmental Concern (AEC) (the state's coastal wetlands[55] are designed Areas of Environmental Concern), and generally if there is any dredging or filling of water or marsh. (NCDEQ, 2015s)
CAMA	NCDEQ	Permits required for construction and development projects that take place in one of the 20 coastal counties and involve dredge and fill activities in coastal waters, wetlands, or construction of coastal structures and roads. (NCDEQ, 2015c)

11.1.5.3. Environmental Setting: Wetland Types and Functions

The U.S. Fish and Wildlife Service's (USFWS) National Wetlands Inventory (NWI) mapping adopted a national Wetlands Classification Standard (WCS) that classifies wetlands according to shared environmental factors, such as vegetation, soils, and hydrology, as defined in Cowardin et al. (1979). The WCS includes five major wetland systems: Marine, Estuarine, Riverine, Lacustrine, and Palustrine. North Carolina includes four of these Systems, as detailed in Table 11.1.5-2. The first four of these include both wetlands and deepwater habitats but the Palustrine includes only wetland habitats. (USFWS, 2015a)

- "The Marine System consists of the open ocean overlying the continental shelf and its associated high-energy coastline. Marine habitats are exposed to the waves and currents of the open ocean and the Water Regimes are determined primarily by the ebb and flow of oceanic tides. Salinities exceed 30 parts per thousand (ppt), with little or no dilution except outside the mouths of estuaries." Where wave energy is low, mangroves, or mudflats may be present."
- "The Estuarine System consists of deepwater tidal habitats and adjacent tidal habitats that are usually semi enclosed by land but have open, partly obstructed or sporadic access to the open ocean, and the ocean water is at least occasionally diluted by freshwater runoff from the land."
- "Riverine System includes all wetlands and deepwater habitats contained within a channel with two exceptions (1) wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens, and (2) habitats with water containing ocean-derived salts in excess of 0.5 ppt."
- "Lacustrine System includes inland water bodies that are situated in topographic depressions, lack emergent trees and shrubs, have less than 30 percent vegetation cover, and occupy greater than 20 acres. Includes lakes, larger ponds, sloughs, lochs, bayous, etc."
- "Palustrine includes all nontidal wetlands dominated by trees, shrubs, persistent emergents, or emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity

[55] Coastal wetlands are "any marsh in the 20 coastal counties that regularly or occasionally floods by lunar or wind tides, and that includes one or more of 10 plant species:: Salt Marsh (Smooth) Cord Grass *(Spartina alterniflora),* Black Needlerush *(Juncus roemerianus),* Glasswort (*Salicornia spp.),* Salt (or Spike) Grass *(Distichlis spicata),* Sea Lavender *(Limonium spp),* Bulrush *(Scirpus spp.),* Saw Grass *(Cladium jamaicense),* Cattail *(Typha spp.),* Salt Meadow Grass *(Spartina patens),* Salt Reed or Giant Cord Grass *(Spartina cynosuroides)* (NCDEQ, 2015s).

due to ocean-derived salts is below 0.5 percent." The System is characterized based on the type and duration of flooding, water chemistry, vegetation, or substrate characteristics (soil types). (Cowardin, Carter, Golet, & LaRoe, 1979) (FGDC, 2013).

In North Carolina, the two main types of wetlands are palustrine (freshwater) wetlands found on river and lake floodplains across the eastern half of the state, and estuarine/marine (tidal) wetlands along the state's coastline, as shown inn Figure 11.1.5-1. Of the more than 4 million acres of wetlands in North Carolina, riverine (4,953 acres) and lacustrine (13,624 acres) wetlands comprise less than 0.5 percent of the total wetlands in the state, and therefore, they are not discussed in detail in this PEIS (USFWS, 2014a).

Table 11.1.5-2 uses 2014 NWI data to characterize and map North Carolina wetlands on a broad-scale.[56] The data are not intended for site-specific analyses and is not a substitute for field-level wetland surveys, delineations, or jurisdictional determinations, which may be conducted, as appropriate, at the site-specific level once those locations are known. The map codes and colorings in Table 11.1.5-2 correspond to the wetland types in the figures.

Table 11.1.5-2: North Carolina Wetland Types, Descriptions, Location, and Amount, 2014

Wetland Type	Map Code and Color	Description [a]	Occurrence	Amount (acres)[b]
Palustrine forested wetland	PFO	PFO wetlands contain woody vegetation that are at least 20 feet tall. Floodplain forests and hardwood swamps are examples of PFO wetlands.	Forested lowlands within the state	3,566,808
Palustrine scrub-shrub wetland	PSS	Woody vegetation less than 20 feet tall dominates PSS wetlands. Thickets and shrub swamps are examples of PSS wetlands.	Throughout the state, often on river and lake floodplains	
Palustrine emergent wetlands	PEM	PEM wetlands have erect, rooted, green-stemmed, annual, water-loving plants, present for most of the growing season in most years. PEM wetlands include freshwater marshes, wet meadows, fens,[c] prairie potholes, and sloughs.[d]	In depressions in the landscape. Eastern part of the state	120,892
Palustrine unconsolidated bottom	PUB	PUB and PAB are commonly known as freshwater ponds, and includes all wetlands with at least 25% cover of particles smaller than stones and a vegetative cover less than 30%.	Throughout the state and Coastal Plains (eastern part of the state)	115,498
Palustrine aquatic bed	PAB	PAB wetlands include wetlands vegetated by plants growing mainly on or below the water surface line.		

[56] The wetland acreages were obtained from the USFWS (2014) National Wetlands Inventory. Data from this inventory was downloaded by state at https://www.fws.gov/wetlands/. The wetlands data contains a wetlands classification code, which are a series of letter and number codes, adapted to the national wetland classification system in order to map from (e.g., PFO). Each of these codes corresponds to a larger wetland type; those wetland areas are rolled up under that wetlands type. The codes and associated acres that correspond to the deepwater habitats (e.g., those beginning with M1, E1, L1) were removed. The wetlands acres were derived from the geospatial datafile, by creating a pivot table to capture the sum of all acres under a particular wetland type. The maps reflect/show the wetland types/classifications and overarching codes; the symbolization used in the map is standard to these wetland types/codes, per the USFWS and Federal Geographic Data Committee.

Wetland Type	Map Code and Color	Description [a]	Occurrence	Amount (acres)[b]
Other Palustrine wetland	Misc. Types	Farmed wetland, saline seep,[e] and other miscellaneous wetlands are included in this group.	Abandoned fields, depressions (seeps), along hillsides and highways	1,451
Riverine wetland	R	R wetlands include rivers, creeks, and streams. They are contained in natural or artificial channels periodically or continuously containing flowing water.	Throughout the state	4,953
Lacustrine wetland	L2	L2 wetlands are lakes or shallow reservoir basins generally consisting of ponded waters in depressions or dammed river channels, with sparse or lacking persistent emergent vegetation, but including any areas with abundant submerged or floating-leaved aquatic vegetation. These wetlands are less than 8.2 feet deep.	Coastal Plain, along the edge of lakes	13,624
Estuarine and Marine intertidal wetland	E2/M2	These intertidal wetlands include the areas between the highest tide level and the lowest tide level. Semidiurnal tides (two high tides and two low tides per day) periodically expose and flood the substrate. Wetland examples include vegetated and non-vegetated brackish (mix of fresh and saltwater), and saltwater marshes, shrubs, beaches, sandbars, or flats.	Along the coast, in the eastern part of the state	237,907
			TOTAL	**4,061,133**

[a] The wetlands descriptions are based on information from the Federal Geographic Data Committee (FGDC)'s Classification of Wetland and Deepwater Habitats of the United States. Based on Cowardin, et.al. 1979, some data has been revised based on the latest scientific advances. The USFWS uses these standards as the minimum guidelines for wetlands mapping efforts (FGDC, 2013).
[b] All acreages are rounded to the nearest whole number. The maps are prepared from the analysis of high altitude imagery. A margin of error is inherent in the use of imagery. The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted (USFWS, 2015c).
[c] Fens are "peat-accumulating wetlands that form at low points in the landscape or near slopes where groundwater intercepts the soil surface" (NCSU, 2016).
[d] Slough: "Swamp or shallow lake system, usually a backwater to a larger body of water" (NOAA, 2014e).
[e] Saline seep is an area where saline groundwater discharges at the soil surface. Saline soils and salt tolerant plants characterize these wetlands. (City of Lincoln, 2015)

Sources: (Cowardin, Carter, Golet, & LaRoe, 1979) (USFWS, 2015b) (FGDC, 2013)

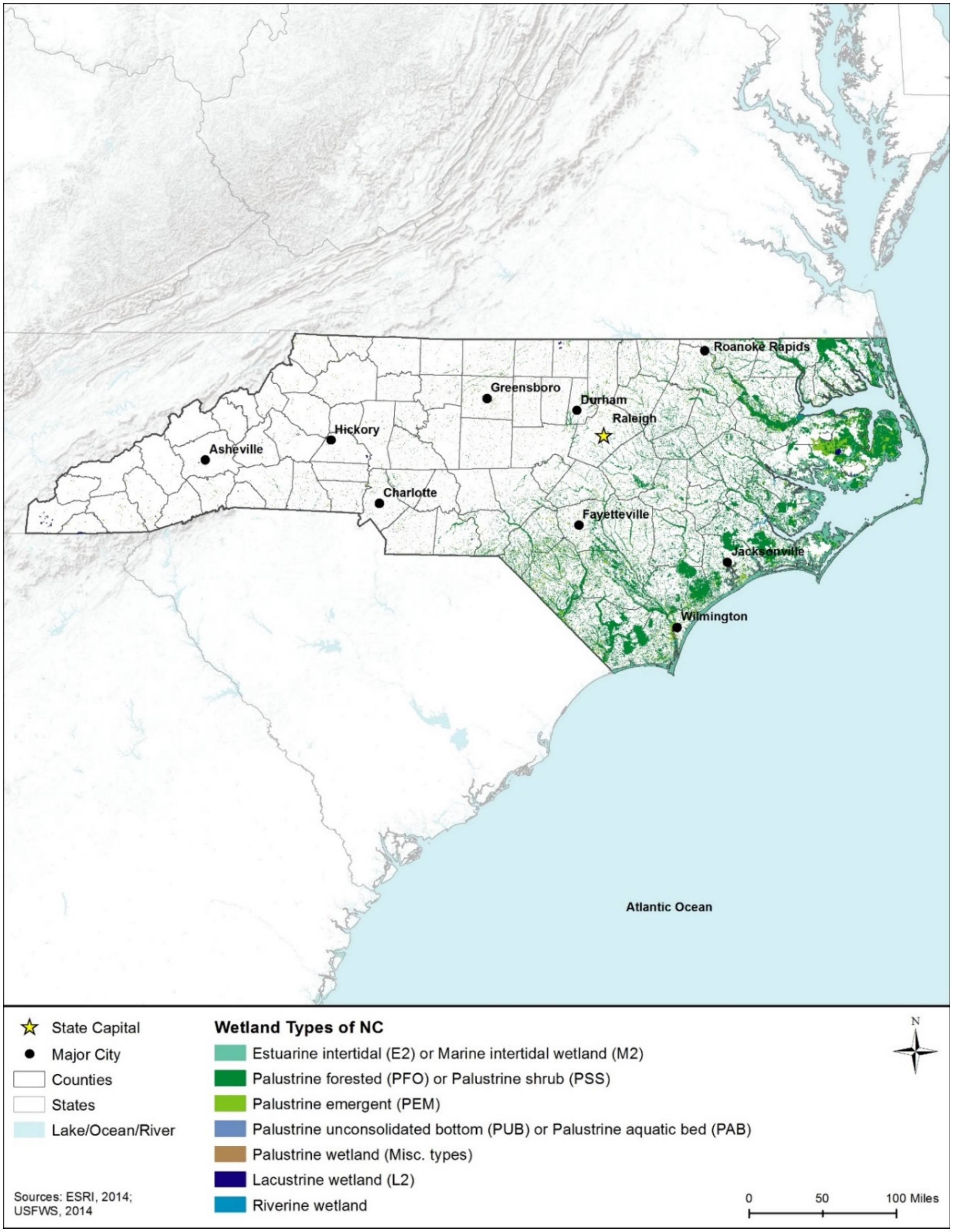

Figure 11.1.5-1: Wetlands by Type, in North Carolina, 2014

Palustrine Wetlands

Figure 11.1.5-2: Pocosin Wetland
(Photo credit: Dr. Curtis Richardson/Duke Wetland Center)

Source: (USEPA, 2013d)

In North Carolina, palustrine wetlands include the majority of vegetated freshwater wetlands (freshwater marshes, swamps, bogs, and ponds). Common tree types found in palustrine forested wetlands (PFO) in North Carolina are oaks (*Quercus spp*.), ash (*Fraxinus spp*), bald cypress (*Taxodium distichum*), American elm (*Ulmus americana),* cottonwood (*Populus spp*.), and box elder *(Acer negundo),* with inkberry (*Ilex grabra*), fetterbush *(Lyonia lucida),* and swamp titi *(Cyrilla racemiflora).* PSS in North Carolina consist of dominant tree species such as alders *(Alnus spp),* willows *(Salix spp)*, buttonbush *(Cephalanthus occidentalis)*, sweet gum *(Liquidambar styraciflua),* and highbush blueberries *(Vaccinium corymbosum)*, and ferns *(Pteridophytes)* (North Carolina Natural Heritage Program, 2012). Approximately 70 percent of the country's pocosins, or evergreen shrub bogs (and PSS wetland), occur in North Carolina (as shown in Figure 11.1.5-2). Found in the southeastern U.S., pocosins prefer high areas, with acidic, nutrient-poor soils. Pocosins retain rainfall for long periods, releasing water slowly (NCSU, 2015c). PFO and PSS are the most common type of palustrine wetlands within North Carolina.

Palustrine emergent wetlands (PEM), or freshwater marsh, fen and slough, in North Carolina support diverse plant and animal populations. Common PEM plants in North Carolina include cattails *(Typha spp.)*, bulrush *(Scirpus spp.)*, reed *(Phragmites spp.),* saw grass *(Cladium jamaicense),* and sedges (*Cyperaceae spp)* (NCSU, 2015c; North Carolina Natural Heritage Program, 2012). Palustrine wetlands also include the shallow water zones of lakes, rivers, and ponds and aquatic beds (PAB/PUB) formed by water lilies and other floating-leaved or free-floating plants. These are the easiest wetlands to recognize and occur throughout the state (NCSU, 2015c).

According to the USEPA, North Carolina has "lost 50 percent of its original 11.1 million acres of wetlands. Between 1950 and 1980, wetland conversion in the North Carolina coastal plain was due largely to forestry (52.8 percent of total area altered), followed by agriculture (42.2 percent) and development, such as urbanization (5 percent)" (USEPA, 2015c). Based on the USFWS NWI 2014 analysis, PFO/PSS wetlands are the dominant type (94 percent), followed by PEM (3 percent), PUB/PAB (ponds) (3 percent), and other palustrine wetlands (less than 1 percent) (USFWS, 2014a). There are currently more than 3.8 million acres of palustrine (freshwater) wetlands in the state (USFWS, 2014a). Main threats to wetlands in North Carolina include population increase, and increased residential and industrial development, agricultural conversion, and urbanization (NCSU, 2015c).

Estuarine and Marine Wetlands

In North Carolina, there are 237,907 acres of estuarine and marine wetlands, which can be vegetated (salt marsh) or unvegetated (mud and sand flats). These wetlands are found between the open saltwater of the bays or Atlantic Ocean and the uplands of the coastal plain and barrier islands. Estuarine wetlands include vegetated mudflats exposed at low tide and salt marshes (tidally flooded grasslands) found in the near shore areas. (NC Wildlife Resources Commission, 2015) Salt marshes are tidally influenced systems that may receive inflow of fresh water from rivers, runoff, or groundwater. The main vegetation includes saltmarsh cordgrass *(Spartina alterniflora)*, black needle rush *(Juncus roemerianus)*, and large saltmeadow cordgrass *(Spartina patens).* (NCSU, 2015c)

As of 2003, approximately 50 percent of the state's coastal wetlands have been drained or converted to other land uses. Although agricultural conversion, the largest historical contributor to wetlands loss, has stopped, wetlands continue to be lost as they are drained or filled for development. (NCDEQ, 2003b) (NC Wildlife Resources Commission, 2015).

11.1.5.4. Wetlands of Special Concern or Value

In addition to protections under the state's wetlands regulations, and national CWA, North Carolina considers bogs as areas of special value due to the habitat they support.

Bogs

In North Carolina, areas classified as a bog are protected under the USACE Nationwide permit. Bogs are acidic wetlands that form thick organic (peat) deposits up to 50 feet deep or more. They have little groundwater influence and are recharged through precipitation. The stagnant, nutrient-poor, acidic water slows all processes in a bog, including nutrient recycling, making bogs very sensitive to external disturbance. Bogs are great habitat for carnivorous pitcher plants. Bogs in western North Carolina provide habitat for the endangered bog turtle (*Glyptemys muhlenbergii*) (NCSU, 2015c).

Important Wetland Sites in North Carolina

"North Carolina's state park system includes 35 state parks, four recreation areas, and [20] natural areas from the mountains to the sea. In maintaining these recreational areas and parks, the NC Division of Parks and Recreation is charged with "protecting and managing the natural and cultural resources within the state parks system," which is accomplished through the Division's Resource Management Program" (North Carolina Wildlife Resources Commission, 2016).

National Natural Landmarks range in size from 10 acres to over 16,000 acres, and are owned by North Carolina Department of the Environment and Natural Resources, The Nature

Conservancy, municipalities, and other conservation organizations and individuals (NPS, 2012a). Section 11.1.8, Visual Resources, describes North Carolina's National Natural Landmarks.

Other wetlands protected under easements or agreements through voluntary government programs and resource conservation groups are found across the state, including Natural Resources Conservation Service (NRCS) Agricultural Conservation Easement Program, natural resource conservation groups such as state land trusts, The Nature Conservancy, Ducks Unlimited, and North Carolina Coastal Land Trust. According to the National Conservation Easement Database, a national electronic repository of government and privately held conservation easements (http://conservationeasement.us/), NRCS holds more than 50,000 acres in conservation easements in North Carolina. (NCED, 2015)

11.1.6. Biological Resources

11.1.6.1. Definition of the Resource

This chapter describes the biological resources for North Carolina. Biological resources include terrestrial[57] vegetation, wildlife, fisheries and aquatic habitats, threatened and endangered species, and communities and species of conservation concern. Because of the topographic variation within the state and its location along the Atlantic coast, North Carolina supports biological resources ranging from marine[58] and estuarine habitat[59] along the east coast and hills and plains in the central area of the state to mountainous areas in the western part of the state.

11.1.6.2. Specific Regulatory Considerations

The proposed project must meet the requirements of NEPA and other applicable laws and regulations. The federal laws relevant to the protection and management of biological resources in North Carolina are summarized Section 1.8, Overview of Relevant Federal Environmental Laws and Executive Orders, and in Appendix C. Table 11.1.6-1 summarizes the major state laws relevant to the state's biological resources.

Table 11.1.6-1: Relevant North Carolina Biological Resources Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Noxious Weed Regulations. Title 02 North Carolina Administrative Code (NCAC) 48A.170	Department of Agriculture and Consumer Services, North Carolina Board of Agriculture	Established a list of Class A, Class B, and Class C Noxious Weeds; regulates the movement and sale of Noxious Weeds; identifies the conditions for, and requires a permit for, movement of Noxious Weeds, identifies regulated articles and allows for inspection.

57 Terrestrial: "Pertaining to the land" (USEPA, 2015e).

58 Marine: "Any marine environment, from pond to ocean, in which plants and animals interact with the chemical and physical features of the environment" (USEPA, 2015e).

59 Estuarine habitat: "An estuary is the area where a river or stream connects to the open sea or ocean, estuarine includes the estuary and its associated habitats such as seagrasses and shellfish beds" (USEPA, 2015e).

State Law/Regulation	Regulatory Agency	Applicability
Aquatic Weed Control Act of 1991. Article 15, § 113A-22	NCDEQ	Allows for the designation of a noxious aquatic weed/plant organism; allows for the control, eradication, and regulation of noxious aquatic wees to protect human health, safety, beneficial use of state waters, and beneficial to plant and animal life.
Natural Preserve Act, NCGS §§ 113A-164.1-164.11	NCDEQ	Authorizes the creation of natural heritage areas and nature preserves.
Fisheries Reform Act of 1997	North Carolina Division of Marine Fisheries (NCDMF)	Designed to prevent overfishing, and directs the protection and enhancement of coastal fisheries habitat through the creation of a Coastal Habitat Protection Plan (CHPP) and Fishery Management Plans (FMP). Requires cooperation among many agencies, including Environmental Management Commission, Coastal Resources Commission, and Marine Fisheries Commission.
CAMA, NCGS §§ 113A-129.1-129.3	NCDEQ with advice from the Coastal Resources Commission (NCCRC)	Applies to 20 coastal counties and establishes a cooperative coastal reserve system. Local government identifies plans for the system and state government establishes areas of environmental concern.
CAMA Areas of Environmental Concern, NCGS §§ 113A-113-115.1	NCCRC	Designation of coastal areas as areas of environmental concern.
North Carolina Dredge and Fill Law § 113-229	NCDMF	Requires permits to dredge and fill in or about estuarine waters or state-owned lakes.
North Carolina Endangered Species Act 15A NCAC 10I	North Carolina WRC	Protects all listed species from take or possession; exceptions can be made with a permit; no open season.

11.1.6.3. Terrestrial Vegetation

The distribution of flora within North Carolina is a function of the characteristic geology,[60] soils, climate,[61] and water of a given geographic area and correlates to distinct areas identified as ecoregions.[62] Ecoregions are broadly defined areas that share similar characteristics, such as climate,[63] geology, soils, and other environmental conditions, and represent ecosystems contained within a region. The boundaries of an ecoregion are not fixed, but rather depict a general area with similar ecosystem types, functions, and qualities (National Wildlife Federation, 2015) (USDA, 2015a) (World Wildlife Fund, 2015).

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[60] Geology: "The study of the planet earth – the materials it is made of, the processes that act on those materials, the products formed, and the history of the planet and its life forms since its origin" (USEPA, 2015e).

[61] Climate: "The average weather conditions in a particular location or region at a particular time of the year. Climate is usually measured over a period of 30 years or more" (USEPA, 2015e).

[62] Ecoregion: "A relatively homogeneous ecological area defined by similarity of climate, landform, soil, potential natural vegetation, hydrology, or other ecologically relevant variables" (USEPA, 2015e).

[63] Climate: "Climate in a narrow sense is usually defined as the "average weather," or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands of years. The classical period is 3 decades, as defined by the World Meteorological Organization (WMO)" (USEPA, 2015e).

Ecoregion boundaries often coincide with physiographic[64] regions of a state. The ecoregions mapped by the USEPA are the most commonly referenced, although individual states and organizations have also defined ecoregions that may differ slightly from those designated by the USEPA. The USEPA divides North America into 15 broad Level I ecoregions. These Level I ecoregions are further divided into 50 Level II ecoregions. These Level II ecoregions are further divided into 182 smaller Level III ecoregions. This Section provides an overview of the terrestrial vegetation resources for North Carolina at USEPA Level III. (USEPA, 2016)

As shown in Figure 11.1.6-1, the USEPA divides North Carolina into four Level III ecoregions (from west to east): Blue Ridge, Piedmont, Southeastern Plains, and Middle Atlantic Coastal Plain. These four ecoregions support a variety of plant communities, which are all predicated on their general location within the state.

- The Blue Ridge is in the western area of North Carolina and includes the Blue Ridge and Smoky Mountains. "The southern Blue Ridge is one of the richest centers of biodiversity in the eastern U.S. It is one of the most floristically diverse ecoregions, and includes Appalachian oak forests, northern hardwoods, and, at the highest elevations in Tennessee and North Carolina, Southeastern spruce-fir forests. Shrub, grass, and heath balds, hemlock, cove hardwoods, and oak-pine communities are also significant."
- In central North Carolina, the "Piedmont ecoregion comprises a transitional area between the mostly mountainous ecoregions of the Appalachians to the northwest and the relatively flat coastal plain to the southeast… Once largely cultivated, much of this region is in planted pine or has reverted to successional pine and hardwood woodlands. The historic oak-hickory-pine forest was dominated by white oak (*Quercus alba*), southern red oak (*Quercus falcata*), post oak (*Quercus stellata*), and hickory (*Carya* spp.), with shortleaf pine (*Pinus echinata*), loblolly pine (*Pinus taeda*), and to the north and west, Virginia pine (*Pinus virginiana*)."
- The Southeastern Plains ecoregion is composed of "irregular plains with broad interstream areas have a mosaic of cropland, pasture, woodland, and forest. Natural vegetation was predominantly longleaf pine, with smaller areas of oak-hickory-pine...Elevations and relief are...generally less than in much of the Piedmont. Streams in this area are relatively low-gradient and sandy-bottomed."
- The Middle Atlantic Coastal Plain ecoregion "consists of low elevation, flat plains, with many swamps, marshes, and estuaries. Forest cover in the region, once dominated by longleaf pine in the Carolinas, is now mostly loblolly and some shortleaf pine, with patches of oak, gum, and cypress near major streams...Poorly drained soils are common, and the region has a mix of coarse and finer textured soils...Pine plantations for pulpwood and lumber are typical, with some areas of cropland." (Griffith, et al., 2002)

[64] Physiographic: "The natural, physical form of the landscape" (USEPA, 2015e).

Figure 11.1.6-1 shows the location of the four ecoregions within North Carolina. Table 11.1.6-2 provides a summary of the general abiotic[65] characteristics, vegetative communities, and the typical vegetation found within each of the ecoregions.

Communities of Concern

North Carolina contains several vegetative communities of concern that include rare natural plant communities, plant communities with vulnerability or sensitivity to disturbance, and communities that provide habitat for both rare plant and wildlife species. The ranking system for these communities gives an indication of the relative rarity, sensitivity, uniqueness, or vulnerability of these areas to potential disturbances. This ranking system also provides an indication as to the level of potential impact a particular community[66] could experience from an action.

The North Carolina Natural Heritage Program (NHP), part of the NCDEQ manages a statewide inventory that includes lists of all types of natural communities known to occur, or that have historically occurred, in the state. The historical occurrences are important for assessing previously undocumented occurrences or re-occurrences of previously documented species. As with most state heritage programs, the North Carolina NHP ranking system assesses rarity using a state rank (S1, [67] S2, S3, S4, S5). The methodology for determining state ranks of species and natural communities was developed by NatureServe, the North Carolina NHP, and other collaborators (e.g., universities, government agencies, botanical gardens, and other conservation organizations). The ranking method is based on best available information and factors such as rarity (abundance, viability, extent, area of occupancy), short-term and long-term trends, and threats to the species or ecosystem (Master, et al., 2012) (NCDEQ-NHP, 2015a).

North Carolina NHP considers natural community types ranked S1, S2, and S3 to be critically imperiled, imperiled, and vulnerable, respectively. Community types ranked S4 and S5 are more common and considered apparently secure, and secure, respectively. Natural community types assigned a rank of "S1" include critically imperiled communities in North Carolina because of extreme rarity or otherwise very vulnerable to extirpation and five or fewer community occurrences and less than 1,000 individuals of a species (NCDEQ-NHP, 2015a).

Vegetation in North Carolina were ranked for rarity in the state (S1, S2, S3, S4, S5). 'North Carolina Appendix A, Table A-1 summarizes the rarest terrestrial plant communities found in North Carolina, defined as those with a state rank of S1. (NCDEQ-NHP, 2014b)

[65] Abiotic: "Characterized by absence of life; abiotic materials include non-living environmental media (e.g., water, soils, sediments); abiotic characteristics include such factors as light, temperature, pH, humidity, and other physical and chemical influences" (USEPA, 2016).
[66] Community: "In ecology, an assemblage of populations of different species within a specified location in space and time. Sometimes, a particular subgrouping may be specified, such as the fish community in a lake or the soil arthropod community in a forest" (USEPA, 2015e).
[67] S1 Critically Imperiled "Critically imperiled in North Carolina due to extreme rarity or some factor(s) making it especially vulnerable to extirpation (local extinction) from the state. Typically 5 or fewer occurrences or very few remaining individuals (<1,000)" (NCDEQ-NHP, 2014b).

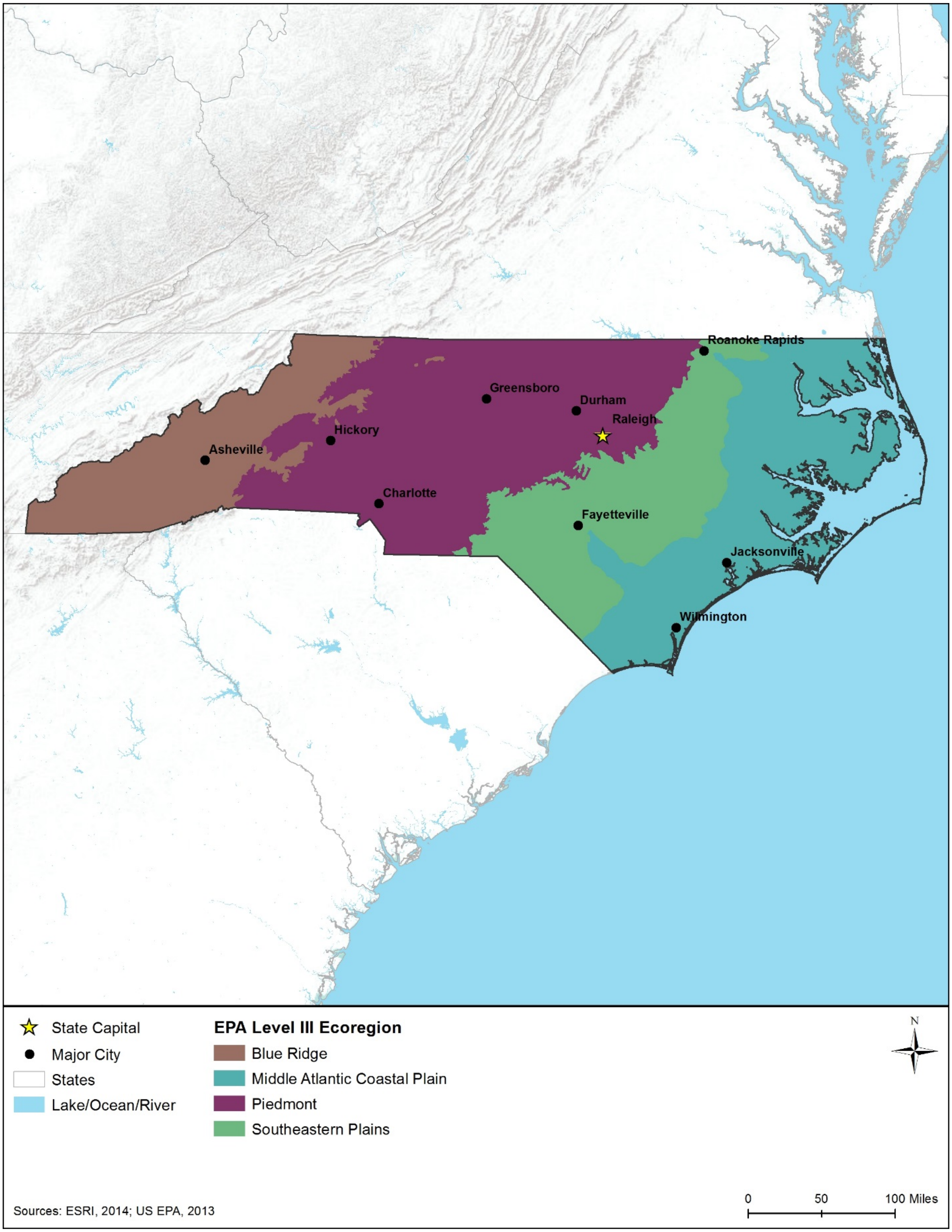

Figure 11.1.6-1: USEPA Level III Ecoregions in North Carolina

Table 11.1.6-2: USEPA Level III Ecoregions of North Carolina

Ecoregion Number	Ecoregion Description	Abiotic Characterization	General Vegetative Communities	Typical Vegetation
Geographic Region: Western North Carolina, Smoky Mountains				
66	Blue Ridge	A rugged terrain that includes mountainous areas with high peaks, narrow ridges, and hilly plateaus primarily on metamorphic rocks; annual rainfall ranges from 40 inches in dry areas to more than 100 inches in wet areas.	Tulip poplar, chestnut oak, white oak, black locust, red maple, pine species in lower elevations. Beech, yellow birch, yellow buckeye, and maples are typical in higher elevations. Fraser fir, red spruce, yellow birch, and rhododendron in highest elevations	Hardwood Trees – basswood (*Tilia* L.); beech (*Fagus* L.); birch (*Betula L.*); buckeye (*Aesculus L.*), Carolina silverbell (*Halesia carolina*); red, white, black, scarlet, and chestnut oaks (*Quercus* L.); poplar (Populus L.); sugar maple (*Acer saccharum*); tuliptree (*Liriodendron tulipifera*) Conifer Trees – Fraser fir (*Abies fraseri*); hemlock (*Tsuga carriere*); pitch, shortleaf, table mountain, and Virginia pines (*Pinus* L.); red spruce (*Picea rubens*) Shrubs – dogwood (*Cornus* L.), flame azalea (*Rhododendron calendulaceum*), mountain laurel (*Kalmia latifolia)*, rhododendron (*Rhododendron* L.)
Geographic Region: Eastern North Carolina, bounded by Atlantic Ocean				
63	Middle Atlantic Coastal Plain	Found on flat plains at low elevations with poorly drained soils (a mix of coarse and fine textured soils) underlain by unconsolidated sediments; is lower and flatter than Ecoregion 65, Southeastern Plains.	Mosaic of swamp, marsh, estuary, and forested; primarily pine, with patches of oak, gum, and cypress trees near streams	Hardwood Trees – green ash (*Fraxinus pennsylvanica*), gum (*Nyssa* L.), oaks, red maple (*Acer rubrum*) Conifer Trees – bald cypress (*Taxodium distichum*) Rich.,Atlantic white cedar (*Chamaecyparis thyoides*); red cedar (*Juniperus virginiana*); loblolly, longleaf, pond, shortleaf pines; cabbage palmetto (*Sabal palmetto*); swamp red bay (*Persea borbonia*), swamp tupelo (*Nyssa biflora*); sweetbay (*Magnolia virginiana*)
Geographic Region: Central North Carolina				
45	Piedmont	Composed of irregular plains and some hills on fine textured sand; considered a transitional area between the mountainous Appalachian ecoregions to the northwest and the flat coastal plain to the southeast.	Woodland, oak- hickory-pine forest	Hardwood Trees – hickory (*Carya* spp.), oaks Conifer Trees – shortleaf pine (*Pinus echinata*), loblolly pine (*Pinus taeda*), Virginia pine (*Pinus virginiana*)

Ecoregion Number	Ecoregion Description	Abiotic Characterization	General Vegetative Communities	Typical Vegetation
65	Southeastern Plains	This ecoregion has greater relief/elevation change than the Southern Coastal Plain and less change than the Piedmont ecoregion; sands, silts, and clays are geologically younger than the Blue Ridge and Piedmont ecoregions.	Mosaic of forest and woodland; longleaf pine dominant, with small areas of oak-pine-hickory	Hardwood Trees – turkey oak (*Quercus laevis*), blackjack oak (*Quercus marilandica*), hickory Conifer Trees – longleaf pine, loblolly pine, shortleaf pine

Sources: (USEPA, 2015d) (Griffith, et al., 2002)(CEC, 2011)

Nuisance and Invasive Plants

There are a large number of undesirable plant species that are considered nuisance and invasive[68] plants that are non-native to areas with the potential to spread causing harm to the environment, local economy, and human health. Noxious weeds are typically non-native species introduced into an ecosystem inadvertently; however, on occasional native species can be considered a noxious weed. Noxious weeds greatly affect agricultural areas, forest management, natural, and other open areas (GPO, 2011). The U.S. government has designated certain plant species as noxious weeds in accordance with the Plant Protection Act of 2000 (7 U.S.C. 7701 et seq.). As of September 2014, 112 federally recognized noxious weed species have been catalogued in the United States (88 terrestrial, 19 aquatic, and 5 parasitic) (USDA, 2015b).

The North Carolina Board of Agriculture identified 19 prohibited noxious weed species classified as Class A, B, or C that are regulated in North Carolina (Table 11.1.6-3) (NC Department of Agriculture & Community Services, 2011). Class A noxious weeds are those that are on the Federal Noxious Weed List or any noxious weed that is not native to the state, not currently known to occur in the state, and poses a threat to the state (regulated in all areas of North Carolina). Class B noxious weeds are those that are not native to the state, are present in fewer than 20 counties statewide, and poses a threat to the state. Class C noxious weeds are weeds that are not feasible to eradicate. Table 11.1.6-3 includes the complete prohibited plant list for North Carolina, and the noxious class for each identified plant.

Table 11.1.6-3: North Carolina Prohibited Plant List

Common Name	Scientific Name	Class
Bittersweet, oriental	*Celastrus orbiculatus*	C
Bushkiller	*Cayratia japonica*	B
Elodea, African	*Lagarosiphon spp*. (all species)	A
Fern, water	*Salvinia spp*. (all except S. minima)	A
Fieldcress, yellow	*Rorippa sylvestris*	B
Floating heart, crested	*Nymphoides cristata*	A
Floating heart, yellow	*Nymphoides peltata*	A
Lythrum	*Lythrum spp.* (any not native to North Carolina)	B
Mile-a-Minute	*Persicaria perfoliata*; synonym: *Polygonum perfoliatum*	B
Puncturevine	*Tribulus terrestris*	B
Stonecrop, swamp	*Crassula helmsii*	A
Thistle, Canada	*Cirsium arvense*	B
Thistle, musk	*Carduus nutans*	B
Thistle, plumeless	*Carduus acanthoides*	B
Vitex, beach	*Vitex rotundifolia*	B
Water snowflake	*Nymphoides indica*	A
Water-chestnut	*Trapa spp.*	A
Watermilfoil, Eurasian	*Myriophyllum spicatum*	B
Waterprimrose, Uruguay	*Ludwigia hexpetala*	B

Source: (NC Department of Agriculture & Community Services, 2011)

[68] Invasive: "These are species that are imported from their original ecosystem. They can out-compete native species as the invaders often do not have predators or other factors to keep them in check" (USEPA, 2015e).

The North Carolina DEQ, Division of Water Resources has designated 17 of the listed noxious aquatic plants as part of the Federal Noxious Weed list, with 14 additional plant species listed as noxious aquatic weeds in North Carolina (NCWRC, 2006). Seven of these 31 aquatic plant species are also included on the Prohibited Weed List (Table 11.1.6-3). These species are discussed further in Section 11.1.6.5, Fisheries and Aquatic Habitats.

11.1.6.4. Terrestrial Wildlife

This section discusses the terrestrial wildlife species in North Carolina, divided among mammals,[69] birds,[70] reptiles and amphibians,[71] and invertebrates.[72] Terrestrial wildlife are those species of animals, and their habitats, that live predominantly on land. Terrestrial wildlife include common big game species, small game animals and furbearers,[73] nongame animals, and their habitats found in North Carolina. A discussion of non-native or invasive wildlife species is also included.

North Carolina has a rich biological legacy and is home to a wide range of terrestrial wildlife species. There are an estimated 499 native terrestrial wildlife species, which includes 260 birds, 80 amphibians, 79 reptiles, and 80 mammals. Of the native terrestrial species in the state, there are 214 priority species as identified in the NC Wildlife Action Plan (WAP). Of these 214 species, 92 are birds, 41 are amphibians, 43 are reptiles, and 38 are mammals. Many of these priority species are state and/or federally protected and include 22 bird species, 17 amphibian species, 20 reptile species, and 16 mammal species. (NCWRC, 2005a)

Mammals

Of the 80 mammal species present in North Carolina, 38 are considered rare, leaving 42 common mammals (NCWRC, 2005b). Two of the largest mammals found in North Carolina are the black bear (*Ursus americanus*) and white-tailed deer (*Odocoileus virginianus*). Other mammals include the grey fox (*Urocyon cinereoargenteus*), red fox (*Vulpes vulpes*), coyote (*Canis latrans*), bobcat (*Lynx rufus*), raccoon (*Procyon lotor*), Virginia opossum (*Dedelphis virginiana*), mink (*Mustela vision*), muskrat (*Ondatra zibethicus*), and southern flying squirrel (*Glaucomys volans*) (NCWRC, 2015a).

Legal hunting of mammals is permitted under the authority of the North Carolina Wildlife Resources Commission (NCWRC) during appropriate seasons for several of these common mammal species. Two of the mammals are big game species in North Carolina: black bear and white-tailed deer. Several smaller mammals commonly found in North Carolina are classified as small game and/or furbearers: bobcat, grey and red fox, raccoon, Virginia opossum, beaver

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[69] Mammals: "Warm-blooded vertebrates that give birth to and nurse live young; have highly evolved skeletal structures; are covered with hair, either at maturity or at some stage of their embryonic development; and generally have two pairs of limbs, although some aquatic mammals have evolved without hind limbs" (USEPA, 2015e).

[70] Birds: "Warm-blooded vertebrates possessing feathers and belonging to the class Aves" (USEPA, 2015e).

[71] Amphibian: "A cold-blooded vertebrate that lives in water and on land. Amphibians' aquatic, gill-breathing larval stage is typically followed by a terrestrial, lung-breathing adult stage" (USEPA, 2015e).

[72] Invertebrates: "Animals without backbones: e.g., insects, spiders, crayfish, worms, snails, mussels, clams, etc." (USEPA, 2015e).

[73] Furbearer is the name given to mammals that traditionally have been hunted and trapped primarily for fur.

(*Castor canadensis*), mink, muskrat, and river otter (*Lontra canadensis*). Hunting is permitted for game animals, and furbearers can be trapped. Common nongame species include coyote, groundhog (*Marmota monax*), nutria (*Myocastor coypus*), and southern flying squirrel.

North Carolina has identified and ranked nine terrestrial mammals as S1 (Critically Imperiled). These critically imperiled mammals include the elk (*Cervus elaphus*), red wolf (*Canis rufus*), Buxton Woods white-footed deermouse (*Peromyscus leucopus buxtoni*), oldfield deermouse (*Peromyscus polionotus*), Pungo white-footed deermouse (*Peromyscus leucopus easti*), Florida eastern woodrat (*Neotoma floridana floridana*), gray bat (*Myotis grisescens*), northern yellow bat (*Lasiurus intermedius*), and Virginia big-eared bat (*Corynorhinus townsendii virginianus*) (NCDEQ-NHP, 2015b). Six mammal species are federally protected, and are discussed in Section 11.1.6.6, Threatened and Endangered Species and Species of Conservation Concern.

Birds

The number of native bird species documented in North Carolina varies according to the timing of the data collection effort, changes in bird taxonomy,[74] and the reporting organization's method for categorizing occurrence and determining native versus non-native status. This section begins with a summary of native bird species found in North Carolina. Although the numbers differ slightly, the taxonomic richness of the state is evident. The variety of ecological communities (i.e., coastal areas, mountains, rivers and lakes, valleys, plains, etc.) in North Carolina supports a large variety of bird species.

According to the *Official List of the Birds of North Carolina* annual report in 2014, there were 461 birds identified as definitive in North Carolina (458 extant[75] species and 3 extinct species) (Carolina Bird Club, 2014). The NHP identifies 75 birds as breeding in North Carolina, and of the 75 bird species, 16 are ranked as S1, Critically Imperiled (NCDEQ-NHP, 2015a). Sixty-five bird families are represented are known to occur in North Carolina. *Anatidae* (waterfowl) is the most strongly represented family, with 44 species listed (Carolina Bird Club, 2014). Other well-represented families include, *Parulidae* (wood warblers), *Scolopacidae* (sandpipers), *Laridae* (gulls and terns), *Emberizidae* (towhees and new world sparrows), and *Tyrannidae* (flycatchers) (Carolina Bird Club, 2014). North Carolina lists 92 birds determined to be Species of Greatest Conservation Need (SGCN) (NCWRC, 2005a). Five threatened and endangered birds are in North Carolina. Section 11.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, lists and briefly describes these protected species.

North Carolina is located within the Atlantic Flyway, which spans more than 3,000 miles from the Arctic tundra to the Caribbean. It is the most densely human-populated of the four waterfowl migration flyways in North America (Ducks Unlimited, 2015). Large numbers of waterfowl and non-waterfowl birds utilize this flyway and other migration corridors and pathways throughout the state during their annual migrations northward in the spring and southward in the fall. Despite the human population and development, the coastal areas of North Carolina are an

[74] Taxonomy: "A formal representation of relationships between items in a hierarchical structure" (USEPA, 2015e).
[75] Extant: "A species that is currently in existence (the opposite of extinct)" (USEPA, 2015e).

important ecological resource for migrating birds. Audubon North Carolina manages 20 coastal sanctuaries along the Atlantic Flyway (Audubon North Carolina, 2015). "The Migratory Bird Treaty Act (MBTA) makes it illegal for anyone to take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird, or the parts, nests, or eggs of such a bird except under the terms of a valid permit issued pursuant to Federal regulations" (USFWS, 2013b). The USFWS is responsible for enforcing the MBTA and maintaining the list of protected species. The migratory bird species protected under the MBTA are listed in 50 CFR Part 10.13 (USFWS, 2013b).

Bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*) are protected under the Bald and Golden Eagle Protection Act. Bald eagles are generally found near large rivers and lakes in North Carolina throughout the year, and are present throughout North Carolina (eBird, 2015a). Golden eagles generally nest in mountains and cliffs. Golden eagles are found in northern North Carolina, with concentrations near the coast on in the east and in the mountains to the west (eBird, 2015b).

A number of Important Bird Areas (IBAs) have also been identified in North Carolina, as can be seen in Figure 11.1.6-2. The IBA program is an international bird conservation initiative with a goal of identifying the most important places for birds so these areas can be protected/conserved. These IBAs are identified according to standardized, scientific criteria through a collaborative effort among state, national, and international conservation-oriented non-governmental organizations (NGOs), state and federal government agencies, local conservation groups, academics, grassroots environmentalists, and birders. These IBAs link global and continental bird conservation priorities to local sites that provide critical habitat for native bird populations. IBA priority areas are based on a number of specific criteria. Generally, global IBAs are sites determined important for globally rare species or support bird populations at a global scale. Continental IBAs are sites determined important for continentally rare species or support bird populations at a continental scale, but do not meet the criteria for a global IBA. State IBAs are sites determined important for state rare species or support local populations of birds.

An estimated 100 sites in North Carolina are approved IBAs, covering more than 150,000 acres in the coastal plain, piedmont, and mountain regions of the state (Audubon North Carolina, 2011). Cape Hatteras National Seashore and Cape Lookout National Seashore IBAs provide major resting and feeding areas for migratory birds (NPS, 2015b). Bird conservation efforts in North Carolina involve various programs that protect and enhance both populations and habitat of target bird species. In addition to protection through federal and state regulations, land conservation programs also protect habitat for birds and other wildlife. Examples of land conservation programs include the Conservation Trust for North Carolina, North Carolina Coastal Land Trust, and the Game Lands program managed by the NCWRC.

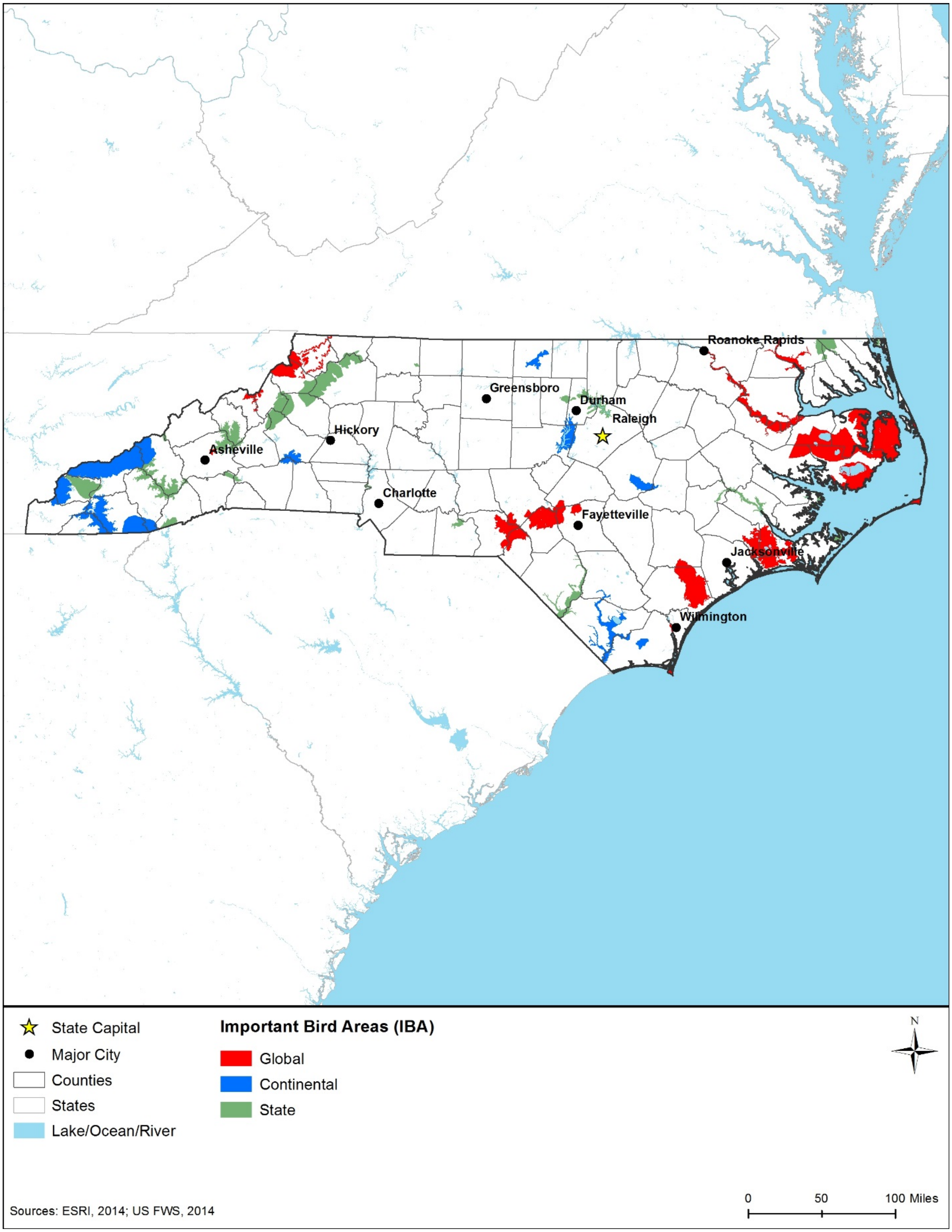


Figure 11.1.6-2: IBAs of North Carolina

Reptiles and Amphibians

A total of 165 native reptile and amphibian species occur in North Carolina, including 75 reptiles and 90 amphibians (NCDEQ-NHP, 2015a). North Carolina also contains habitat for 60 species of salamanders, 30 frogs and toads, 22 turtles (six marine species, and 16 terrestrial, semi-aquatic, or aquatic species), and 37 snakes. These species occur in a wide variety of habitats statewide. Of these 165 species, the state lists 19 reptiles and 17 amphibians as rare species (S1) (NCDEQ-NHP, 2015a).

Non-protected turtles (snappers, mud, and musk turtles) may be trapped and consumed if fewer than four reptiles are collected in a season (NCWRC, 2015a). North Carolina allows the harvest and consumption of unprotected frogs and salamanders if fewer than 25 individual amphibians collected (NCWRC, 2015a). In North Carolina, and per the ESA, it is illegal to hunt, fish, trap, or take endangered, threatened, or special concern reptile and amphibian species, including their eggs or young.

Four threatened and endangered reptiles are in North Carolina. Section 11.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, describes these protected species.

Invertebrates

Most of North Carolina’s terrestrial invertebrates are not well documented, resulting in an incomplete ecological understanding of this group of species. North Carolina is home to a large number of invertebrate species, including freshwater and terrestrial gastropods,[76] spiders, moths and butterflies, mayflies, stoneflies, caddisflies, dragonflies and damselflies, beetles, grasshoppers and katydids, crustaceans (shrimps and amphipods), and freshwater mussels

The *Natural Heritage Program List of the Rare Animal Species of North Carolina* includes estimates of the total number of species by families, but due to the lack of information regarding some invertebrate families, it does not include species estimates for spiders and some insect families (mayflies, stoneflies, caddisflies, and beetles) (NCDEQ-NHP, 2015a). The *Lepidoptera* family (moths and butterflies) have been extensively studied and it is estimated that more than 1,000 species have been studied in North Carolina (NCWRC, 2005a). In addition, the North Carolina Division of Water Quality collects macroinvertebrate data for wadeable and non-wadeable rivers, streams, swamps of North Carolina (NCWRC, 2005a). Within North Carolina, 13 spider species, 27 insects, and several crustaceans are state and/or federally listed (NCDEQ-NHP, 2015a).

Ten threatened and endangered invertebrates are in North Carolina. Section 11.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, identifies these protected species.

[76] Gastropods: “Any member of a large class of mollusks (Gastropoda), commonly called snails. Gastropods live in marine, freshwater, and terrestrial habitats. They have a univalve, often spiral shell (or none at all), a muscular foot for locomotion, and distinctive sensory organs” (Smithsonian Institution, 2016).

Invasive Wildlife Species

North Carolina has not adopted official rules regarding invasive wildlife species. However, one species is targeted for control. Once considered a game animal, the feral swine (*Sus scrofa*) (wild boar or feral hog) is now considered an undesirable species in North Carolina due to the threat this species poses to agricultural crops, ecological communities, and other properties, along with its potential to cause disease in other species. As part of NCWRC attempts to control and contain the feral swine, a hunter harvest survey is conducted annually in North Carolina. The hunt survey data provides NCWRC biologists with an estimate of feral swine in the state (NCWRC, 2013).

Other exotic species identified in North Carolina include the tongueless or African clawed frog (*Xenopus* spp.) (NCWRC, 2015b), gypsy moth (*Lymantria dispar*), Emerald ash borer (*Agrilus planipennis*) and Hemlock wooly adelgid (*Adelges tsugae*) (NCWRC, 2005a)(NCFS, 2016). The gypsy moth and emerald ash borer are classified as pests due to their damaging defoliation of hardwood trees. The introduced Hemlock wooly adelgid attacks the eastern hemlock (*Tsuga canadensis*) and Carolina hemlock (*T. caroliniana*); the trees usually die within a couple of years of Hemlock wooly adelgid infestation (Havill, Viera, & Salom, 2014).

Additionally, invasive bird species such as the European starling (*Sturnus vulgaris*) and House sparrow (*Passer domesticus*) exist in North Carolina. These two bird species can out compete native secondary cavity nesters for breeding opportunities (Carolina Bird Club, 2016b) (Carolina Bird Club, 2016a).

Invasive wildlife species are important to consider when proposing a project since project activities may result in conditions that favor the growth and spread of invasive wildlife populations. These situations may result from directly altering the landscape or habitat to a condition that is more favorable for an invasive species, or by altering the landscape or habitat to a condition that is less favorable for a native species.

Aquatic invasive species are described in more detail in Section 11.1.6.5, Fisheries and Aquatic Habitats.

11.1.6.5. Fisheries and Aquatic Habitats

This section discusses the aquatic wildlife species in North Carolina, including fish, invertebrates, marine mammals, and sea turtles. A summary of non-native and invasive aquatic species is presented in this section. Fish are divided into freshwater and saltwater species, although many of North Carolina's fish are diadromous (i.e., anadromous[77] and catadromous[78]), reflecting the state's location along the Atlantic coast and the variety of aquatic habitats that North Carolina provides. The Gulf Stream is nearest to land off the coast of North Carolina, and this warm current contributes to the well-regarded fisheries in this coastal area (NCDEQ-DMF, 2008). A distinctive feature of the North Carolina landscape with regard to aquatic wildlife are

[77] Anadromous: "Referring to the lifecycle of fishes, such as salmon, in which adults travel upriver from the sea to breed, usually returning to the area where they were born." (USEPA, 2015e)
[78] Catadromous: "An organism which lives in fresh water and goes to the sea to spawn, such as some eels." (USEPA, 2015e)

the drainage divisions of the state and the habitat diversity associated with these divisions. Streams range from high-elevation and cool, with gravel and boulder bottoms and low to moderate fertility, to lower-elevation warm streams with cobble-gravel and sand bottoms and moderate fertility. Streams in coastal areas are warm with sand and mud bottoms and high fertility (NCWRC, 2005a). The coastal plain area includes habitats such as wetlands, salt marshes, barrier islands and lagoons, and other coastal features that provide habitat for a multitude of fisheries and aquatic wildlife (Diemer & Bobyarchick, 2005).

These variable conditions provide habitat for a diverse array of aquatic organisms. Both essential fish habitat (EFH) identified by the Magnuson-Stevens Fishery Conservation and Management Act and critical habitat for threatened and endangered aquatic species, as defined by the ESA, exist within the aquatic communities of North Carolina and are discussed in Section 11.1.6.6, Threatened and Endangered Species and Species of Conservation Concern.

Marine Mammals

This section briefly introduces the marine mammal species found in North Carolina waters. Common marine mammals found in offshore waters include the bottlenose dolphin (*Tursiops truncatus*) and harbor porpoise (*Phocoena phocoena*) (NCWRC, 2005a). Based on marine mammals annual stranding data for 1997 through 2008, other marine mammal species found in North Carolina offshore waters include the short-beaked common dolphin (*Delphinus delphis*), short-finned pilot whale (*Globicephala macrorhynchus*), striped dolphin (*Stenella coeruleoalba*), pygmy sperm whale (*Kogia breviceps*), and dwarf sperm whale (*Kogia sima*) (Byrd, Hohn, G.N. Lovewell, & Thayer, 2014).

Many whale species occur offshore of North Carolina as they migrate northward towards feeding grounds and southward towards warmer waters for breeding. Their presence offshore is often unnoticed because of their transient nature and deep ocean preference.

North Carolina also recognizes the federal protection of one marine mammal species. Detailed information on the marine mammal species listed under the federal ESA and North Carolina ESA are presented in Section 11.1.6.6, Threatened and Endangered Species and Species of Conservation Concern.

Marine Reptiles

Six species of sea turtles occur in U.S. waters, all of which are protected under the ESA. Five of these sea turtles occur in North Carolina's waters; they are the hawksbill sea turtle (*Eretmochelys imbricata*), Kemp's Ridley sea turtle (*Lepidochelys kempii*), leatherback sea turtle (*Dermochelys coriacea*), loggerhead sea turtle (*Caretta caretta*), and green sea turtle *(Chelonia mydas)* (NMFS, 2015) (NPS, 2016a). The hawksbill, and leatherback sea turtles are present in the waters off the Atlantic coast of North Carolina. Loggerhead and green sea turtles regularly nest on the beaches of North Carolina, and the Kemp's Ridley sea turtle occasionally nests on North Carolina beaches (NMFS, 2015). For more information on these protected sea turtles, refer to Section 11.1.6.6, Threatened and Endangered Species and Species of Conservation Concern.

Freshwater Fish

North Carolina is home to more than 240 species of freshwater fish (NCWRC, 2005a). The most species-rich river basins are the Yadkin-Pee Dee and the Roanoke. North Carolina waters offer a diverse assemblage of fish such as largemouth bass (*Micropterus salmoides*), brown trout (*Salmo trutta*), Atlantic salmon (*Salmo salar*), smallmouth bass (*Micropterus dolomieu*), brook trout (*Salvelinus fontinalis*), rainbow trout (*Oncorhynchus mykiss*), brown bullhead (*Ameiurus nebulosus*), bluegill (*Lepomis macrochirus*), yellow perch (*Perca flavescens*), and black crappie (*Pomoxis nigromaculatus*).

Saltwater Fish

North Carolina's nearshore marine waters are home to a large number of saltwater fish species inhabiting the wide variety of marine habitats. North Carolina "maintains the second-largest estuarine system on the East Coast and the fifth-largest wetlands area in the nation," with a large diversity of habitats (North Carolina State University, 1997).

Many saltwater fish species are known for their recreational and commercial fishing value. Commonly caught species in the marine waters off the coast of North Carolina include Black Sea bass *(Centropristis striata)*, black drum (*Pogonias cromis)*, flounder (*Paralichthys* spp.), jumping mullet (*Mugil cephalus)*, red drum (*Sciaenops ocellatus*), and spot (*Leiostomus xanthurus*). Offshore marine species include grouper (*Epinephelus* spp.), snapper (*Lutjanus campechanus*), porgy (*Pagrus pagrus*), seabass (*Centropristis* spp.), grunt (*Haemulon plumieri*), jacks (*Seriola dumerili*), mackerel (*Scomberomorus* spp.), and tuna (*Thunnus* spp.). Shark species are also known to exist in the waters off North Carolina's coast (NCDEQ-NHP, 2015c). Table 11.1.6-4 presents a list of popular saltwater sportfish in North Carolina.

Six threatened and endangered freshwater fish are in North Carolina. Section 11.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, identifies these protected species.

Table 11.1.6-4: Popular Saltwater Sportfish Species in North Carolina

Common Name	Scientific Name	General Habitat
Black drum	*Pogonias cromis*	Whole coastline, prefer bays and inlets, found in a range of salinities.
Black sea bass	*Centropristis striata*	Whole coastline, irregular hard-bottom areas, juvenile fish are common in estuaries with high salinity during the summer.
Bluefish	*Pomatomus saltatrix*	Whole coastline, inshore and offshore.
Cobia	*Rachycentron canadum*	Whole coastline, inshore and nearshore waters, prefers warmer waters, commonly found near structures such as reefs, shelves, and wrecks.
Croaker	*Micropogonias undulatus*	Whole coastline, muddy, and sand bottom areas, juveniles common in estuaries.
Gulf flounder	*Paralichthys albigutta*	Whole coastline, ranging from nearshore rocky reefs to inshore and tidal creeks, sandy or muddy bottoms.

Common Name	Scientific Name	General Habitat
Southern flounder	*Paralichthys lethostigma*	Whole coastline, ranging from coastal to estuarine waters, sandy or muddy bottoms.
Summer flounder	*Paralichthys dentalus*	From north of the state down to Cape Lookout, high-salinity waters, spends winter offshore, spends spring and summer in coastal and estuarine waters.
Gray trout	*Cynoscion regalis*	Whole coastline, commonly inshore during the spring and summer, offshore during the winter.
Hickory shad	*Alosa mediocris*	Roanoke, Chowan, Neuse, and Tar rivers during the spring.
Jumping mullet	*Mugil cephalus*	Whole coastline, ranging from coastal waters to estuarine water and rivers, sandy or muddy bottoms.
King mackerel	*Scomberomorus cavalla*	Whole coastline, inshore and offshore depending on water temperature and food availability.
Pompano	*Trachinotus carolinus*	Whole coastline, nearshore and inshore, high-salinity.
Red drum	*Sciaenops ocellatus*	Whole coastline, coastal and estuarine waters.
Sea mullet	*Menticirrhus americanus*	Whole coastline, ranging from offshore to estuarine waters, sandy or muddy bottoms.
Sheepshead	*Archosargus probatocephalus*	Whole coastline, found in a range of salinities, coastal waters around structures covered with barnacles, mussels, and oysters.
Atlantic spadefish	*Chaetodipterus faber*	Whole coastline, prefers warm water, inshore and nearshore during the summer, offshore during the winter, commonly found close to natural and manmade structures.
Spanish mackerel	*Scomberomorus maculatus*	Whole coastline, open water near the coast, sometimes found in the mouths of rivers.
Spot	*Leiostomus xanthurus*	Whole coastline, coastal to estuarine waters, shallow waters in the summer, continental shelf edge in the winter.
Speckled trout	*Cynoscion nebulosus*	Whole coastline, found in rivers, estuaries, shallow coastal waters, sea grass beds, salt marshes, and tidal pools with high salinity.
Striped bass	*Morone saxatilis*	Whole coastline, freshwater and saltwater. Found around piers, jetties, surf troughs, rips, flat, and rocks.
Tarpon	*Megalops atlanticus*	Whole coastline, inshore waters and bays, found in a range of salinities and temperatures.

Sources: (Adams, et al., 2012) (Froese & Pauly, 2015) (NCDEQ-DMF, 2015b) (NCWRC, 2010)

Shellfish and Other Invertebrates

The percentage of freshwater shellfish (freshwater mollusks) and crayfish found in the southeastern United States ranges from 91 to 95 percent of the species found in North America. North Carolina is home to a significant portion of the species found in the southeastern United States. As of 2005, there were 56 mussel species (40 priority species) and 41 crayfish species (21 priority species) in North Carolina's freshwater environments (NCWRC, 2005a). The brackish wetlands and estuaries located behind the barrier islands of North Carolina provide habitat for and support many types of shellfish, such as oysters, scallops, and clams (NCDEQ-DMF, 2015c). These species are important to North Carolina's marine shellfish industry.

According to the NCDEQ, the status of oyster, scallop, and clam fisheries are classified as being of concern, depleted, and unknown, respectively (NCDEQ-DMF, 2015d). North Carolina has an Oyster Sanctuary Program, which includes 10 sanctuaries built on former oyster producing sites between Dare and Carteret Counties, including in Pamlico Sound (NCDEQ-DMF, 2013). A Shellfish Rehabilitation Program to provide more habitat for larval oysters and clams is another component the effort to improve shellfish species and habitat in North Carolina (NCDEQ-DMF, 2015e).

There are two national seashores managed by the National Park Service (NPS) in North Carolina: Cape Hatteras National Seashore (74 miles of coastline) and Cape Lookout National Seashore (56 miles of coastline). Commercially and recreationally fished shellfish within the waters of these two seashores include blue crab (*Callinectes sapidus*), hard clam (*Mercenaria mercenaria*), scallop (*Argopectens irradians*), oyster (*Crassostrea virginica*), and shrimp (*Penaeus* spp.) (NPS, 2004a) (NPS, 2006a).

North Carolina regulates the management of shellfish farming through the Shellfish Lease and Franchise Program. As of February 2014, there were 172 shellfish leases and 50 shellfish franchises in coastal North Carolina (NCDEQ-DMF, 2014). Shellfish harvesting in North Carolina is restricted according to the issuance of polluted areas proclamations, which identify prohibited areas for shellfish harvesting due to the threats of contamination (NCDEQ-DMF, 2015a).

Invasive Aquatic Species

As previously discussed, North Carolina has adopted regulations that prohibit or regulate the possession, transport, importation, sale, purchase and introduction of select invasive species, both plants and animals. The noxious weeds recognized by NCDEQ (15A NCAC 02G.0602) include 17 species, 7 of which are also on the federal noxious weeds list. Noxious aquatic plant species regulated in North Carolina are identified below (NCWRC, 2006). Noxious aquatic plant species regulated in North Carolina are regulated by the Aquatic Weed Control Act of 1991 (Article 15, Aquatic Weed Control, §§ 113A-22) and N.C. Plant Pest Law (Article 36, Plant Pests, §§ 419-423.1). The North Carolina Department of Agriculture and Consumer Services (NCDACS) has identified the following noxious weeds in the state:

<u>North Carolina Noxious Weeds (Federally-listed Species)</u>

- Swamp stonecrop (*Crassula helmsii*);
- African elodea (*Lagarosiphon major*);
- Floating heart. crested (*Nymphoides cristata*);
- Water snowflake (*Nymphoides indica*);
- Floating heart. yellow (*Nymphoides peltata*);
- Water fern (*Salvinia spp*.), all species except *S. rotundifolia*; and
- Water chestnut (*Trapa spp*.), all species.

North Carolina Noxious Weeds (state-listed species)

- Plumeless thistle (*Carduus acanthoides*);
- Musk thistle (*Carduus nutans*);
- Bushkiller (*Cayratia japonica*);
- Canada thistle (*Cirsium arvernse*);
- Uruguay waterprimrose (*Ludwigia hexapetala*);
- Any *Lythrum* spp.;
- Eurasian watermilfoil (*Myriophyllum spicatum*);
- Mile-a-Minute weed (*Persicaria perfoliata*);
- Yellow fieldcress (*Rorippa sylvestris*);
- Puncturevine (*Tribulus terrestris*);
- Beach vitex (*Vitex rotundifolia*); and
- Bittersweet oriental (*Celastrus orbiculatus*).

(NC Department of Agriculture & Community Services, 2011)

The NCWRC has also identified several freshwater aquatic animal species that pose significant threats to the state and has jurisdiction to control their transport, purchase, possession, sale or stocking in the public or private waters of North Carolina. This includes several fish species, three crayfish, and four mollusk species. Prohibited aquatic animal species are listed below (North Carolina State University, 2015).

North Carolina Prohibited Aquatic Animal Species

- piranha (*Phgocentrus* spp.);
- walking catfish (*Clarias batrachus*);
- snakehead fish (from the Family *Channidae*);
- black carp (*Mylopharyngodon piceus*);
- bighead carp (*Hypophthalmichthys nobilis*);
- silver carp (*Hypophthalmichthys molitrix*);
- rudd (*Scardinius erythropthalomus*);
- round goby (*Neogobius melanostomus*);
- tubenose goby (*Proterorhinus marmoratus*);
- ruffe (*Gymnocephalus cernuus*);
- grass carp (*Ctenopharyngodon idella*);
- swamp eel (*Monopterus albus*);
- red shiner (*Cyprinella lutrensis*);
- virile crayfish (*Orconectes (Gremicambarus) virilis*);
- rusty crayfish (*Orconectes (Procericambarus) rusticus*);
- Australian red claw crayfish or “red claw” (*Cherax quadricarinatus*, or other species of *Cherax*);
- Japanese mysterysnail (*Cipangopaludina japonica*);
- Chinese mysterysnail (*Cipangopaludina chinensis malleata*);
- red-rim melania (*Melanoides tuberculatus*);
- zebra mussel (*Dreissena polymorpha*); and
- quagga mussel (*Dreissena rostriformis bugensis*) or any mussel in the family Dreissenidae.

Certified sterile triploid grass carp can be bought, possessed, or stocked to control aquatic vegetation, but only under a permit issued by the NCWRC Executive Director. Other invasive freshwater animals that are not included on state and federal lists but are still considered a nuisance in North Carolina include the flathead catfish (*Pylodictis olivaris*), tongueless or African clawed frog, and Asian clam (*Corbicula fluminea*) (USGS, 2015k).

There are also invasive marine species identified in North Carolina, although they are fewer in number than freshwater species. The red lionfish (*Pterois volitans*) is the only marine fish recognized as a nuisance in North Carolina. The Asian shore crab (*Hemigrapsus sanguineus*) is another invasive marine species of concern, becoming established along the coast of North Carolina and is well established along the Atlantic coast to Maine (USGS, 2015k).

Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act identifies and protects those fish habitats that are necessary for spawning, breeding, feeding, or growth to maturity. These habitats are termed "Essential Fish Habitat" or EFH. NOAA provides an online mapping application and website to provide the public a means to obtain illustrative representations of EFH. This tool is used to identify the existing conditions for a project location to identify sensitive resources.[79] North Carolina Appendix A, Table A-2 present a summary of EFH for both Mid-Atlantic and South Atlantic species of the North Carolina coast.

Under the Magnuson-Stevens Act, National Marine Fisheries Service also considers a second, more limited habitat designation for each species in addition to EFH. Habitat Areas of Particular Concern (HAPC) are described as subsets of EFH "which are rare, particularly susceptible to human-induced degradation, especially ecologically important, or located in an environmentally stressed area" (MAFMC, 2016). "In general, HAPCs include high value intertidal and estuarine habitats, offshore areas of high habitat value or vertical relief, and habitats used for migration, spawning, and rearing of fish and shellfish" (Minerals Management Service, 2007). "HAPCs are not afforded any additional regulatory protection under the Magnuson-Stevens Act; however, federal actions with potential adverse impacts to HAPC will be more carefully scrutinized during the consultation process and will be subject to more stringent EFH conservation recommendations" (Minerals Management Service, 2007) (NOAA, 2010). Table 11.1.6-5 presents a summary of HAPC along or near the North Carolina coast.

[79] NOAA's Essential Fish Habitat Mapper v 3.0 was used to identify "EFH areas of particular concern" and "EFH areas protected from fishing". As of July 2016, the procedure to use this interactive tool is as follows: 1) Visit http://www.habitat.noaa.gov/protection/efh/habitatmapper.html. 2) Select "EFH Mapper" under Useful Links. 3) After closing the opening tutorial, select the "Region" of interest from the drop-down menu. 4) Select the species under "Essential Fish Habitat" to view the areas in the selected region protected for the various life states (i.e., eggs, larvae, juvenile, adult, or all).

Table 11.1.6-5: Habitat Areas of Particular Concern for North Carolina

Species	Description of EFH - HAPC
Tilefish	Offshore
Coastal Migratory Pelagics (Mackerel) (*Scomberomorus maculatus*, *Rachycentron canadum*)	Sandy shoals of Capes Lookout, Cape Fear, and Cape Hatteras from shore to the ends of the respective shoals, but shoreward of the Gulf stream; The Point, The Ten-Fathom Ledge, and Big Rock in North Carolina; Pelagic *Sargassum*; and Atlantic coast estuaries with high numbers of Spanish mackerel and cobia based on abundance data from the ELMR Program. Estuaries meeting these criteria for Spanish mackerel include Bogue Sound and New River, North Carolina.
Corals	Offshore (the 10-Fathom Ledge, Big Rock, and The Point in North Carolina).
Dolphin/Wahoo (*Corypaena hippurus*, *Acanthocybium solanderi*)	Offshore (the 10-Fathom Ledge, Big Rock, and The Point in North Carolina).
Snapper/Grouper (*Lutjanus campechanus*, *Epinephelus spp*.)	Medium to high profile offshore hard bottoms where spawning normally occurs; localities of known or likely periodic spawning aggregations; nearshore hard bottom areas; The Point, The Ten Fathom Ledge, and Big Rock in North Carolina); mangrove habitat; seagrass habitat; oyster/shell habitat; all coastal inlets; all state-designated nursery habitats of particular importance to snapper grouper (e.g., Primary and Secondary Nursery Areas designated in North Carolina); pelagic and benthic *Sargassum*; all hermatypic coral habitats and reefs; and Council-designated Artificial Reef Special Management Zones (SMZs).
Shrimp (*Penaeus spp*.)	All coastal inlets, all state-designated nursery habitats of particular importance to shrimp (in North Carolina this would include all Primary Nursery Areas and all Secondary Nursery Areas), and state-identified overwintering areas
Red Drum (*Sciaenops ocellatus*)	All coastal inlets, all state-designated nursery habitats of particular importance to red drum (in North Carolina this would include all Primary Nursery Areas and all Secondary Nursery Areas); documented sites of spawning aggregations in North Carolina, South Carolina, Georgia, and Florida; other spawning areas identified in the future; and habitats identified for submerged aquatic vegetation.
Spiny Lobster (*Panulirus argus*)	None.

Source: (NOAA, 1999)

11.1.6.6. Threatened and Endangered Species and Species of Conservation Concern

The USFWS is responsible for administering the ESA (16 U.S.C §1531 et seq.) in North Carolina. The USFWS has identified 42 federally endangered and 17 threatened species known to occur in North Carolina (USFWS, 2015d). The National Park Service has identified an additional listed species known to occur in the state (NPS, 2016a). Of the 60 federally listed species occurring in North Carolina, 10 species have designated critical habitat[80] in the state (Figure 11.1.6-3) and 5 additional species have critical habitats in other states (USFWS, 2015e). There are four candidate[81] species identified by USFWS as occurring within North Carolina (USFWS, 2015f). Candidate species are not afforded statutory protection under the ESA; however, the USFWS recommends considering these species during environmental planning because they could be listed in the future (USFWS, 2014b). The 60 federally listed species include 7 mammals, 5 reptiles, 5 birds, 6 fishes, 10 invertebrates, and 27 plants (USFWS, 2015d), and are discussed in detail under the following sections.

Federal land management agencies maintain lists of species of concern for their landholdings; these lists are not discussed below as they are maintained independently from the ESA. For future site-specific analysis on those lands, consultation with the appropriate land management agency would be required.

[80] Critical habitat includes "the specific areas (i) within the geographic area occupied by a species, at the time it is listed, on which are found those physical or biological features (I) essential to conserve the species and (II) that may require special management considerations or protection; and (ii) specific areas outside the geographic area occupied by the species at the time it is listed upon determination that such areas are essential to conserve the species" (16 U.S.C §1532(5)(A)).

[81] Candidate species are plants and animals that the USFWS has "sufficient information on their biological status and threats to propose them as endangered or threatened under the ESA, but for which development of a proposed listing regulation is precluded by other higher priority listing activities."

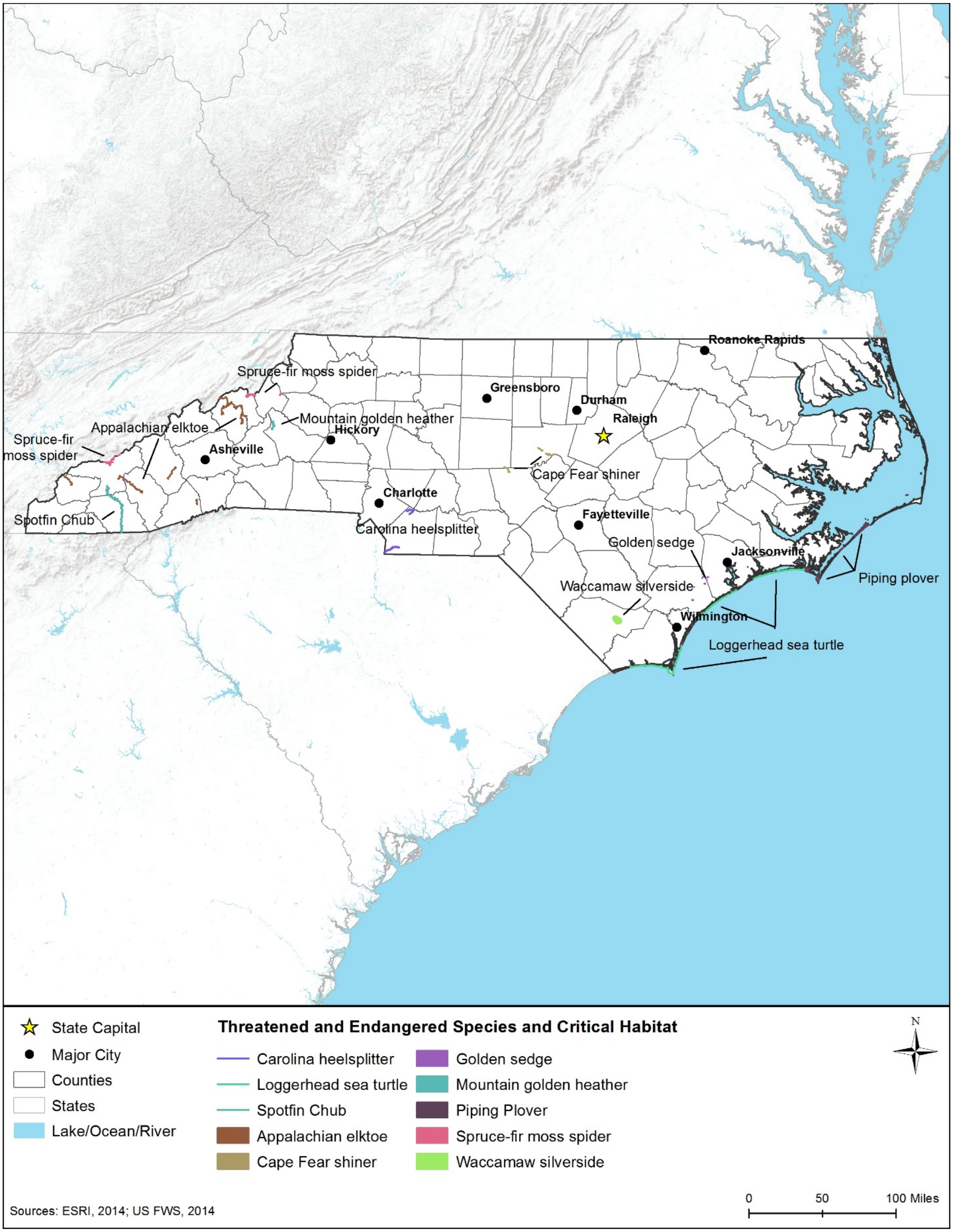


Figure 11.1.6-3: ESA Designated Critical Habitat in North Carolina

Mammals

Six endangered and one threatened mammal species are federally listed for North Carolina, as summarized in Table 11.1.6-6. The Carolina northern flying squirrel (*Glaucomys sabrinus coloratus*), gray bat (*Myotis grisescens*), Indiana bat (*Myotis sodalis*), and Virginia big-eared bat (*Corynorhinus townsendii virginianus*) are all generally found in the western portion of the state, while the northern long-eared bat (*Myotis septentrionalis*) is found statewide. An experimental population of red wolf (*Canis rufus*) is found in the Alligator River National Wildlife Refuge in eastern North Carolina. The marine mammal, the West Indian manatee (*Trichechus manatus*), is found along the coast of North Carolina. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in North Carolina is provided below.

Table 11.1.6-6: Federally Listed Mammal Species of North Carolina

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in North Carolina	Habitat Description
Terrestrial Mammals				
Carolina Northern Flying Squirrel	*Glaucomys sabrinus coloratus*	E	No	High-elevation hardwood/conifer forests; found in western North Carolina in the Appalachian Mountains where climate is cool.
Gray Bat	*Myotis grisescens*	E	No	Caves in limestone karst regions near rivers; found in the western portion of the state.
Indiana Bat	*Myotis sodalis*	E	No	Trees and snags, caves, and abandoned mines; found in the western portion of the state.
Northern Long-eared Bat	*Myotis septentrionalis*	T	No	Trees and snags, caves, and abandoned mines; found throughout the state.
Red Wolf	*Canis rufus*	E/XN	No	Forested areas; experimental population in Alligator River National Wildlife Refuge (five counties in eastern North Carolina).
Virginia Big-eared Bat	*Corynorhinus townsendii virginianus*	E	No	Caves in karst regions with large presence of oak-hickory or beech-maple-hemlock tree communities; found in three counties in the northwestern portion of North Carolina.
Marine Mammals				
West Indian Manatee	*Trichechus manatus*	E	No	Coastal waters, estuaries, and warm water outfalls.

[a] E = Endangered, T = Threatened, XN = Non-Essential Experimental Population
Source: (USFWS, 2015d)

Terrestrial Mammals

Carolina Northern Flying Squirrel. The Carolina northern flying squirrel is a small nocturnal squirrel that can grow 10 to 12 inches in length and weigh 3 to 5 ounces. This species has grey with brownish to reddish fur along the back and greyish white fur in the front (USFWS, 2015g). The Carolina northern flying squirrel was listed as endangered in 1985 (50 FR 26999 27002, July 01, 1985). Regionally, this squirrel is known to occur in North Carolina, Virginia, and Tennessee. In North Carolina, this species is known to occur in 14 counties in the western portion of the state, but it may also occur in other areas (USFWS, 2015g).

Carolina northern flying squirrel
Photo credit: USFWS

The primary habitat for the Carolina northern flying squirrel include northern hardwoods, such as yellow birch (*Betula alleghaniensis*), red spruce (*picea rubens*), and fraser fir (*Abies fraseri*) found at high elevation habitats in the Appalachian Mountains were the climate is moist and cool. This species is active year-round and nests in tree cavities of northern hardwoods during the winter. Additionally, this squirrel feeds mainly on fungi, lichens, and occasionally eats nuts. The current threats to this species include limited sub-species and various human-related impacts, such as habitat destruction, fragmentation, clearing of forest, introduction of insect pest, and development (USFWS, 1990a).

Gray Bat. The grey bat is an insectivorous[82] bat that weighs approximately 7 to 16 grams and is longer than any other species in the genus *Myotis*. The gray bats have dark gray fur after molt in July or August and then the fur transitions to a chestnut brown (USFWS, 1997a). This species was federally listed as endangered in 1976 (41 FR 17736 17740, April 28, 1976). Regionally, this species is known to occur in limited geographic regions of limestone karst within southeastern states from Kansas and Oklahoma east to Virginia and North Carolina (USFWS, 1997a) (USFWS, 2015h). In North Carolina, the gray bat is known to occur in Buncombe, Haywood, Madison, Swain, and Transylvania Counties in the western portion of the state (USFWS, 2015h).

Gray bats live in caves all year, hibernating in deep vertical caves in the winter and roost in caves scattered along rivers the rest of the year. Most caves are in limestone karst regions and near rivers where these bats feed on flying aquatic and terrestrial insects. Current threats to this species include human disturbance, habitat loss, and degradation due to flooding, and commercialization of caves such as adding gates that alter the air flow, humidity, and temperature of caves (USFWS, 1982).

Indiana Bat. The Indiana bat is a small, insectivorous mammal measuring approximately 3.0 to 3.5 inches in length with a wingspan of 9.5 to 10.5 inches. The Indiana bats have dull grayish chestnut fur and strongly resembles the more common little brown bat (*Myotis lucifugus)* (USFWS, 2015i) (USFWS, 2015j). The Indiana bat was originally federally listed as “in danger

[82] Insectivorous: “An animal that feeds on insects.” (USEPA, 2013b)

of extinction" under early endangered species legislation in 1967 (32 FR 4001, March 11, 1967) and was incorporated into the ESA as an endangered species (16 U.S.C. §1531 et seq.). In 2005, only 457,000 Indiana bats were known to exist in its range, less than half of the population of 1967 (USFWS, 2015i). Regionally, this species is currently found in the central portion of the eastern U.S., from Vermont west to Wisconsin, Missouri, and Arkansas, and south and east to northwest Florida. In North Carolina, the Indiana bat is known to occur in Cherokee, Graham, Haywood, Rutherford, and Swain Counties in the western portion of the state, and may also occur in other parts of the state (USFWS, 2015j). Critical habitat has been defined for several caves in the region, but none are in North Carolina (USFWS, 1977).

In the fall, the Indiana bats migrate to their hibernation sites in caves and abandoned mines in order to mate and build up fat reserves for hibernation season in the winter. Upon emerging from hibernation, the bats feed near their hibernations sites (within 10 miles) before they migrate to their summer habitats, where the females roost (USFWS, 2015i). Some of these summer habitats can be as far as 300 miles away from their hibernation areas (USFWS, 2004). Indiana bats roost in trees during the day and feed at night in a variety of habitats, although streams, floodplain forests, ponds, and reservoirs are preferred. Females roost together in maternity colonies under the loose bark of dead or dying trees, or under the loose bark of shaggy-barked trees, although the physical characteristics of individual trees appear to be more of a factor than the species of tree. Nevertheless, tree species that have been noted as preferred by Indiana bat include shagbark hickory (*Carya ovata*), white oak (*Quercus alba*), silver maple (*Acer saccharinum*), sugar maple (*Acer saccharum*), green ash (*Fraxinus pennsylvanica*), eastern cottonwood (*Populus deltoides*), and American elm (*Ulmus rubra*) (USFWS, 2012a).

The threats to this species include the disturbance and intentional killing of hibernating and maternity colonies, disturbances to air flow in caves from the improper installation of security gates, habitat fragmentation and degradation, the use of pesticides or other environmental contaminants, and White Nose Syndrome (USFWS, 2004) (USFWS, 2004). White Nose Syndrome is a rapidly spreading fungal disease that afflicts hibernating bats (USGS-NWHC, 2015).

Northern Long-eared Bat. The northern long-eared bat is a brown furred, insectivorous bat. This bat is medium-sized, reaching a total length of 3 to 3.7 inches, with long ears relative to other members of the genus *Myotis* (USFWS, 2015m). The northern long-eared bat was listed as endangered in 2013 (78 FR 72058 72059, December 2, 2013) and was relisted as threatened in 2015 (80 FR 17973 18033, April 2, 2015). In the U.S., its range includes most of the eastern and north central states. In North Carolina, the northern long-eared bat is known to occur in 34 counties across the state (USFWS, 2015n).

Northern long-eared bats hibernates during winter in caves and mines that exhibit constant temperatures and high humidity, which do not have air currents. In the summer, they roost singly or in colonies beneath bark, or in crevices or cracks of both live and dead trees. Although mating occurs in the fall, fertilization occurs following hibernation, from which pregnant females then migrate to summer areas where they roost in small colonies (USFWS, 2015m).

White Nose Syndrome is the leading cause for the decline of this species. The numbers of northern long-eared bats in hibernacula has decreased by 99 percent in the northeast United States. (USFWS, 2015n). Other threats include temperature or air flow impacts to hibernating habitat, incompatible forest management practices, habitat fragmentation, and wind farm operations (USFWS, 2015m).

Red Wolf. The red wolf is known for the characteristic reddish color of its fur, most apparent behind the ears and along the neck and legs, but is mostly brown and buff colored with some black along its back. Intermediate in size to gray wolves and coyotes, the average adult red wolf weighs 45-80 pounds, stands about 26 inches at the shoulder, and is about 4 feet long from the tip of the nose to the end of the tail (USFWS, 2015o). The red wolf was listed as endangered in 1967 (32 FR 4001, March 11, 1967). Regionally, the species was known to occur in Florida, North Carolina, and South Carolina. The species was declared extinct in 1980. However, a few wolves were bred in captivity and an experimental population was reintroduced in North Carolina in the Alligator River National Wildlife Refuge. In North Carolina, the experimental population is known to occur in Beaufort, Dare, Hyde, Tyrrell, and Washington Counties in the eastern portion of the state (USFWS, 2015p).

Red wolf Photo credit: USFWS

The primary habitat for the red wolf includes large forested/non-developed areas (at least 170,000 acres in size). The current threats to this species include hunting/extermination by humans and habitat loss (USFWS, 1990b).

Virginia Big-eared Bat. The Virginia big-eared bat is a light to dark brown furred, insectivorous mammal measuring 1.5 to 2 inches long and weighting 7 to 12 grams. The Virginia big-eared bat was listed as endangered in 1979 (44 FR 69206 69208, November 30, 1979). Regionally, this species is known to occur only in Kentucky, North Carolina, Tennessee, Virginia, and West Virginia. In North Carolina, it is known or believed to occur in Avery, Caldwell, and Watauga Counties in the northwestern region of the state (USFWS, 2015q). Critical habitat has been defined in West Virginia for the species, but no designated critical habitat is in North Carolina (USFWS, 2015l).

This species typically resides in karst caves during both summer and winter months, usually in areas of oak-hickory or beech-maple-hemlock tree communities. The Virginia big-eared bat prefers cold areas in the entrance of caves; in the winter during hibernation, they move deeper in the caves (USFWS, 1984a). The primary current threats to the Virginia big-eared bat are human disturbance to their maternity roosts, habitat loss, and vandalism (USFWS, 2011).

Marine Mammals

West Indian manatee Photo credit: USFWS

West Indian Manatee. The West Indian Manatee (*Trichechus manatus*) averages 9 feet in length and weighs about 1,000 pounds (USFWS, 2015f). The manatee was listed as endangered in 1967 (32 FR 4001, March 11, 1967) and was grandfathered into the ESA of 1973. The West Indian manatee is also protected under the Marine Mammal Protection Act (MMPA). The USFWS proposed to reclassify the West Indian manatee from endangered to threatened with a public comment period starting on January 8, 2016 (81 FR 1000 1026). The manatee has a large, seal-shaped body with flippers and a large tail, and is typically gray in color (USFWS, 2015f). Manatees found in mainland U.S. waters are recognized as a separate subspecies known as the Florida manatee (*Trichechus manatus latirostris*) (USFWS, 2001a).

West Indian manatees are found in tropical and subtropical coastal and river waters. The Florida manatee is found along the southeast U.S. coast, while the Antillean subspecies (*Trichechus manatus manatus*) is typically encountered along the Caribbean coast of Central and South America, and locally throughout the West Indies (USFWS, 2001a). “Shallow grass beds with ready access to deep channels are preferred feeding areas in coastal and riverine habitats. Manatees often use secluded canals, creeks, embayments, and lagoons, particularly near the mouths of coastal rivers and sloughs, for feeding, resting, mating, and calving” (USFWS, 2001a). Manatees have been found in all Atlantic coast counties of North Carolina (USFWS, 2016b).

Threats to West Indian manatees include death or serious injury from vessel strikes and habitat loss or fragmentation leading to decreased availability of warm-water refuges (USFWS, 2001a) (USFWS, 2016).

Reptiles

Four endangered and one threatened reptile species are federally listed and known to occur in North Carolina, as summarized in Table 11.1.6-7. All five listed reptile species — hawksbill sea turtle (*Eretmochelys imbricata*), green sea turtle *(Chelonia mydas)*, Kemp’s Ridley sea turtle (*Lepidochelys kempii*), leatherback sea turtle (*Dermochelys coriacea*), and loggerhead sea turtle (*Caretta caretta*) — are found along the coast of North Carolina (NMFS, 2015) (NPS, 2016a). Information on the habitat, distribution, and threats to the survival and recovery of each of these species is provided below.

Table 11.1.6-7: Federally Listed Reptile Species of North Carolina

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in North Carolina	Habitat Description
Hawksbill Sea Turtle	*Eretmochelys imbricata*	E	No	Warm, shallow, coastal waters of reefs, lagoons, inlets, and bays with submerged aquatic vegetation; found along coast.
Green Sea Turtle	*Chelonia mydas*	E	No	Warm, shallow, coastal waters of reefs, lagoons, inlets, and bays with submerged aquatic vegetation.
Kemp's Ridley Sea Turtle	*Lepidochelys kempii*	E	No	Muddy or sandy bottoms where prey items can be found, in waters rarely greater than 160 feet deep; found along the coast.
Leatherback Sea Turtle	*Dermochelys coriacea*	E	No	Coastal waters and the open sea environment, found along the coast.
Loggerhead Sea Turtle	*Caretta caretta*	T	Yes; Coastal areas of Brunswick, Carteret, New Hanover, Onslow, and Pender Counties.	Open sea environment and inshore area such as salt marshes, creeks, bays, and lagoons; found along the coast.

[a] E = Endangered, T = Threatened
Source: (USFWS, 2015d) (USFWS, 2015l)

Hawksbill Sea Turtle. The hawksbill sea turtle is one of the smaller sea turtles. It was listed as endangered in 1970 (35 FR 8491 8498, June 2, 1970). The hawksbill sea turtle has overlapping plates that are thicker than those of other sea turtles are. This protects them from being battered against sharp coral and rocks during storm events. Adults range in size from 30 to 36 inches and weigh up to 300 pounds. Its upper shell is dark brown with faint yellow streaks and a yellow under shell. The hawksbill is found throughout all of the oceans of the world (NOAA, 2014a) (USFWS, 2015s). Even though in the Atlantic they range from the East Coast of the United States to northern Brazil, they are rarely found offshore of East Coast states (NOAA, 2015e). The waters surrounding Culebra, Mona, and Monito Islands, Puerto Rico are designated as critical habitat for the continued survival and recovery of hawksbill turtles (63 FR 46693 46701 September 2, 1998). In North Carolina, the hawksbill sea turtle is known to occur in 10 coastal counties, but are not known to nest on North Carolina beaches (NC Wildlife Resources Commission, 2005).

Hawksbill sea turtles prefer warm, shallow, coastal waters of reefs, lagoons, inlets, and bays with submerged aquatic vegetation. As an omnivore, the hawksbill sea turtle feeds primarily on sponges, algae, and invertebrates and is most often associated with the coral reef community. Nesting for these turtles occurs on remote beaches in the Gulf of Mexico and the Caribbean Sea in two to three year cycles, where females will lay between 140 to 200 eggs (USFWS, 2015s).

Current threats to the hawksbill sea turtle include accidental capture in fishing lines, vessel strikes, contaminants, oil spills, disease, habitat loss of coral reef communities, and commercial exploitation. Outside of the U.S., a current threat is the harvest of their meat and eggs, which was the historic threat to this species causing their decline (NOAA, 2014a).

Green Sea Turtle. The green sea turtle is "the largest of all of the hard-shelled sea turtles" (NOAA, 2016b). It was listed as endangered in 2016 (81 FR 20057 20090, May 6, 2016) (NOAA, 2016a). "Their top shell is smooth with shades of black, gray, green, brown, and yellow; their bottom shell is yellowish white." The adults grow to approximately 3 feet and weight between 300-350 pounds. The green sea turtle is found throughout all of the major oceans of the world, but "generally found in tropical and subtropical water along continental coasts and islands between 30 degree North and 30 degree South" (NOAA, 2016b). Critical habitat includes the "waters surrounding the island of Culebra, Puerto Rico" and the island's outlying Keys (USFWS, 2016a).

This species "are the only marine turtles to exclusively eat plants…They feed primarily on seagrasses and algae." Nesting season typically occurs between June and September, with females laying eggs in 2 to 4 year cycles. "[G]reen sea turtle nests contain an average of 135 eggs, which will incubate for approximately 2 months before hatching" (NOAA, 2016b). Current threats to the green sea turtle include "harvest of eggs and adults, incidentals capture in fishing gear, fibropapillomatosis (disease)…loss or degradation of nesting habitat, disorientation of hatchlings by beachfront lighting; nest predation by native and non-native predators; degradation of foraging habitat; marine pollution and debris; watercraft strikes; and incidental take from channel dredging and commercial fishing operations" (NOAA, 2016b) (USFWS, 2016a).

Kemp's Ridley Sea Turtle. The Kemp's Ridley sea turtle is considered the smallest sea turtle species and the most endangered. These turtles can grow to more than 2-feet long and weigh up to 100 pounds (NOAA, 2015f) (USFWS, 2015t). The Kemp's Ridley sea turtle was first federally listed in 1970 (35 FR 18319 18322, December 2, 1970) under the Endangered Species Conservation Act and grandfathered into the ESA in 1973 (USFWS, 2015v). Their range includes the Gulf of Mexico and the U.S. Atlantic seaboard, from New England to Florida. They prefer nearshore habitats characterized by muddy or sandy bottoms where their prey items can be found, in waters rarely greater than 160 feet deep. They feed mostly on crabs, but also consume jellyfish, fish, and an array of mollusks (NOAA, 2015f). In North Carolina, the Kemp's Ridley sea turtle is known from seven coastal counties but are not known to nest on North Carolina beaches (NC Wildlife Resources Commission, 2005).

Kemp's Ridley sea turtles gather in large groups in Tamaulipes, Mexico where approximately 95 percent of this species' breeding occurs. Nesting occurs as early as April and into July. Some males migrate yearly between breeding and feeding grounds, whereas others remain near breeding grounds throughout the year. Hatchlings drift with the currents or float with plant material rafts for approximately two years (NOAA, 2015f). Historically, the decline of this species was the harvesting of their sea turtle eggs during nesting. Current threats to this species include the direct harvest of adults and eggs, accidental capture in fishing lines, recreational activities on beaches, and pollution (USFWS, 2015t).

Leatherback sea turtle Photo credit: USFWS

Leatherback Sea Turtle. The leatherback sea turtle is the deepest-diving and most wide-ranging sea turtle, growing 4 or 8-feet long and weighing 500 to 2,000 pounds (USFWS, 2015x). The leatherback sea turtle was listed as endangered in 1970 (35 FR 8491 8498, June 2, 1970) and was grandfathered into the ESA of 1973 (USFWS, 2015y). The leatherback sea turtle is capable of tolerating a wide range of water temperatures; hence its wide global distribution, including parts of the Atlantic, Pacific, and Indian Ocean. The occurrence in the United States is rare for the Atlantic population, with the most significant location within the east coast being in southeastern Florida (NOAA, 2015g) (USFWS, 2015x). In North Carolina, the leatherback sea turtle is known from 11 coastal counties and are known to nest on North Carolina beaches (NC Wildlife Resources Commission, 2005). Designated critical habitat is in Sandy Point Beach on St. Croix; there is no critical habitat is designated in North Caolina (USFWS, 2015y).

Leatherback sea turtles are found in ocean waters and nearshore coastal waters. Their main diet includes jellyfish, salps (a transparent barrel-shaped tunicate[83]), and other soft-bodied animals (NOAA, 2015g). For reproduction, the female leatherback sea turtles nest at 2 to 3-year intervals during the months from roughly March to July. Nest-building occus during the night. Each female turtle can create up to 11 nests per nesting season (USFWS, 2015x). Current major threats to the species include harvesting of turtles and their eggs, hunting, incidental capture in fishing gear, and consumption of plastics that were mistaken for jellyfish (NOAA, 2015g).

Loggerhead Sea Turtle. The loggerhead sea turtle is a smaller sea turtle that can grow to an average length of 3 feet and weight of 250 pounds. This species has a reddish-brown carapace and flippers, and is characterized by its large head (USFWS, 2015z). The loggerhead sea turtle was initially listed as threatened throughout its range in 1978, and by 2011 nine different distinct populations were listed and the northwestern Atlantic Ocean population remained listed as threatened (76 FR 58868 58952, September 22, 2011) (USFWS, 2015y). Critical habitat was designated in 2014 (79 FR 39755 39854, July 10, 2014) (USFWS, 2015aa). Regionally, this turtle is known to occur throughout temperate and tropical regions in the Atlantic, Pacific, and Indian Oceans with the most nesting areas in the western Atlantic Ocean. Nesting by the loggerhead sea turtle occurs from Texas to Virginia along the southeastern coast of the United States. (USFWS, 2008a). In North Carolina, the loggerhead sea turtle is known from eight coastal counties and nests on North Carolina beaches (NC Wildlife Resources Commission, 2005).

[83] Tunicate: "Commonly known as 'sea squirts.' The body of an adult tunicate is quite simple, being essentially a sack with two siphons through which water enters and exits. Water is filtered inside the sack-shaped body" (University of California Museum of Paleontology, 2006).

The preferred habitat for the loggerhead sea turtle is the open sea environment, but they also occur in inshore area such as salt marshes, creeks, bays, and lagoons. Open beaches are the preferred location for nesting along the coast and coral reefs and rocky places are the preferred feeding areas for the loggerhead sea turtles (NOAA, 2014b). Current threats to the logger head sea turtle include incidental captures in in fishing gear, directed harvesting of eggs, and loss and degradation of habitats (NOAA, 2014b) (USFWS, 2008a).

Birds

Two endangered and three threatened avian species are federally listed and known to occur in North Carolina as summarized in Table 11.1.6-8. The piping plover (*Charadrius melodus*), red knot (*Calidris canutus rufa*), and roseate tern (*Sterna dougallii dougallii*) are found along the North Carolina coast, while the red-cockaded woodpecker (*Picoides borealis*) and wood stork (*Mycteria americana*) are found across the North Carolina coastal plain region. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in North Carolina is provided below. (USFWS, 2015d) (USFWS, 2015l)

Table 11.1.6-8: Federally Listed Bird Species of North Carolina

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in North Carolina	Habitat Description
Piping Plover	*Charadrius melodus*	T	Yes, 18 units in 7 coastal counties.	Intertidal zone of ocean beaches, ocean washover areas, mudflats, sand flats, wrack lines, and the shorelines of coastal ponds, lagoons, and salt marshes; found along the coast.
Red-cockaded Woodpecker	*Picoides borealis*	E	No	Mature pine forests; known from 45 counties across eastern NC.
Red Knot	*Calidris canutus rufa*	T	No	Intertidal marines, estuaries, and bays; found along the coast.
Roseate Tern	*Sterna dougallii dougallii*	E	No	Salt marsh, islands, and beaches with sparse vegetation; known from two coastal counties.
Wood Stork	*Mycteria americana*	T	No	Primarily feed in fresh and brackish wetlands and nest in cypress or other wooded swamps. Known from four counties in southeastern part of NC.

[a] E = Endangered, T = Threatened

Source: (USFWS, 2015d) (USFWS, 2015l)

Piping Plover. The piping plover is a small, pale brown-colored shorebird with a short beak and black band across its forehead, measuring approximately 7.25 inches in length. The piping plover listed as endangered in 1985 for the Great Lakes watershed of both the United States and Canada, and as threatened in the remainder of its range in the U.S. (50 FR 50726 50734, December 11, 1985). Regionally, the piping plover occurs in the Northern Great Plains, along the Atlantic Coast, and in the Great Lakes Area within the U.S. (USFWS, 2001b). In North

Carolina, the piping plover occurs along the coastal beaches (USFWS, 2015ab). Piping plovers breed in three geographic regions of North America, composed of two separate subspecies. Those breeding on the Atlantic Coast of the U.S. and Canada are of the subspecies *C. m. melodus*, whereas the other subspecies, *C. m. circumcinctus*, includes two distinct populations, one, which breeds on the Northern Great Plains of the U.S. and Canada, and the other, which breeds on the Great Lakes (USFWS, 2015ac). Critical habitat has been defined for the species in 18 units within Dare, Hyde, Carteret, Onslow, Pender, New Hanover, and Brunswick Counties in coastal North Carolina (USFWS, 2015l).

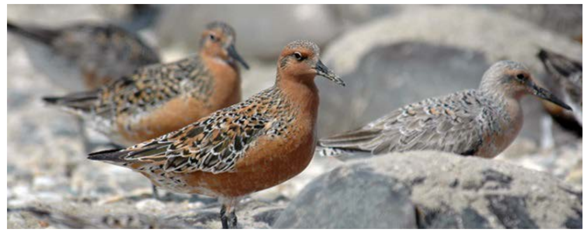
This species feeds in the intertidal zone of ocean beaches, ocean washover areas, mudflats, sand flats, wrack lines, and the shorelines of coastal ponds, lagoons, and salt marshes. They feed on worms, fly larvae, beetles, crustaceans, and other marine macroinvertebrates (USFWS, 1996a). The preferred habitat are wide, open, sandy beaches with little vegetation. This species nests in small creeks or wetlands and create shallow nest lined with pebbles or broken shells. The female would lay an average of two to four eggs and both female and male care for them until eggs hatch (USFWS, 1996a) (USFWS, 2001b)).

Current threats to this species include habitat loss and degradation, human disturbance, pets, predation, flooding from coastal storms, and environmental contaminants (USFWS, 1996a) (USFWS, 2001b).

Red-cockaded Woodpecker. The red-cockaded woodpecker is a small black and white woodpecker that grows approximately 7 inches with a wingspan of about 15 inches. It is characterized by its black cap and white cheek patches (USFWS, 2015ad). Male red-cockaded woodpeckers have red marking on the side of their neck (USFWS, 2015mmm) (USFWS, 2015qrs). The red-cockaded woodpecker was listed as endangered in 1970 under early endangered species legislation (35 FR 16047 16048, October 13, 1970) and was grandfathered into the ESA in 1973. Regionally, this species is known to occur in open pine forests in the southeast from Virginia south to Florida and west to Oklahoma and Texas. In North Carolina, the red-cockaded woodpecker is known from 45 counties across the eastern part of the state (USFWS, 2015ae).

The preferred habitat for the red-cockaded woodpecker is mature pine forests, with the preferred pine species being the longleaf pines (*Pinus palustris*). This species forages on pine trunks and branches and flakes away bark in search of insects such as beetles, ants, spiders, other insects found on pine trees, and occasional wild fruits and pine seeds. Current threats to the red-cockaded woodpecker include lack of suitable habitats (USFWS, 2003).

Red Knot. The red knot is a medium-sized shorebird; it is approximately 9 inches in length with a wingspan up to 20 inches, making it among the largest of the small sandpipers (USFWS, 2005). It was recently federally listed as a threatened species in 2014 (79 FR 73705 73748, December 11, 2014). The red knot migrates annually from its



Red knot Photo credit: USFWS

breeding grounds above the Arctic Circle to the tip of South America where it winters. During spring and fall migration, the red knot travels in "non-stop segments of 1,500 miles and more, ending at stop sites called "staging areas." Some have been documented to fly more than 9,300 miles from south to north every spring and return south in autumn (USFWS, 2005) (USFWS, 2014c). In North Carolina, the species is known from 18 coastal counties (USFWS, 2015af).

The preferred habitat is intertidal marines, estuaries, and bays. Mussel beds are important food sources for the red knot. The red knots eat mussels and other mollusks mostly all year; however during migration season they eat horseshoe crab eggs (*Limulus polyphemus*) (USFWS, 2005). In North Carolina, where red knots occur in fall, winter, and spring, the birds primarily use oceanfront beaches and inlets between barrier islands, as well as sandy shoals. North Carolina roost sites are above the mean high tide line and on sandy shoals (USFWS, 2014c). Current threats to the red knot include sea level rise; coastal development; shoreline stabilization; dredging; reduced food availability at their migration stopovers; and disturbance by humans, dogs, vehicles, and climate change (USFWS, 2014c) (USFWS, 2016c).

Roseate Tern *(Northeast U.S., Western Hemisphere)**.*** The endangered roseate tern is approximately 16 inches in length with light-gray wings and a black cap. During breeding season, the roseate tern's white chest gains a rosy tinge, and its bill and legs turn from black to orange-red (USFWS, 2011a). The roseate tern was listed as endangered in 1987 in the northeast region and threatened in the southeast region (52 FR 42064 4206, November 2, 1987) (USFWS, 1987a). This bird nest in colonies on sand/gravel beaches or pebbly/rocky offshore barrier islands along the Atlantic coast from Nova Scotia south to Long Island, New York, and on the southern tip of Florida. The northeastern population appear to winter primarily in the waters off Trinidad and northern South America from the Pacific coast of Columbia to eastern Brazil (USFWS, 1998a). In North Carolina, the species is known from Carteret and Dare Counties along the Atlantic coast (USFWS, 2015ag).

This species is a marine bird that breeds along the coasts on salt marsh islands and beaches with sparse vegetation. The roseate tern feeds on small fish such as the American sand lance. Present threats include vegetation changes in breeding areas, disturbances from human activities in coastal areas, competition with gulls for suitable nest sites, and predation (USFWS, 2011a).

Wood Stork. The wood stork is a large, long-legged wading bird, about 50 inches tall, with a wingspan of 60 to 65 inches. The plumage is white except for black primaries and secondaries and a short black tail. The bill is black, thick at the base, and slightly decurved. Immature birds are dingy gray and have a yellowish bill (USFWS, 2015ah). The bird was federally listed as a threatened species in 1984 (49 FR 7332 7335, February 28, 1984). The wood stork is the only stork regularly occurring in the United States. The breeding range of the species extends from the southeastern United States south through Mexico and Central America, and through South America to western Ecuador, eastern Peru, Bolivia, and northern Argentina (USFWS, 1997b). The species is known from Bladen, Brunswick, Columbus, and Sampson Counties in the southeastern North Carolina coastal plain (USFWS, 2015ah).

The preferred habitat includes a variety of freshwater and estuarine wetlands for nesting, feeding, and roosting. Freshwater colony sites must remain inundated throughout the nesting cycle to protect against predation and abandonment. Foraging sites occur in shallow, open water where prey concentrations are high, such as freshwater marshes, roadside and agricultural ditches, narrow tidal creeks or shallow tidal pools, managed impoundments, and depressions in cypress heads or swamp sloughs (USFWS, 1997b). Current threats to the wood stork include loss of feeding habitat, water level manipulations affecting drainage, predation, and/or lack of nest tree regeneration, human disturbance, and pesticides/chemical pollutants (USFWS, 1997b).

Wood stork Photo credit: USFWS

Fish

Four endangered and two threatened fish species are federally listed and known to occur in North Carolina, as summarized in Table 11.1.6-9. The Cape Fear shiner (*Notropis mekistocholas*) and Roanoke logperch (*Percina rex*) are found in central North Carolina. Spotfin chub (*Erimonax monachus*) is found in western North Carolina. Waccamaw silverside (*Menidia extensa*) is found in southeastern North Carolina. The Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) and shortnose sturgeon (*Acipenser brevirostrum*) are found in coastal plain rivers. In addition, the sicklefin redhorse (*Moxostoma sp.*) is a candidate species in western North Carolina (USFWS, 2015f). Information on the habitat, distribution, and threats to the survival and recovery of each of the listed species in North Carolina is provided below.

Table 11.1.6-9: Federally Listed Fish Species of North Carolina

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in North Carolina	Habitat Description
Atlantic Sturgeon	*Acipenser oxyrinchus oxyrinchus*	E	No	Spawn in moderately flowing fresh water of deep rivers and live in coastal waters and estuaries; known from 26 eastern counties in NC.
Cape Fear Shiner	*Notropis mekistocholas*	E	Yes, in Chatham, Lee, Moore, and Randolph Counties.	Gravel, cobble, and boulder substrate, with slow pools, riffles, and slow runs; endemic to 5 counties in central NC.
Roanoke Logperch	*Percina rex*	E	No	Medium to large streams and rivers with warm water and moderate gradient; found in four counties in the north-central portion of NC.

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in North Carolina	Habitat Description
Shortnose Sturgeon	*Acipenser brevirostrum*	E	No	Nearshore marine, estuarine, and riverine habitats; found in coastal counties.
Spotfin Chub	*Erimonax monachus*	T	Yes, in Little Tennessee River main channel.	Clear large creeks or medium size rivers up in montane areas; found within Macon and Swain Counties.
Waccamaw Silverside	*Menidia extensa*	T	Yes, in Columbus County.	Shallow, open water over a clean, dark sand substrate with no vegetation; endemic to Lake Waccamaw and its tributaries.

[a] E = Endangered, T = Threatened
Source: (USFWS, 2015d) (USFWS, 2015l) (USFWS, 2015f)

Atlantic Sturgeon. The Atlantic sturgeon is an anadromous fish, which can grow up to 14 feet and weigh up to 800 pounds. The species ranges from dark blue to green-brown which fades down to whiter underbellies. They can be distinguished from shortnose sturgeon due to the Atlantic sturgeon's size and five rows of spiky plates on its back (NOAA, 2014c). As identified by the USFWS in 2012, there are five distinct population segments (DPS) for the Atlantic sturgeon: Chesapeake Bay, Carolina, South Atlantic, New York Bight, and the Gulf of Maine (USFWS, 2015ai). With the exception of the Gulf of Maine, which lists the Atlantic sturgeon as threatened, these DPS list the Atlantic sturgeon listed as endangered (77 FR 5913 5982, February 6, 2012). The Atlantic sturgeon has a historic range from the St. Croix River in Maine to Saint John's River in Florida and is presently found in 32 rivers in the United States. Historically, Atlantic sturgeon were abundant in most North Carolina coastal rivers and estuaries; the largest fishery occurring in the Roanoke River/Albemarle Sound system and in the Cape Fear River (NOAA, 2007). The species is known from 26 counties in the eastern portion of North Carolina.

Atlantic sturgeon spawn in moderately flowing fresh water of deep rivers and live in coastal waters and estuaries when not spawning. Overharvest historically led to widespread declines in their abundance, but current threats include bycatch of sturgeon in fisheries targeting other species, habitat degradation, and loss from human activities, inability to access habitat from locks and dams, and ship strikes (USFWS, 2013c).

Cape Fear Shiner. The Cape Fear shiner is a small (rarely exceeding 2 inches in length), moderately stocky minnow. The fish's body is flushed with a pale silvery yellow, and a black band runs along its side. The fins are yellowish and somewhat pointed. The upper lip is black, and the lower lip bears a thin black bar along its margin. The lateral line is complete but dips slightly from its head to below the dorsal fin. The round eye is moderate in size and is located on the side of the head. It is distinguished from all other *Notropis* by having an elongated alimentary tract with two convolutions crossing the intestinal bulb (USFWS, 1988). The Cape Fear shiner was listed as endangered in 1987 (52 FR 36034 36039, September 25, 1987). The species is known only from four small populations in the Cape Fear River drainage in central North Carolina, within the counties of Chatham, Harnett, Lee, Moore, and Randolph (USFWS, 1988). Critical habitat has been designated for the species in Rocky River, Bear Creek, Fork Creek, and Deep River in Chatham, Lee, Moore, and Randolph Counties (USFWS, 2015l).

The preferred habitat for the Cape Fear shiner includes gravel, cobble, and boulder substrate, with slow pools, riffles, and slow runs often associated with water willow (*Justicia*) beds. Juveniles are often found in slackwater, along large rock outcrops in mid-stream and in flooded side channels and pools (USFWS, 1988). This species is threatened because it is vulnerable to a catastrophic event (such as a toxic chemical spill) because of its small distribution; dam construction in the Cape Fear River system also impacts the species' rocky riverine habitat and alters stream flows (USFWS, 1988).

Roanoke Logperch. The Roanoke logperch is one of the larger darter fish that grows approximately six inches long. This species is dark green with yellowish to green sides and white to yellowish body. It is distinguished by its elongated and cylindrical to slab-sided body (USFWS, 1992a). The Roanoke logperch was listed as endangered in 1989 (54 FR 34468 34472, August 18, 1988). Regionally, this species is known to occur only in North Carolina and Virginia. In North Carolina, the species is known from Caswell, Forsyth, Rockingham, and Stokes Counties in the north-central portion of the state (USFWS, 2015aj).

Roanoke logperch Photo credit: USFWS

The preferred habitat for the Roanoke logperch include medium to large streams and rivers with warm water and moderate gradient. Males tend to occur more in shallow riffles while the females tend to occur more in deep runs over gravel, which are the ideal conditions for spawning. Spawning occurs during the months of March or April. This species feeds mainly on aquatic insects; most of their diet consist of caddisfly larvae and chironomids found under stones, which they move with their snout. Current threats to the survival of the Roanoke logperch include destruction and degradation of habitat by turbidity and silt, chemical spills, organic pollution, channelization, impoundment, and the intrusion of cold water into their habitats (USFWS, 1992a).

Shortnose Sturgeon. The shortnose sturgeon is the smallest of the three eastern North American sturgeon species, averaging approximately 3.5 feet in length and weighing up to 50 pounds. The shortnose sturgeon are long-lived fishes with lifespans of 30 to 67 years and are among the most primitive of the bony fishes (NOAA, 2014d). This species was listed as endangered in 1967 (32 FR 4001, March 11, 1967). In North Carolina, it is known from 16 coastal counties (USFWS, 2015ak).

The preferred habitats are nearshore marine, estuarine, and riverine habitats. Adult shortnose sturgeon feed on large crustaceans and mollusks, while juvenile sturgeon feed on small crustaceans and benthic insects. Females of this species can live up to 67 years and males approximately 30 years. This species spawns upstream in freshwater and then moves downstream and offshore to marine environments along the continental shelf. Historically, the shortnose sturgeon was not sought after by the commercial fishing industry, but was often taken incidentally during attempts for Atlantic sturgeon. Current threats to this species include pollution, overfishing, construction of dams, and dredging (NOAA, 2014d).

Spotfin Chub. The threatened spotfin chub is a small fish with an elongated body that grows approximately 3.7 inches. It has an olive color body with silver on the sides and white at the bottom (USFWS, 1983a). This species was listed as threatened in 1977 (42 FR 45526 45530, September 9, 1977). Historically, it was known to occur along the Tennessee River and its associated streams with occurrences in Alabama, Georgia, North Carolina, Tennessee, and Virginia. Currently, it is only known to occur in Alabama, North Carolina, and Virginia with multiple non-essential experimental populations in Tennessee. In North Carolina, it is known to occur in Macon and Swain Counties in the western portion of the state. Critical habitat has been defined for the species along the Little Tennessee River main channel in Macon and Swain Counties from the Fontana Lake backwaters upstream to the North Carolina-Georgia state line (USFWS, 2015l).

Suitable habitats for the spotfin chub consist of clear large creeks or medium size rivers up in montane areas. These water systems must have cool and warm water with moderate gradients and gravel at the bottom. The spotfin chub uses the gravel at the bottom of creeks or rivers to lay their eggs in between rocks for protection. Current threats to the survival of this species include dams that disrupt the natural flow, channelization of streams, and water quality degradation from siltation, industrial runoff, and urban runoff. (USFWS, 1983a) (IUCN, 2014)

Waccamaw Silverside. The threatened Waccamaw silverside is a lacustrine species that is gregarious and is usually found in schools near the surface. This species, sometimes referred to as the “skipjack” or “glass minnow,” is a long, slender, almost transparent fish with a silvery stripe along each side. Adults are about 2.5 inches long. The body is laterally compressed, the eyes and mouth are large, and the jaw is sharply angled upward. The scales are very small and tissue paper thin. The species has two dorsal fins, widely separated and transparent, supported by flexible spines (USFWS, 1993a). The Waccamaw silverside was listed as threatened in 1987 (52 FR 11277 11286, April 8, 1987). The species is known only from Lake Waccamaw and in the upper Waccamaw River directly below the lake in Columbus County, North Carolina (USFWS, 1993a) (USFWS, 2015al). Critical habitat has been designated for the species in Columbus County in Lake Waccamaw and Big Creek, upstream from Lake Waccamaw (USFWS, 2015l).

The species forages in areas of shallow, open water over a clean, dark sand substrate with no vegetation and spawns in open-water areas near the shoreline. Water quality and habitat deterioration/alteration (caused by increasing siltation, nutrient or pollutant loading, or by altering water temperature or pH) and the introduction/invasion of nonnative species are the most significant threats to the species’ continued existence (USFWS, 1993a).

Invertebrates

There are nine endangered and one threatened invertebrate species that are federally listed and known to occur in North Carolina (Table 11.1.6-10). Insects and spiders include the Saint Francis’ Satyr butterfly (*Neonympha mitchellii francisci*) found in the central portion of the state, and the spruce-fir moss spider (*Microhexura montivaga*) found in the western portion of the state. Mussels and snails include Appalachian elktoe (*Alasmidonta raveneliana*), Cumberland pearlymussel bean (*Villosa trabalis*), littlewing pearlymussel (*Pegias fabula*), and noonday globe (*Patera clarki nantahala*) in the western portion of the state, Carolina heelsplitter (*Lasmigona decorata*) and James spinymussel (*Pleurobema collina*) in the central portion of the state, and dwarf wedgemussel (*Alasmidonta heterodon*) and Tar River spinymussel (*Elliptio steinstansana*) in the eastern portion of the state. Also, two candidate species, magnificent ramshorn (*Planorbella magnifica*) and rattlesnake-master borer moth (*Papaipema eryngii*), both in the southeastern part of the state, are found in North Carolina. Information on the habitat, distribution, and threats to the survival and recovery of each of the listed species in North Carolina is provided below. (USFWS, 2015d) (USFWS, 2015l) (USFWS, 2015f)

Table 11.1.6-10: Federally Listed Invertebrate Species of North Carolina

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in North Carolina	Habitat Description
Appalachian Elktoe	*Alasmidonta raveneliana*	E	Yes, in 8 counties in western North Carolina.	Relatively shallow medium-sized creeks and rivers with cool, well-oxygenated, and moderate- to fast-flowing water; the species is endemic to the upper Tennessee River system in the mountains of western North Carolina.
Carolina Heelsplitter	*Lasmigona decorata*	E	Yes, in in Goose Creek, Duck Creek, and Waxhaw Creek in Union County.	Mud, muddy sand, or muddy gravel substrates along stable, well-shaded stream banks; known from Mecklenburg, Richmond, and Union Counties in the south-central portion of the state.
Cumberland Pearlymussel Bean	*Villosa trabalis*	E	No	Small rivers and streams with clean fast flowing water and sand and gravel substrates in riffle and shoal areas; in North Carolina, known only from Cherokee County in the western portion of the state.
Dwarf Wedgemussel	*Alasmidonta heterodon*	E	No	Creek and river areas with slow to moderate current and sand, gravel, or muddy bottoms; In North Carolina, known from the northeastern region of the state in the Tar River and Neuse River watersheds.

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in North Carolina	Habitat Description
James Spinymussel	*Pleurobema collina*	E	No	Sand and gravel bottoms of unpolluted free-flowing streams with a variety of slow to moderate flow regimes; in North Carolina, known from Caswell, Rockingham, and Stokes Counties in the north-central portion of the state.
Littlewing Pearlymussel	*Pegias fabula*	E	No	Medium size rivers and streams with high gradient and cool clear water; in North Carolina, known from Macon and Swain Counties in the western portion of the state.
Noonday Globe	*Patera clarki nantahala*	T	No	Exposed rock with rich soil, a complex association of plants, and moist conditions; known only from the Nantahala River gorge in Swain County.
Saint Francis' Satyr Butterfly	*Neonympha mitchellii francisci*	E	No	Wide, wet meadows dominated by sedges and other wetland graminoids; known from only Cumberland and Hoke Counties in the central portion of the state.
Spruce-fir Moss Spider	*Microhexura montivaga*	E	Yes, in five counties in western North Carolina.	Well-drained mosses growing on shady rocks in mountain forests with Fraser fir and red spruce; In North Carolina, known from 11 counties in the western portion of the state.
Tar River Spinymussel	*Elliptio steinstansana*	E	No	Relatively fast-flowing, well-oxygenated water, in sites with a substrate comprised of relatively silt-free, uncompacted gravel/coarse sand; known from seven counties in the northeastern part of the state.

[a] E = Endangered, T = Threatened
Source: (USFWS, 2015d) (USFWS, 2015l) (USFWS, 2015f)

Appalachian Elktoe. The Appalachian elktoe is a freshwater mussel, with a thin, but not fragile, kidney-shaped shell, reaching up to about 3.2 inches in length, 1.4 inches in height, and 1 inch in width. Juveniles generally have a yellowish brown periostracum (outer shell surface), whereas the periostracum of the adults is usually dark brown in color. Although rays are prominent on some shells, particularly in the posterior portion of the shell, many individuals have only obscure greenish rays. The shell nacre (inside shell surface) is shiny, often white to bluish white, changing to a salmon, pinkish, or brownish color in the central and beak cavity portions of the shell (USFWS, 1996b). The Appalachian elktoe was federally listed as endangered in 1994 (59 FR 60324 60334 November 23, 1994). The species is endemic to the upper Tennessee River system in the mountains of western North Carolina and eastern Tennessee; in North Carolina, it is known from nine counties in the western portion of the state (USFWS, 1996b) (USFWS, 2015am). Critical habitat has been defined for the species in six units in the Tuckasegee River, Cheoah River, Little River, West Fork Pigeon River, Pigeon River, North Toe River, South Toe River, Toe River, Cane River, and Nolichucky River (Graham, Haywood, Jackson, Macon, Mitchell, Swain, Transylvania, and Yancey Counties) (USFWS, 2015l).

Suitable habitats for the Appalachian elktoe consist of relatively shallow medium-sized creeks and rivers with cool, well-oxygenated, and moderate- to fast-flowing water. It has been observed in gravelly substrata, often mixed with cobble and boulders; in cracks in bedrock; and occasionally in relatively silt-free, coarse, sandy substrata. Current threats to the survival of this species include water quality and habitat degradation resulting from impoundments, stream channelization projects, and point and nonpoint sources of siltation and other pollutants (USFWS, 1996b).

Carolina Heelsplitter. The Carolina heelsplitter is a freshwater mussel, with an ovate, trapezoid-shaped, unsculptured shell. The shell of the largest known specimen of the species measures 4.6 inches in length, 1.56 inches in width, and 2.7 inches in height. The shell's outer surface varies from greenish brown to dark brown in color, and shells from younger specimens have faint greenish brown or black rays. The nacre (inside surface) is often pearly white to bluish white, grading to orange in the area of the umbo (USFWS, 1997c). The Carolina heelsplitter was federally listed as endangered in 1993 (58 FR 34926 34932, June 30, 1993). The species is found in the Catawba and Pee Dee River watersheds in North Carolina and the Pee Dee and Savannah River watersheds (and possibly the Saluda River) in South Carolina; in North Carolina, it is known from Mecklenburg, Richmond, and Union Counties in the south-central portion of the state (USFWS, 2015an) (USFWS, 1997c). Critical habitat has been defined for the species in Goose Creek, Duck Creek, and Waxhaw Creek in Union County, North Carolina (USFWS, 2015l).

Suitable habitats for the Carolina heelsplitter include mud, muddy sand, or muddy gravel substrates along stable, well-shaded stream banks; however, live specimens have been found in the main channel of a stream, in a relatively clean substrate comprised of sand, gravel, and cobble. The stability of stream banks appears to be very important to the species. Current threats to the survival of this species include water quality and habitat degradation resulting from impoundments and stream channelization projects, point and nonpoint sources of siltation, and other pollutants (USFWS, 1997c).

Cumberland Pearlymussel Bean. The endangered Cumberland bean is a small to medium size freshwater mussel with an elongated oval shaped shell that grows approximately 2.2 inches. Its shell is smooth with no ridges and is an olive green, yellowish to brown, or blackish colored shell with dark green rays (USFWS, 2011b). The Cumberland bean was federally listed as endangered in 1976 (41 FR 24062 24067, June 14, 1976) and an experimental population was established in Alabama and Tennessee in 2007 and 2001 respectively. Regionally, this species is known to occur in Alabama, Kentucky, North Carolina, and Virginia. In North Carolina, the

Cumberland bean is known from only Cherokee County in the western portion of the state (USFWS, 2015ao).

Suitable habitats for the Cumberland bean consist of small rivers and streams with clean fast flowing water and with sand and gravel substrates in riffle and shoal areas. The reproduction cycle for this species is similar to most other mussels; however, these mussels have been associated with the fantail darter (*Etheostoma flabellare*) and striped darter (*Etheostoma virgatum*) as their host fish. As most mussels, current threats to the survival of this species include channelization, impoundment, siltation from coal mining, and pollution from urban and agricultural runoff (USFWS, 2011b) (USFWS, 1984b).

Dwarf Wedgemussel. The dwarf wedgemussel is a small, brown, or yellowish-brown freshwater mussel that usually grows less than 1.5 inches in length (USFWS, 2010). The dwarf wedgemussel was federally listed as endangered in 1990 throughout its range (55 FR 9447 9451, March 14, 1990). In North Carolina, it is known from 11 counties in the northeastern region of the state in the Tar River and Neuse River watersheds (USFWS, 1993b) (USFWS, 2015ap).

The dwarf wedgemussls are sedimentary filter feeders that feed off suspended particles and algae at the bottom of rivers. This species inhabits creek and river areas with slow to moderate current and sand, gravel, or muddy bottoms. This species requires either the tessellated darter (*Etheostoma olmstedi*) or the mottled sculpin (*Cottus bairdi*) in order to complete their lifecycle. The current threats to this species include silt deposition, water quality degradation, sedimentation from development, and agricultural runoff (USFWS, 2010).

James Spinymussel. The James spinymussel is a small freshwater mussel with a yellowish to dark brown shell that grows approximately three inches in length and has one to three short spines on its shell. The James spinymussel was federally listed as endangered in 1988 (53 FR 27689 27693, July 22, 1988). It is regionally known to occur in North Carolina, Virginia, and West Virginia. In North Carolina, it is known from Caswell, Rockingham, and Stokes Counties in the north-central portion of the state (USFWS, 1990c) (USFWS, 2015aq).

Suitable habitat for the James spinymussel consist of sand and gravel bottoms of unpolluted free-flowing streams with a variety of slow to moderate flow regimes. This species feeds on plankton and reproduces sexually with the assistance of seven different host fish. Current threats to this species include loss and depletion of suitable habitat. Degradation of water quality from siltation, impoundment, pollution, and sewage discharge causes these mussels to be more vulnerable to competition. Additionally, the increased invasion of the non-native Asiatic clam (*Corbicula fluminea*) is causing a major threat to the survival of the James spinymussel (USFWS, 1990c).

Littlewing Pearlymussel. The littlewing pearlymussel is a small freshwater mussel that grows up to 1.5 inches in length. The shell of this species is light green or dark yellowish with dark rays, but usually the shell is eroded and has a chalky appearance (USFWS, 2015ar). The littlewing pearlymussel was federally listed as endangered in 1988 (53 FR 45861 45865, November 14, 1988). Historically, the littlewing pearlymussel was known to occur in numerous rivers associated to the Tennessee River systems and the Cumberland River systems. In North

Carolina, the species is known from Macon and Swain Counties in the western portion of the state (USFWS, 1989a) (USFWS, 2015as).

Suitable habitats for the littlewing pearlymussel consist of medium size rivers and streams with cool clear water. Usually, these mussels are found behind large rocks. The reproduction cycle for this species is similar to most mussels; however, it is not known what species of fish serve as host for these mussels. Specific factors for the decline of populations is not known but is believe that current threats are similar to other mussels, which include dams, dredging, and water quality degradation (USFWS, 1989a) (USFWS, 2015ar).

Noonday Globe. The noonday globe is a snail, with a subglobose,[84] imperforate shell of about 5 ½ whorls. It measures about 0.7 inches in width and is only 0.4 inches in height. The shell is reddish and can be shiny when fresh. The noonday globe was federally listed as threatened in 1978 (43 FR 28932 28935 July 3, 1978). The species is endemic to North Carolina and is known only from the Nantahala River gorge in Swain County in the western portion of the state (USFWS, 1984c) (USFWS, 2015at).

Suitable habitats for the noonday globe include exposed rock with rich soil, a complex association of plants, and moist conditions. Current threats to the survival of this species include human activity in the Nantahala River gorge, increasing threats from forest fires, or trampling, which damages the species' sensitive habitat (USFWS, 1984c).

Saint Francis' Satyr Butterfly. The Saint Francis' Satyr butterfly is a small dark brown butterfly with a wingspan from 1.3 to 1.7 inches. Saint Francis' satyr has conspicuous eyespots on the lower surfaces of the wings. These eyespots have a dark maroon-brown center, and within the eyespots are lighter opalescent patches that reflect a silver cast. The border of these dark eyespots is straw yellow in color, with an outermost border of dark brown. The eyespots are usually round to slightly oval and are well developed on the forewing as well as on the hind wing. The spots are accented by two bright orange bands along the posterior wing edges and two somewhat darker orange-brown bands across the central portion of each wing (USFWS, 1996c). The Saint Francis' Satyr butterfly was federally listed as endangered in 1994 (59 FR 18324 18327, April 18, 1994). The species is endemic to the sandhills of North Carolina and is known from a single metapopulation in Cumberland and Hoke Counties in the central portion of the state (USFWS, 1996c) (USFWS, 2015au).

Habitat for the butterfly includes wide, wet meadows dominated by sedges and other wetland plants. These meadows are often relicts of beaver activity and/or periodic wildfires. Current threats to this species include habitat alterations from fire suppression or beaver eradication, and human collection (the species is highly prized by private and commercial collectors) (USFWS, 1996c).

Spruce-fir Moss Spider. The spruce-fir moss spider is one of the smallest members of tarantulas, measuring 0.10 to 0.15 inches in length. The spider ranges from light brown to darker reddish browns. The species was federally listed as endangered in 1995 (60 FR 6968 6974, February 6, 1995). Historically, the spruce-fir moss spider lived throughout the mountains of

[84] Subglobose: "Somewhat or almost globose; almost spherical in shape" (Oxford University Press, 2016)

southern Appalachia and today is present on few mountaintops in western North Carolina, eastern Tennessee, and southwest Virginia (USFWS, 1998b). In North Carolina, the species is known from nine counties in the western portion of the state (USFWS, 2015av). Critical habitat has been defined for the species, which includes areas in Avery, Caldwell, Mitchell, Swain, and Watauga Counties, North Carolina (USFWS, 2015l).

Typical habitat for this spider is damp and well-drained mosses growing on shady rocks in mountain forests of Fraser fir and red spruce. However, Fraser fir trees in the Southern Appalachian Mountains have recently suffered from infestation by the balsam wooly adelgid (*Adelges piceae).* Death and thinning of the tree canopy results in significant changes in the forest, specifically increased temperatures and decreased moisture, which directly affects suitable habitats for this species. Additional threats for the spruce-fir moss spider include habitat destruction from logging operations, storm damage, air pollution, climate change, disease, and insect damage (USFWS, 1998b).

Tar River Spinymussel. The Tar River spinymussel is a medium-sized mussel reaching about 2.4 inches in length. The shell surface is generally smooth and shiny, and the mussel is rhomboid-shaped with up to six spines on each valve, though not every individual with have spines. The outer skin of this mussel is orange-brown and covered with greenish rays when young, becoming darker or blackish brown with fainter rays when mature. The Tar River spinymussel was federally listed as endangered 1985 (50 FR 26572 26575, June 27, 1985). The species is endemic to North Carolina, is known from only the Tar River and Swift Creek, and is listed in seven counties in the northeastern part of the state. (USFWS, 1992b) (USFWS, 2015aw).

Suitable habitats for the Tar River spinymussel include relatively fast-flowing, well-oxygenated water, in sites with a substrate comprised of relatively silt-free, uncompacted gravel/coarse sand. Threats to the species include water quality and habitat degradation resulting from siltation and the runoff and discharge of agricultural, municipal, and industrial pollutants (USFWS, 1992b).

Plants

Eighteen endangered and nine threatened plant species are federally listed and known to occur in the North Carolina, as summarized in Table 11.1.6-11. Additionally, one candidate plant species is listed in the state, the Hirst Brothers'panic grass (*Dichanthelium hirstii)* found along the east coast from Onslow County south. The 27 listed plant species have different ranges throughout North Carolina, from the Appalachian Mountains in the west to the coastal plain in the east. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in North Carolina is provided below. (USFWS, 2015d) (USFWS, 2015l) (USFWS, 2015f)

Table 11.1.6-11: Federally Listed Plant Species of North Carolina

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in North Carolina	Habitat Description
American Chaffseed	*Schwalbea americana*	E	No	Successional habitats; known from 6 counties in southeast North Carolina.
Blue Ridge Goldenrod	*Solidago spithamaea*	T	No	Rock outcrops, ledges, cliffs, and balds at high elevations; known from Ashe, Avery, Mitchell, and Watauga Counties in northwestern North Carolina.
Bunched Arrowhead	*Sagittaria fasciculata*	E	No	Saturated to flooded soils, typically located just below the origin of slow, continuous seeps on gently sloping terrain in deciduous woodlands; known from only Henderson County.
Canby's Dropwort	*Oxypolis canbyi*	E	No	Open and sparse wetlands; known from Scotland County in south-central North Carolina.
Cooley's Meadowrue	*Thalictrum cooleyi*	E	No	Wet pine savannas, grass-sedge bogs, and savanna-like areas with circumneutral soils; known from 5 counties in the southeastern portion of the state.
Dwarf-flowered Heartleaf	*Hexastylis naniflora*	T	No	Acidic soils along bluffs and adjacent slopes, in boggy areas next to streams and creekheads, and along slopes of nearby hillsides and ravines; known in 10 counties in North Carolina.
Golden Sedge	*Carex lutea*	E	Yes, in Onslow and Pender Counties.	Wet savanna/hardwood ecotones and open wet savannas; known only from the Northeast Cape Fear River watershed in Pender and Onslow Counties.
Green Pitcher-plant	*Sarracenia oreophila*	E	No	Moist upland areas and along boggy, sandy streambanks; in North Carolina, known only from Clay County in the southwestern corner of the state.
Harperella	*Ptilimnium nodosum*	E	No	Shallow ponds in hilly terrain and along gravelly stream-banks of swift moving water; known from Chatham, Granville, and Lee Counties, located in the central and north-central portion of the state.

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in North Carolina	Habitat Description
Heller's Blazingstar	*Liatris helleri*	T	No	High cliffs, rock outcrops, ledges, and grassy balds in the Blue Ridge Mountains; known from only 5 North Carolina counties.
Michaux's Sumac	*Rhus michauxii*	E	No	Successional habitats; known from 16 counties across central part of the state.
Mountain Golden Heather	*Hudsonia montana*	T	Yes, in Burke County.	Exposed chilhowee quartzite ledges and outcrops found along Linville Gorge; known only from Burke and McDowell Counties.
Mountain Sweet Pitcher-plant	*Sarracenia rubra ssp. Jonesii*	E	No	Bogs and a few streamsides in the Blue Ridge Mountains; known only from Henderson and Transylvania Counties.
Pondberry	*Lindera melissifolia*	E	No	Seasonally flooded wetlands, sandy sinks, pond margins, and swampy depressions; in North Carolina, known from four counties in the southeastern portion of the state.
Roan Mountain Bluet	*Hedyotis purpurea var. montana*	E	No	Rocky exposures at high elevations; found in the Appalachian Mountains.
Rock Gnome Lichen	*Gymnoderma lineare*	E	No	Rocky exposures at high elevations; found in the Appalachian Mountains.
Rough-leaved Loosestrife	*Lysimachia asperulaefolia*	E	No	Ecotones or edges between longleaf pine uplands and pond pine pocosins; known from 15 counties in southeastern North Carolina.
Schweinitz's Sunflower	*Helianthus schweinitzii*	E	No	Areas of full to partial sun with poor soils, including roadsides; known from 14 counties in central North Carolina.
Seabeach Amaranth	*Amaranthus pumilus*	T	No	Coastal areas of barrier beaches; known from eight coastal counties.
Sensitive Joint-vetch	*Aeschynomene virginica*	T	No	Sediments in intertidal zones and salty rivers; Known from Beaufort, Craven, Hyde, and Lenoir Counties along the eastern coast.
Small Whorled Pogonia	*Isotria medeoloides*	T	No	Hardwood stands that include beech, birch, maple, oak, hemlock, and hickory; found in 10 counties in the central and western portion of the state.

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in North Carolina	Habitat Description
Small-anthered Bittercress	*Cardamine micranthera*	E	No	Streambeds and sandbars; Dan River watershed in Forsyth and Stokes Counties.
Smooth Coneflower	*Echinacea laevigata*	E	No	Open woods, glades, cedar barrens, dry limestone bluffs, and roadsides; known from six counties in central North Carolina.
Spreading Avens	*Geum radiatum*	E	No	Rocky outcrops, steep slopes, and on gravelly talus on high-elevation cliffs in full sun with shallow acidic soils; known from eight counties in western North Carolina.
Swamp Pink	*Helonias bullata*	T	No	Forested wetlands; found within the southern Appalachian Mountains of western North Carolina.
Virginia Spiraea	*Spiraea virginiana*	T	No	Rocky often flood scoured banks of high velocity streams and rivers; found along the Appalachian Mountains in western North Carolina.
White Irisette	*Sisyrinchium dichotomum*	E	No	Mid elevation slopes characterized by open, dry to moderate-moisture oak hickory forests; known from Burke, Henderson, Polk and Rutherford Counties.

[a] E = Endangered, T = Threatened
Source: (USFWS, 2015d) (USFWS, 2015l) (USFWS, 2015f)

American Chaffseed. The American chaffseed is a perennial member of the figwort family that grows 12 to 24 inches high and has large purple and yellow tubular flowers that form a spike-like cluster (USFWS, 2014d). American chaffseed was listed as endangered in 1992 (57 FR 44703 44708, September 29, 1992). The American chaffseed is a coastal plain species with a range that extends throughout the Atlantic and Gulf coasts (USFWS, 2014d). In 2008, 53 known extant sites were recorded in this range. In North Carolina, the species is known from 18 extant and six extirpated locations in Bladen, Cumberland, Hoke, Moore, Pender, and Scotland Counties in the southeastern part of the state (USFWS, 2008b).

Suitable habitat for this species includes “pine flatwoods, fire-maintained savannas, and ecotonal areas between peaty wetlands and xeric (dry) sandy soils, bog borders, and other open grass-sedge systems.” “The American chaffseed occurs in sandy (sandy peat, sandy loam), acidic, and seasonally moist to dry soils…[and]... in species-rich plant communities where grasses, sedges, and savanna dicots are numerous.” Threats to the American chaffseed are loss of habitat due to development and natural vegetation succession. (USFWS, 2014d)

Blue Ridge Goldenrod. The Blue Ridge goldenrod is a perennial herb, which grows from a short, stout rhizome. The erect stem is 4 to 8 inches tall, greenish-brown and becoming more strongly ribbed and reddish and usually covered with whitish hairs. Flowers are yellow and flowering occurs from July to September (USFWS, 1987b). Blue Ridge goldenrod was listed as threatened in 1985 (50 FR 12306 12309, March 28, 1985). The species is endemic to a limited area in the Blue Ridge Mountains of North Carolina and eastern Tennessee (USFWS, 1987b). The species is known from Ashe, Avery, Mitchell, and Watauga Counties in northwestern North Carolina (USFWS, 2015ay).

Suitable habitat for this species consists of rock outcrops, ledges, cliffs, and balds at high elevations (generally above 4,600 feet). The plants grow in humus or clay loams on igneous and metasedimentary rock. Soils are generally acidic and shallow. Threats to the Blue Ridge goldenrod include disturbance from construction/development, being trampled by hikers/sightseers, acid precipitation, and atmospheric pollution (USFWS, 1987b).

Bunched Arrowhead. The bunched arrowhead is a small (to 16 inches in height) herbaceous plant. Emergent leaves are spatulate in shape and up to 12 inches long and 0.8 inches wide. Winter rosette and submersed leaves are linear in shape, usually 0.4 inches wide and up to 4 inches long. Flowering begins in mid-May and continues to July. The fruit matures a few weeks after flowering (USFWS, 1983b). Bunched arrowhead was listed as endangered in 1979 (44 FR 43700 43701, July 25, 1979). The species is endemic to a limited area between Greenville, South Carolina, and Asheville, North Carolina (USFWS, 1983b). In North Carolina, the species is known or believed to occur in Henderson County (USFWS, 2015az).

Suitable habitat for the bunched arrowhead includes saturated or flooded soils, typically located just below slow, continuous seeps on gently sloping terrain in hardwood forests. Threats to the species include disturbance of its extremely limited habitat, including development for pasture and residential homes (USFWS, 1983b).

Canby's Dropwort. Canby's dropwort is a perennial herb that grows to heights between 2.5 and 4 feet. The plant's stems are thin and stiff, holding slender leaves and extending up to small, five-petal flower clusters with colors typically ranging from white to red (USFWS, 2011c). The species was federally listed as an endangered plant species in 1986 (51 FR 6690 6693, February 25, 1986). The species' range extends along Atlantic coastal states from Maryland to Georgia; in North Carolina, the species known or believed to occur in Scotland County in the south-central part of the state (USFWS, 2015ba).

Habitat for Canby's dropwort include open ponds, swamps, and sloughs, ultimately uninhibited by intensive canopy cover and on wet soils for a majority of the year. Wetland areas located near coastal regions with sandy or muddy upper soil layers provide adequate habitat for the species. Habitat loss, hydrologic alterations, environmental degradation from herbicides, and insect predation are all current threats to the species' survival (USFWS, 2011c).

Cooley's Meadowrue. The endangered Cooley's meadowrue is a tall herb (3 feet or more in flower), with the slender stems erect in sunny locations and lax or sprawling in shade. Leaflets are about 0.8 inches long, mostly narrow (four or more times as long as wide). Male and female flowers are on separate plants, in loose few-flowered clusters, appearing at the top of the plants in late June to early July (USFWS, 1994a). Cooley's meadowrue was listed as endangered in 1989 (54 FR 5935 5938, February 7, 1989). The species is known from occurrences in northwest Florida, southwest Georgia, and in coastal North Carolina; in North Carolina, the species is known from Brunswick, Columbus, New Hanover, Onslow, and Pender Counties in the southeastern portion of the state (USFWS, 2015bb).

Suitable habitat for this species includes wet pine savannas, grass-sedge bogs, and savanna-like areas in habitat kept open by frequent fire or other disturbances. Threats include habitat loss due to anthropogenic[85] activities, including forestry, agriculture, and drainage of wet areas, road building, and fire suppression (USFWS, 1994a).

Dwarf-flowered Heartleaf. The threatened dwarf-flowered heartleaf is a low growing herbaceous plant with heart-shaped leaves are dark green in color. Their maximum height rarely exceeds 6 inches. The jug-shaped flowers are usually beige to dark brown in color and appear from mid-March to early June. The flowers are small and inconspicuous and are found near the base of the petioles. The fruit matures from mid-May to early July (USFWS, 1989b). Dwarf-flowered heartleaf was listed as threatened in 1989 (54 FR 14964 14967, April 14, 1989). The species is known from an area in the upper piedmont of North Carolina and adjacent South Carolina; in North Carolina, there are 10 counties in the western portion of the state where the species is known or believed to occur (USFWS, 1989b) (USFWS, 2015bc).

Suitable habitat for this species includes acidic soils along bluffs and adjacent slopes, in boggy areas next to streams and creekheads, and along the slopes of nearby hillsides and ravines. Threats to the dwarf-flowered heartleaf include habitat destruction from conversion to agriculture, residential, commercial, and industrial development, and pond construction (USFWS, 1989b).

Golden Sedge. The golden sedge is a small plant, generally 1 to 2 feet tall, but occasionally reaching up to 3 feet tall. The yellowish green leaves are grasslike, with those of the culm mostly basal and up to 11 inches in length, while those of the vegetative shoots reach a length of 25.6 inches. Two to four flowering spikes occur on each plant, with the tallest spike being male and the one to three lateral spikes being female (USFWS, 2014e).

Golden sedge was listed as endangered in 2002 (67 FR 3120 3126, January 1, 2002). The species is endemic to the outer coastal plain of North Carolina, where it is only known from the Northeast Cape Fear River watershed in Pender and Onslow Counties (USFWS, 2014e) (USFWS, 2015bd). Critical habitat for the species has been defined within Pender and Onslow Counties (USFWS, 2015l).

Suitable habitat for this species includes wet savanna/hardwood ecotones and open wet savannas. Golden sedge is generally found in areas with an open to sparse canopy, a patchy shrub layer, and/or a dense herb cover. It may also occur in fire suppressed closed canopy forests. Threats to

[85] Anthropogenic: "Made by people or resulting from human activities. Usually used in the context of emissions that are produced as a result of human activities." (USEPA, 2015d)

golden sedge include habitat alteration caused by fire suppression, conversion of limited known habitat for residential, commercial, or industrial development, highway and utility expansion, and wetland drainage activities associated with silviculture, agriculture and development projects. In addition, roadside and utility right-of-way populations are vulnerable to extirpation from herbicide application. Invasive species, small population size, and drought are other threats to the species (USFWS, 2014e).

Green Pitcher-plant. The green pitcher-plant is a carnivorous herb arising from moderately branched rhizomes. The species has two leaf types. The pitcher leaves (hollow leaves), which appear in spring, are 8 to 30 inches long and 2.4 to 4 inches in circumference and are green to yellow-green. A similarly colored hood arches over the opening of the leaves. The pitcher leaves wither by late summer, but are replaced by flattened leaves that persist until the next season. (USFWS, 1994b) (USFWS, 2015be)

The fruit is a tuberculate capsule (USFWS, 1994b) (USFWS, 2015be). Green pitcher-plant was listed as endangered in 1979 (44 FR 54922 54923, September 21, 1979). The species is restricted to areas of the Cumberland Plateau and the Ridge and Valley Provinces in northeast Alabama and the Blue Ridge of Georgia and North Carolina. This species previously occurred in Coastal Plain and Piedmont areas in Alabama and Georgia and in the Cumberland Plateau of eastern Tennessee (USFWS, 1994b). In North Carolina, the species is known only from Clay County, in the southwestern corner of the state (USFWS, 2015be).

Suitable habitat for this species includes moist upland areas and along boggy, sandy streambanks. Soils of the green pitcher plant sites are generally acidic and derived from sandstones or shales. Soils of the upland sites are sandy clays or loams while those of the streambank sites are almost pure sand. Threats include clearing and degradation of land for residential, agricultural, silvicultural, and industrial purposes, impoundments, trampling and soil disturbance by cattle, over-collection by botanists or commercial dealers, and fire suppression (USFWS, 1994b).

Harperella. Harperella, or pond harperella, is a perennial herb that grows between half a foot and three feet tall. Its thin stalks have quill-like leaves and end in small white flowers with typically five petals each (USFWS, 2015bf). The species was listed as endangered in 1988 within the Northeast Region (53 FR 37978 37982, September 28, 1988). Harperella's range reaches down the east coast from Maryland down to Georgia and extends across to Oklahoma (USFWS, 2015bg). Within North Carolina, harperella is known or believed to exist in Chatham, Granville, and Lee Counties, in the central and north-central portion of the state (USFWS, 2015bg).

Habitat for pond harperella consists of shallow ponds in hilly terrain and along gravelly stream-banks of swift moving water. Threats to harperella consist of water changes in flow, depth, and quality, along with human factors such as damming, hydrologic alterations, and development. Habitat destroyed due to aforementioned reasons by either overwhelming water coverage or severe dehydration can detrimentally impact the species' survival, as even natural water changes can remarkably influence a subpopulation's survival (USFWS, 2015bf).

Heller's Blazingstar. The Heller's blazingstar is a perennial herb that grows from a rootstock 0.8 to 2.0 inches broad. One or more erect or arching stems arise from a tuft of narrow pale green basal leaves. The stems reach up to 15.7 inches in height and are topped by a showy spike of lavender flowers 2.8 to 7.9 inches long. Flowering occurs from July through September, and fruits are borne from August to October (USFWS, 2000). Heller's blazingstar was listed as threatened in 1987 (52 FR 44397 44401, November 19, 1987). The species is endemic to North Carolina and is only known from eight locations in Ashe, Avery, Burke, Caldwell, and Watauga Counties in the northwestern portion of the state (USFWS, 2000) (USFWS, 2015bh).

Suitable habitat for this species includes high cliffs, rock outcrops, ledges, and grassy balds in the Blue Ridge Mountains. The plants grow in humus or clay loams on igneous and metasedimentary rock. Threats include recreational and residential development, trampling, collection, and acid precipitation and other forms of atmospheric pollution that have been found to be concentrated at higher elevations in the Southern Appalachians (USFWS, 2000).

Michaux's Sumac. The Michaux's sumac, part of the cashew family, is a densely hairy shrub with one to three-foot stems and evenly serrated, oblong leaflets. The species contains male and female small greenish-yellow flowers within the same plant, which flower in June and July and produce a red drupe fruit in August through October (USFWS, 2015bi). Michaux's sumac was listed as endangered in 1989 (54 FR 39850 39857, September 28, 1989). This species is distributed throughout the Atlantic coastal plains in the southern U.S. (USFWS, 1993c). In North Carolina, the species is known from 16 counties across the central part of the state (USFWS, 2015bi).

Suitable habitat consists of sandy or rocky open woods and survives best in areas where some form of disturbance has occurred, such as wildfire or maintained clearings. The most critical threat to this species is low reproductive capacity, fire suppression, and habitat loss due to development (USFWS, 2015bi).

Mountain Golden Heather. The mountain golden heather is a tiny, needle-leaved shrub with yellow flowers. It usually grows about 6 inches tall, in clumps from 4 - 8 inches across. The plants have the general appearance of a large moss or low juniper, but their branching is more open, their leaves are about one-quarter of an inch long, and the plant is often somewhat yellow-green in color, especially in shaded areas. The flowers appear in early or mid-June, are nearly an inch across, and have five blunt-tipped petals (USFWS, 2011d). Mountain golden heather was listed as threatened in 1980 (45 FR 69360 69363, October 20, 1980). The species is known from the Pisgah National Forest in Burke and McDowell Counties in northwestern North Carolina (USFWS, 1983c) (USFWS, 2015bj). Critical habitat has been designated for the species in Burke County along the Linville Gorge (USFWS, 2015l).

Suitable habitat for this species consists of exposed chilhowee quartzite ledges and outcrops found along Linville Gorge at elevations of 2,800 to 4,000 feet, (USFWS, 1983c) (USFWS, 2011d). Threats include intensive recreational use by hikers, climbers, and campers that has resulted in a loss of plants due to trampling and soil compaction. Plants have also been taken from the wild by collectors. A major contributor to the decline of this species is the exclusion of natural wildfire from its habitat. Recent studies have shown that the habitat of mountain golden heather is adapted to periodic fire. Wildfire suppression has changed forest composition, allowing shrubs and trees to take over the naturally open habitat required by golden heather (USFWS, 2011d).

Mountain Sweet Pitcher-plant. The mountain sweet pitcher-plant is a carnivorous perennial herb with tall, hollow pitcher-shaped leaves and red sweet-smelling flowers. The pitchers are a waxy dull green, usually reticulate-veined with maroon-purple. The tube of the pitchers is retrorsely hairy within and often partially filled with liquid and decayed insect parts. The unusual red flowers (yellow in rare cases) appear from April to June, with fruits ripening in August. Flowering plants reach heights of 29 inches (USFWS, 1990d) (USFWS, 2011e). Mountain sweet pitcher-plant was listed as endangered in 1988 (53 FR 38470 38474, September 30, 1988). The species is known from the upstate of South Carolina and southwestern North Carolina; in North Carolina, it is known from Henderson and Transylvania Counties (USFWS, 2011e) (USFWS, 2015bk).

Suitable habitat for this species includes bogs and a few streamsides in the Blue Ridge Mountains of North Carolina and South Carolina, usually on soils of Toxaway silt loam or Hatboro loam series. Most sites occur in level depressions associated with floodplains; however, a few occur in “cataract bog” or “waterslide” situations, where sphagnum and other typical bog species line the sides of waterfalls on granite rock faces. The most serious threat to mountain sweet pitcher plant is the destruction or degradation of its small wetland habitat. Collecting from wild populations continues to be a problem for carnivorous plants, even though cultivated sources are available for almost all species (USFWS, 1990d) (USFWS, 2011e).

Pondberry. The pondberry is a deciduous shrub, growing from less than 1 foot to more than 6 feet in height. Shrubs usually are sparsely branched, with fewer branches on smaller plants. Plants are rhizomatous, frequently propagating by vegetative sprouts and forming colonies. Each plant is either male or female, and produces clusters of small, yellow flowers in early spring prior to leaf development, from buds on branches produced from the growth during the preceding year. Immature fruits are green and ripen to red by fall (USFWS, 2015bl). Pondberry was listed as endangered in 1986 (51 FR 27495 27500, July 31, 1986). The species is known from Alabama, Arkansas, Georgia, Mississippi, Missouri, North Carolina, and South Carolina; in North Carolina, the species is known from four counties in the southeastern portion of the state (USFWS, 2015bl).

Suitable habitat for this species includes in seasonally flooded wetlands, sandy sinks, pond margins, and swampy depressions. Threats to the species include alteration or destruction of its habitat through land-clearing, drainage modification, timber-harvesting, and disturbance from domestic animals (USFWS, 1993d).

Roan Mountain Bluet. The endangered Roan Mountain bluet contains larger funnel-shaped red-purple flowers, small oval leaves, and small round fruit (USFWS, 2011f). Roan Mountain bluet was listed as endangered in 1996 (55 FR 12793 12797, April 5, 1996). The Roan Mountain bluet is known to occur in high mountains of North Carolina, Tennessee, and Virginia. In North Carolina, the Roan Mountain bluet is known from Ashe, Avery, Mitchell, Watauga, and Yancey Counties in the northwestern portion of the state (USFWS, 2015bm).

Suitable habitat includes rocky exposures at high elevations above 4,000 feet above mean sea level. Threats to the species include development, and human recreational activities at trail-side locations (USFWS, 2011f).

Rock Gnome Lichen. The rock gnome lichen grow in dense colonies and contain small narrow blue-grey strap-like lobes (USFWS, 2015bn). The rock gnome lichen was listed as endangered in 1995 (60 FR 3557 3562, January 18, 1995). The rock gnome lichen is known to occur throughout the Appalachian Mountains (USFWS, 2015bn). In North Carolina, the rock gnome lichen is known from 13 counties in the western portion of the state (USFWS, 2015bo).

Habitat for the rock gnome lichen is limited to vertical rock faces where water seeps flow during wet periods and generally occurs in areas of high elevation and with high humidity. The greatest threat to the rock gnome lichen is from human activities in recreational trail areas, as well as development, and lack of canopy shading (USFWS, 2015bn).

Rough-leaved Loosestrife. The endangered rough-leaved loosestrife is a perennial herb that grows 11.8 – 23.6 inches tall. The triangular shaped leaves are often opposite on shorter stems and tend to be arranged in whorls of three or four encircling taller stems. The leaves are widest at the base (0.3 – 0.8 inches wide) and have three prominent veins. Contrary to the common name, the leaf surfaces are smooth to the touch. The yellow flowers are 0.6 inches across with yellow-orange anthers. Flowering occurs from mid-May through June, with fruits (capsules) present from July through October (USFWS, 2011g). Rough-leaved loosestrife was listed as endangered in 1987 (52 FR 22585 22589, June 12, 1987). The species is endemic to the coastal plain and sandhills of North Carolina and South Carolina; in North Carolina, it is known from 15 counties in the southeastern part of the state (USFWS, 1995) (USFWS, 2015bp).

Suitable habitat for this species includes edges between longleaf pine uplands and in areas of dense shrub and vine growth usually on a wet, peaty, poorly drained soil on moist to seasonally saturated sands and on shallow organic soils. Rough-leaf loosestrife has also been found on deep peat in the low shrub community of large North Carolina bays (shallow, elliptical, poorly drained depressions of unknown origin). This species inhabits fire-maintained habitats, and several populations are known from roadsides and power line rights of way where regular maintenance mimics fire. Fire suppression, wetland drainage, and residential and commercial development are the most significant threats to the continued existence of the species (USFWS, 2011g).

Schweinitz's Sunflower. The Schweinitz's sunflower is a perennial that grows approximately 6.5 feet tall and can occasionally reach heights of 16 feet. The upper third bears secondary branches at 45-degree angles. The leaves are arranged in pairs on the lower part of the stem but usually occur singly (or alternate) on the upper parts. Leaves are attached to the stem at right angles, and the tips of the leaves tend to droop. The leaves are thick and stiff, with a rough upper surface. The plant produces small yellow flowers from late August until frost (USFWS, 2011h). Schweinitz's sunflower was listed as endangered in 1991 (56 FR 21087 21091, May 7, 1991). Schweinitz's sunflower is endemic to the piedmont of North Carolina and South Carolina; in North Carolina, it is known from 14 counties in the central part of the state (USFWS, 1994c) (USFWS, 2015bq).

Suitable habitat for this species includes areas of full to partial sun with poor soils, such as thin clays that vary from wet to dry. It is believed that this species once occurred in natural forest openings or grasslands. Many of the remaining populations occur along roadsides. Habitat destruction, fire suppression, alteration of native habitat, roadside and utility right of way maintenance, industrial development, mining, encroachment by exotic species, and highway construction and improvement have all contributed to the decline of Schweinitz's sunflower. This species occurs in many rapidly developing areas within the piedmont region of North and South Carolina, which is the largest threat to its survival (USFWS, 2011h).

Seabeach Amaranth. The seabeach amaranth is an annual plant with pinkish-red stems and small rounded leaves up to one inch in diameter. Flowers are inconspicuous and yellow and flower in June and July, and continue to flower until their death in in the fall (USFWS, 2015br). The seabeach amaranth was listed as threatened in 1993 (58 FR 18035 18042, April 7, 1993). Seabeach amaranth occurs on coastal areas between New York and South Carolina. In North Carolina, seabeach amaranth is known from eight coastal counties (USFWS, 2015bs).

This annual grows in coastal areas along barrier beaches just above the high tide line spreading close to the ground. This species shares habitat with other protected species such as the piping plover and roseate tern. The plants trap sand and subsequently can create mounds up to three cubic yards in size. Threats to seabeach amaranth include beach stabilization structures, off-road vehicles, habitat fragmentation, and insects that prey heavily on the plants (USFWS, 2015br).

Sensitive Joint-vetch. The sensitive joint-vetch is an annual plant from the legume family that can grow up to 6 feet tall. It has yellow pea-shaped flowers during the months of July to October (USFWS, 2014f). The species was listed in 1992 as threatened (57 FR 21569 21574, May 20, 1992). Sensitive joint-vetch are found in four states: Maryland, New Jersey, North Carolina, and Virginia. In North Carolina, they are known from Beaufort, Craven, Hyde, and Lenoir Counties along the eastern coast (USFWS, 2015bt).

They are found throughout the outer fringes of the intertidal zone from fresh water to salty tidal rivers and marshes on accumulated sediment. These sites are nutrient deficient, and may suffer from muskrat herbivory. Threats include dredging and filling marshes, dam construction, shoreline stabilization, human development, sedimentation, invasive species, and salt-water intrusion from sea level rise (USFWS, 2015bt) (USFWS, 2014f).

Small Whorled Pogonia. The small whorled pogonia is a member of the orchid family, which grows between 10 to 14 inches in height with greenish yellow flowers (USFWS, 2008c). The small whorled pogonia was federally listed as endangered in 1982 (47 FR 39827 39831, September 9, 1982) and in 1994 was reclassified as threatened (59 FR 50852 50857, October 6, 1994). Regionally this species is known to occur in sparse distributions from Maine south to Georgia and eastern to Illinois (USFWS, 2015bu). In North Carolina, this species is known to occur in 10 counties in the central and western portions of the state (USFWS, 2015bu).

The small whorled pogonia occurs in hardwood stands that include beech, birch, maple, oak, hemlock, and hickory that have an open understory, preferring acidic soils along small streams that have a thick layer of litter (USFWS, 2008c). One distinct feature of this species is that it can remain dormant underground for multiple years before reappearing (USFWS, 1992c). Current threats to small whorled pogonia include habitat loss due to urban expansion and forestry practices (USFWS, 2008c).

Small-anthered Bittercress. The small-anthered bittercress is a slender perennial herb with fibrous roots and one branch stem that grows up to 15.8 inches in height, and basal leaves up to two inches in diameter (USFWS, 2006). The small-anthered bittercress was listed as endangered in 1989 (54 FR 38947 38950, September 21, 1989). It only occurs in the Dan River basin in south central Virginia and north central North Carolina (Forsyth and Stokes Counties) (USFWS, 2015bv).

Suitable habitat for the small-anthered bittercress include seepages, wet rock crevices, stream banks, sandbars, and wet woods along streams. Threats to the species include channelization and impoundments, water quality problems, encroachment of invasive species, and herbicides from adjacent agricultural fields (USFWS, 2015bv).

Smooth Coneflower. The smooth coneflower is a perennial herb in the aster family that grows up to 3.3 feet from a vertical rootstock and basal leaves that may reach eight inches in length. The plant produces solitary flowers that are pink to purple in color and droop. Flowering occurs in late May through July and fruits develop in the summer months (USFWS, 2015bw). The smooth coneflower was listed as endangered in 1992 (57 FR 46340 46344, October 8, 1992). This species is known or believed to occur in Virginia, North Carolina, South Carolina, and Georgia, although it historically also occurred regionally throughout the southern U.S. (USFWS, 2015bw). In North Carolina, the species is known from six counties in the central portion of the state (USFWS, 2015bx).

The habitat of the smooth coneflower includes open woods, glades, cedar barrens, dry limestone bluffs, and roadsides. Optimal sites include soils rich in calcium and magnesium, and abundant sunlight. Threats to the species include fire suppression and habitat loss from development (USFWS, 2015bw).

Spreading Avens. The spreading avens is a tall perennial herb growing 8 - 20 inches tall. Its distinctive bright yellow flowers, which are generally up to 1 inch across, appear from June through September, and fruits form and ripen from August through October (USFWS, 2011i). Spreading avens was listed as endangered in 1990 (55 FR 12793 12797, April 5, 1990). The species is known to occur only on high mountain peaks in western North Carolina and eastern Tennessee; in North Carolina, the species is known from eight counties in the western portion of the state (USFWS, 2011i) (USFWS, 2015by).

The habitat of spreading avens includes rocky outcrops, steep slopes, and on gravelly talus on high-elevation cliffs in full sun with shallow acidic soils. Threats to the species include trampling by hikers, climbers, and sightseers, as well as to more pervasive threats such as acid precipitation, and other forms of air pollution. An exotic insect, the balsam woolly adelgid, contributes to the decline of the fir forests adjacent to the cliffs where spreading avens grows. Although spreading avens does not grow beneath dense forest, the death of the adjacent forests results in drier and hotter conditions, as well as increased soil erosion (USFWS, 2011i).

Swamp Pink. The swamp pink is an obligate wetland species[86] in the lily family with fragrant pink wildflowers. Leaves are evergreen lance shaped that form circular clusters that lay flat on the ground. Flowers grow on one to three feet tall stalks in clusters of 30 to 50 individual small pink flowers with blue anthers. The swamp pink was federally listed as threatened in 1988 (53 FR 35076 35080, September 9, 1988). The swamp pink is found on the coastal plains of three states (Delaware, New Jersey, and Maryland) and isolated spots of the southern Appalachian Mountains (USFWS, 2015bz). In North Carolina, the species is known from Ashe, Henderson, Jackson, and Transylvania Counties in the western portion of the state (USFWS, 2015ca).

Suitable habitats for the swamp pink consist of shaded forested wetland areas. Threats include human development that changes the physical and hydraulic conditions of the wetlands and invasive species (USFWS, 2015bz).

Virginia Spiraea. The Virginia spiraea is a perennial shrub species with many branches. The shrub ranges in height from three to seven feet tall with elliptic leaves two to three inches long. The shrub's white flowers appear in June and July at the ends of branches (WVDNR, 2015). The Virginia spiraea was first listed as threatened by endangered species legislation in 1990 (55 FR 24241 24247, June 15, 1990). Regionally, the species occurs along 24 stream systems in Georgia, Tennessee, North Carolina, Kentucky, West Virginia, Virginia, and Ohio. In North Carolina, it is known from the Appalachian Mountains within the counties of Ashe, Graham, Macon, Mitchell, Swain, and Transylvania (USFWS, 2011j).

The Virginia spiraea inhabits rocky often flood scoured banks of high velocity streams and rivers. It is believed that scour is important to the species as it discourages tree growth and prevents canopy closure. Flood frequency and intensity have a large influence on development of suitable habitat for the species. Major threats to the species include dam and reservoir construction that remove or eliminate the species habitat altogether. Damage to the plants from people using the river for recreation is another common threat. Physical damage to the plant stems from hikers, fishermen, boaters, and rafters has been observed at many documented sites of Virginia spiraea. This activity is often a result of an attempt to clear the riverbank for fishing or camping sites(WVDNR, 2015) (USFWS, 2011j).

White Irisette. The white irisette is a perennial herb that generally grows from 10 - 16 inches tall and has winged stems. An individual white irisette plant is typically defined as a cluster of stems arising from fibrous roots. There may be 10 or more stems on one plant. White irisette flowers from late May through July. The seeds are very small and black and three to six seeds are contained in each capsule (USFWS, 2011). White irisette was listed as endangered in 1991 (56 FR 48752 48755, September 26, 1991). This species is known from Burke, Henderson, Polk, and Rutherford Counties, North Carolina (USFWS, 2015cb).

Whit irisette is found on mid elevation slopes, characterized by open, dry to moderate-moisture oak hickory forests. White irisette usually grows in shallow soils on regularly disturbed sites (such as woodland edges and roadsides) and over rocky, steep terrain. White irisette is

[86] Obligate wetland species: "Almost always occur in wetlands. With few exceptions, these plants are found in standing water or seasonally saturated soils (14 or more consecutive days) near the surface." (USACE, 2012b)

threatened by many human caused disturbances, such as residential development, road construction, and possibly herbicide use. It is also indirectly affected by the extirpation of elk and bison and possibly the suppression of fire. The elimination or suppression of these natural disturbances allows vegetative succession to occur, often accompanied by exotic invasive plants that out compete this native species (USFWS, 2015cb).

11.1.7. Land Use, Recreation, and Airspace

11.1.7.1. Definition of the Resource

The following summarizes major land uses, recreational venues, and airspace considerations in North Carolina, characterizing existing, baseline conditions for use in evaluating the potential environmental consequences resulting from implementing the Proposed Action or Alternatives.

Land Use and Recreation

Land use is defined by the Food and Agricultural Organization of the United Nations as "the arrangements, activities and inputs people undertake in a certain land cover type to produce, change, or maintain it" (Di Gregorio & Jansen, 1998). A land use designation can include one or more pieces of land, and multiple land uses may occur on the same piece of land. Land use also includes the physical cover, observed on the ground or remote sensing and mapping, on the earth's surface; land cover includes vegetation and manmade development (USGS, 2012c).

Recreational uses are activities in which residents and visitors participate. They include outdoor activities, such as hiking, fishing, boating, athletic events (e.g., golf), and other attractions (e.g., historic monuments and cultural sites) or indoor activities, such as museums and historic sites. Recreational resources can include trails, , lakes, forests, beaches, recreational facilities, museums, historic sites, and other areas/facilities. Recreational resources are typically managed by federal, state, county, or local governments.

Descriptions of land uses are presented in three primary categories: forest and woodlands, agricultural, and developed. Descriptions of land ownership are presented in four main categories: private, federal, state, and tribal. Descriptions of recreational opportunities are presented in a regional fashion.

Airspace

Airspace is generally defined as the space lying above the earth, above a certain area of land or water, or above a nation and the territories that it controls, including territorial waters (Merriam Webster Dictionary, 2015a). Airspace is a finite resource that can be defined vertically and horizontally, as well as temporally, when discussing it in relation to aircraft activities. Airspace management addresses how and in what airspace aircraft fly. Air flight safety considers aircraft flight risks, such as aircraft mishaps and bird/animal-aircraft strikes. The Federal Aviation Administration (FAA) is responsible for the safe and efficient use of the nation's airspace and has established criteria and limits to its use.

The FAA operates a network of airport towers, air route traffic control centers, and flight service stations. The FAA also develops air traffic rules, assigns use of airspace, and controls air traffic in U.S. airspace. "The Air Traffic Organization (ATO) is the operational arm of the FAA responsible for providing safe and efficient air navigation services to approximately 30.2 million square miles of airspace. This represents more than 17 percent of the world's airspace and includes all of the U.S. and large portions of the Atlantic and Pacific Oceans and the Gulf of Mexico" (FAA, 2014). The ATO is comprised of Service Units (organizations) that support the operational requirements.

The FAA Air Traffic Services Unit (the Unit) manages the National Airspace System (NAS) and international airspace assigned to U.S. control and is responsible for ensuring efficient use, security, and safety of the nation's airspace. FAA field and regional offices (e.g., Aircraft Certification Offices, Airports Regional Offices, Flight Standards District Offices [FSDOs], Regional Offices & Aeronautical Center, etc.) assist in regulating civil aviation to promote safety, and develop and carry out programs that control aircraft noise and other environmental effects (e.g., air pollutants) attributed from civil aviation (FAA, 2015b). The FAA works with state aviation officials and airport planners, military airspace managers, and other organizations in deciding how best to use airspace.

11.1.7.2. Specific Regulatory Considerations

Appendix C summarizes numerous federal environmental laws and regulations that, to one degree or another, may affect land use in North Carolina. However, most site-specific land use controls and requirements are governed by local county, city, and town laws and regulations. Furthermore, many land use controls and requirements are implemented and enforced under the umbrella of land use planning, often with the help and support of state authorities (Table 11.1.7-1). North Carolina does not require local government to develop comprehensive land use plans outside of coastal areas. Because the Nation's airspace is governed by federal laws, there are no specific North Carolina state laws that would alter the existing conditions relating to airspace for this PEIS.

Table 11.1.7-1: Relevant North Carolina Land Use, Recreation, and Airspace Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
North Carolina General Statutes, Chapter 160A	Municipal Board of Control	Provides guidelines for development comprehensive land use plans.
CAMA	NCDEQ	Provides land use planning to 20 coastal areas.
North Carolina General Statutes, Chapter 63 – Aeronautics	NC Cities and municipalities political subdivisions, board or administrative agency(ies)	Addresses the safety of the airspace and flight safety at public airports and obstructions to airspace considerations.

11.1.7.3. Land Use and Ownership

For the purposes of this analysis, North Carolina is classified into land use groups based on coverage type as forest and woodlands, agricultural, and developed land. Land ownership within North Carolina has been classified into four main categories: private, federal, state, and tribal land.

Land Use

Forest and woodlands are the largest portion of land use with 55.4 percent of North Carolina's total land area occupied by this category (Table 11.1.7-2). Agriculture is the second largest area of land use with 22.7 percent of the total land area. Developed areas account for approximately 9.1 percent of the total land area in the state. The remaining 12.8 percent of land includes shrubland, grassland, and recently disturbed areas, shown in Figure 11.1.7-1. (USGS, 2011)

Table 11.1.7-2: Major Land Uses in North Carolina by Coverage Type

Land Use	Square Miles	Percent of Land
Forest and Woodland	26,942	55.4%
Agricultural Land	11,021	22.7%
Developed Land	4,448	9.1%
Shrubland, Grassland, Recently Disturbed Areas	6,207	12.8%

Source: (USGS, 2011)

Forest and Woodland

Forest and woodland areas can be found throughout the state, many of them interspersed with, and adjacent to, agricultural areas. The largest concentrations of forest are in the mountain region in the western part of the state and the southern coastal plain region in the southeastern part of the state. The forested land in these two regions average 61 to 76 percent of the total land area. Most forest and woodland areas throughout North Carolina are privately owned (approximately 61 percent). (USFS, 2013) Section 11.1.6, Biological Resources, presents additional information about terrestrial vegetation.

<u>State Forests</u>

State Forests and Educational State Forests account for 82 square miles of state land (USGS, 2012d) (USGS, 2014d). State Forests and Educational State Forests are managed by the North Carolina Forest Service. The North Carolina Forest Service Strategic Plan states that their mission is "to protect, manage, and promote forest resources for the citizens of North Carolina" (NCFS, 2015a).

<u>Private Forest and Woodland</u>

Approximately 17,188 square miles, or 61 percent of North Carolina's total forestland, is privately owned. The private landowners hold about 6,250 square miles forest in the central region and about 4,300 square miles in the southeastern region of the state (USFS, 2013). For additional information regarding forest and woodland areas, see Section 11.1.6, Biological Resources, and Section 11.1.8, Visual Resources.

Agricultural Land

Agricultural land exists in every region of the state, with the largest concentrations in the Inner Coastal Plain region of eastern North Carolina and the Piedmont region in central North Carolina (Figure 11.1.7-1). Almost 23 percent of North Carolina's total land area is classified as agricultural land (approximately 11,021 square miles). In 2012, there were 50,218 farms in North Carolina and 87 percent were owned and operated by small, family businesses, with the average farm size of 168 acres (USDA, 2014). Some of the state's largest agricultural uses include tobacco, soybeans, corn, sweet potatoes, cotton, wheat, hay, peanuts, hogs, turkeys, and cattle (USDA, 2015c).

Developed Land

Developed land in North Carolina tends to be concentrated within major metropolitan areas and surrounding cities, towns, and suburbs Figure 11.1.7-1. Although only nine about percent of North Carolina land is developed, these areas are highly utilized for residential, commercial, industrial, recreational, and government purposes. Table 11.1.7-3 lists the top five developed metropolitan areas within the state and their associated population estimates, and Figure 11.1.7-1 shows where these areas are located within the developed land use category.

Table 11.1.7-3: Top Five Developed Metropolitan Areas, 2014

Metropolitan Area	Population Estimate
Charlotte (NC/SC)	1,180,484
Raleigh	884,891
Winston-Salem	391,024
Durham	347,602
Greensboro	311,810
Total Population of Top Five Metropolitan Areas	**3,115,811**
Total Estimated State Population	**9,943,964**

Source: (U.S. Census Bureau, 2015d)

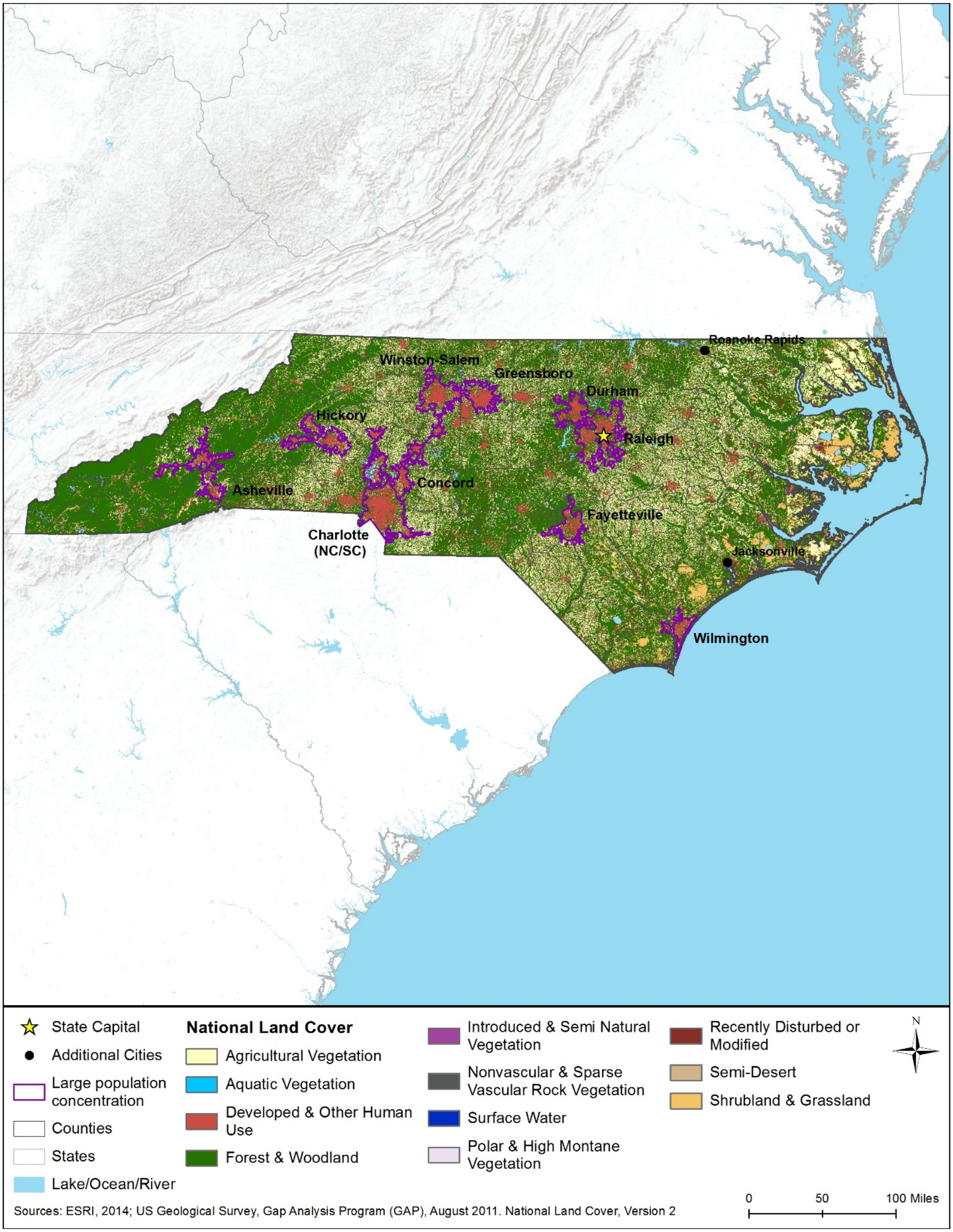


Figure 11.1.7-1: Major Land Use Distribution by Coverage Type

Land Ownership

Land ownership within North Carolina has been classified into four main categories: private, federal, state, and tribal. [87]

Private Land

The majority of land in North Carolina is privately owned, with most of this land falling under the land use categories of agricultural, forest and woodland, and developed (Figure 11.1.7-2). Highly developed, urban, metropolitan areas transition into suburban, agriculture, shrub, and woodland areas, which then transition into more wild and remote areas. Private land exists in all regions of the state,[88] including within the Adirondack and Catskill State Parks.

Federal Land

The federal government manages 3,953 square miles (7.4 percent) of North Carolina land with a variety of land types and uses, including military bases and facilities, National Wildlife Refuges, National Forests, NPS units, recreation areas, and reservoirs. Five federal agencies manage the majority of federal lands throughout the state (Table 11.1.7-3 and Figure 11.1.7-2). There may be other federal lands, but they are not shown on the map due to their small size relative to the entire state. (USGS, 2012d) (USGS, 2014d)

Table 11.1.7-4: Federal Land in North Carolina

Agency	Square Miles	Representative Type
Department of Defense (DoD)	739	Military gases, facilities, ranges; USACE Recreation Areas
USFWS	573	National Wildlife Refuges
U.S. Forest Service (USFS)	1,992	National Forests
NPS [a]	609	National Park, National Heritage Area, National Historic Sites, National Seashores, National Battlefield, National Memorial, and National Military Park
Tennessee Valley Authority (TVA)	40	Reservoirs
Total	**3,953**	**NA**

[a] Additional trails and corridors pass through North Carolina that are part of the National Park System.
Sources: (USGS, 2012d) (USGS, 2014d).

- The DoD owns and manages 739 square miles used for military bases, facilities, and ranges as well as 23 USACE recreation areas, facilities, and flood risk management areas;
- The USFWS owns and manages 573 square miles consisting of 11 NWRs in North Carolina;
- The USFS owns and manages 1,992 square miles consisting of the Nantahala National Forest, Pisgah National Forest, Uwharrie National Forest, and Croatan National Forest;

[87] Land ownership data were retrieved from the Protected Areas Database of the United States (PAD-US), produced by USGS (http://gapanalysis.usgs.gov/padus/). This dataset categorizes lands across the U.S. by conservation, land management, planning, recreation, and ownership, as well as other uses. It is an extensive dataset that contains large quantities of information relevant to the Proposed Action. The data was queried to show Owner and used USGS' PAD-US ownership symbolization for consistency. The PADUS 1.3 geodatabase was downloaded in the summer of 2015, and used consistently throughout all these maps for each state and D.C.
[88] Total acreage of private land could not be obtained for the state.

- The NPS manages 609 square miles consisting of 10 NPS units; and
- The TVA manages 40 square miles consisting of six reservoirs in western North Carolina (Recreation.gov, 2015) (USGS, 2012d) (USGS, 2014d).

State Land[89]

The North Carolina state government owns and manages approximately 1,010 square miles of land, or two percent of the total land in the state. These lands are composed of state parks, recreation areas, natural areas, forests and woodlands, game lands, and lands managed for other purposes (Table 11.1.7-5 and Figure 11.1.7-2).

Table 11.1.7-5: Major Land Uses in North Carolina by Coverage Type

Agency	Square Miles [a]	Type
Division of Parks and Recreation	352	State Parks, State Recreation Areas, State Natural Areas, State Lakes, State Rivers, State Trails
North Carolina Forest Service	82	State Forests
Wildlife Resources Commission and other agencies	576	Game Lands, other purposes

[a] Acres are not additive due to overlapping boundaries of the State Forests, State Parks and Recreation Areas, and Wildlife Management Areas.
Source: (USGS, 2012d) (USGS, 2014d)

The Division of Parks and Recreation manages 352 square miles consisting of 35 State Parks, four State Recreation Areas, 20 State Natural Areas, seven State Lakes, four State Rivers, and four State Trails (North Carolina Division of Parks and Recreation, 2015b);

The North Carolina Forest Service manages 82 square miles consisting of nine State Forests, seven of which are designated Educational State Forests (ESFs) (NCFS, 2015b); and the Wildlife Resources Commission and other agencies manage the remaining 576 square miles as game lands and other purposes.

Tribal Land

The Bureau of Indian Affairs, along with individual American Indian tribes, currently manages 76 square miles, or 0.2 percent of the total land within North Carolina.[90] These lands are composed of one Indian Reservation, the Cherokee Reservation, currently in western North Carolina (USGS, 2012d) (USGS, 2014d). For additional information regarding tribal land, see Section 11.1.11, Cultural Resources.

[89] State land use data for tables and narrative text were derived from specific state sources and may not correspond directly with USGS data that was used for developing maps and figures.
[90] Although the Bureau of Indian Affairs "manages" American Indian lands, the Bureau of Indian Affairs is different than other land management agencies as the lands are held in trust and are sovereign nations.

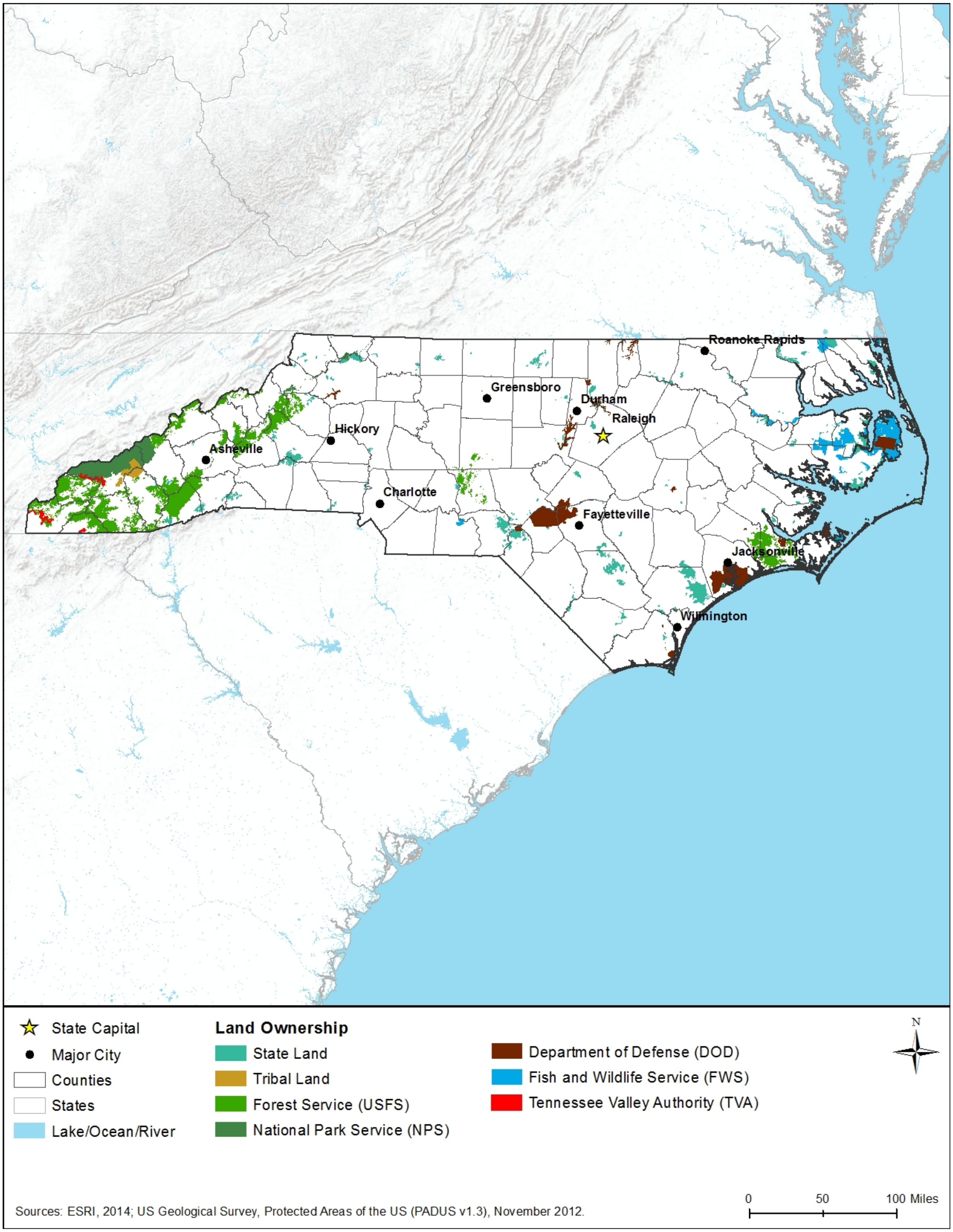


Figure 11.1.7-2: Land Ownership Distribution

11.1.7.4. Recreation

North Carolina's landscape is diverse, with the Appalachian and Blue Ridge Mountains to the west, the Atlantic Ocean to the east, and a piedmont plateau in between. Likewise, population density, affluence, and cultural interests vary widely, too. On the community level, cities and towns provide an assortment of indoor and outdoor recreational facilities including community and recreation centers, theaters, museums, athletic fields and courts, golf courses, multi-use trails, playgrounds, picnicking areas, theme/amusement parks, ski areas and resorts, boat launches, marinas, boardwalks, and beaches. Availability of community-level facilities is typically commensurate to the population's distribution and interests, and the natural resources prominent in the vicinity. North Carolina categorizes its park system into 6 components, with the following number of properties: state parks (35), recreation areas (4), natural areas (20), trails (4), rivers (4), and lakes (7) (NC Division of Parks and Recreation, 2015). North Carolina has strong American Indian, colonial, Revolutionary War, Civil War, and folk culture heritage. There are 27 designated historic sites that provide educational and recreational opportunities (Visit North Carolina, 2015a). The state is well known for its furniture manufacturing, mountain crafts, traditional bluegrass music, the Blue Ridge Parkway, five National Wild and Scenic River sections (National Wild and Scenic Rivers System, 2015f), and two enormous National Seashores. Federally, the NPS, USFS, USFWS, and the USACE manage areas in North Carolina with substantial recreational attributes.

This section discusses key recreational opportunities and activities representative of various regions of North Carolina. The state can be categorized by three distinct recreational regions shown in Figure 11.1.7-3, each of which are presented in the following subsections: Mountain Region, Piedmont Region, and Coast Region.[91] For information on visual resources such as National Scenic Byways and state-designated Byways, see Section 11.1.8, Visual Resources; and for information on culturally/historically significant resources (e.g., National Historic Sites, National Historic Landmarks, sites on the National Register of Historic Places, and Natural Heritage Areas), see Section 11.1.11, Cultural Resources.

[91] Recreational area data was retrieved from the Protected Areas Database of the United States (PAD-US), produced by USGS (http://gapanalysis.usgs.gov/padus/). This dataset categorizes lands across the U.S. by conservation, land management, planning, recreation, and ownership, as well as other uses. It is an extensive data set that contains large quantities of information relevant to the Proposed Action. The data was queried to show the Primary Designation Type of area. To show these in the map, recognizable symbols (e.g., varying shades of green for National Parks and Forests) were used as PAD-US does not have a standard symbolization for recreational resources. The PADUS 1.3 geodatabase was downloaded in the summer of 2015, and used consistently throughout all these maps for each state and D.C.

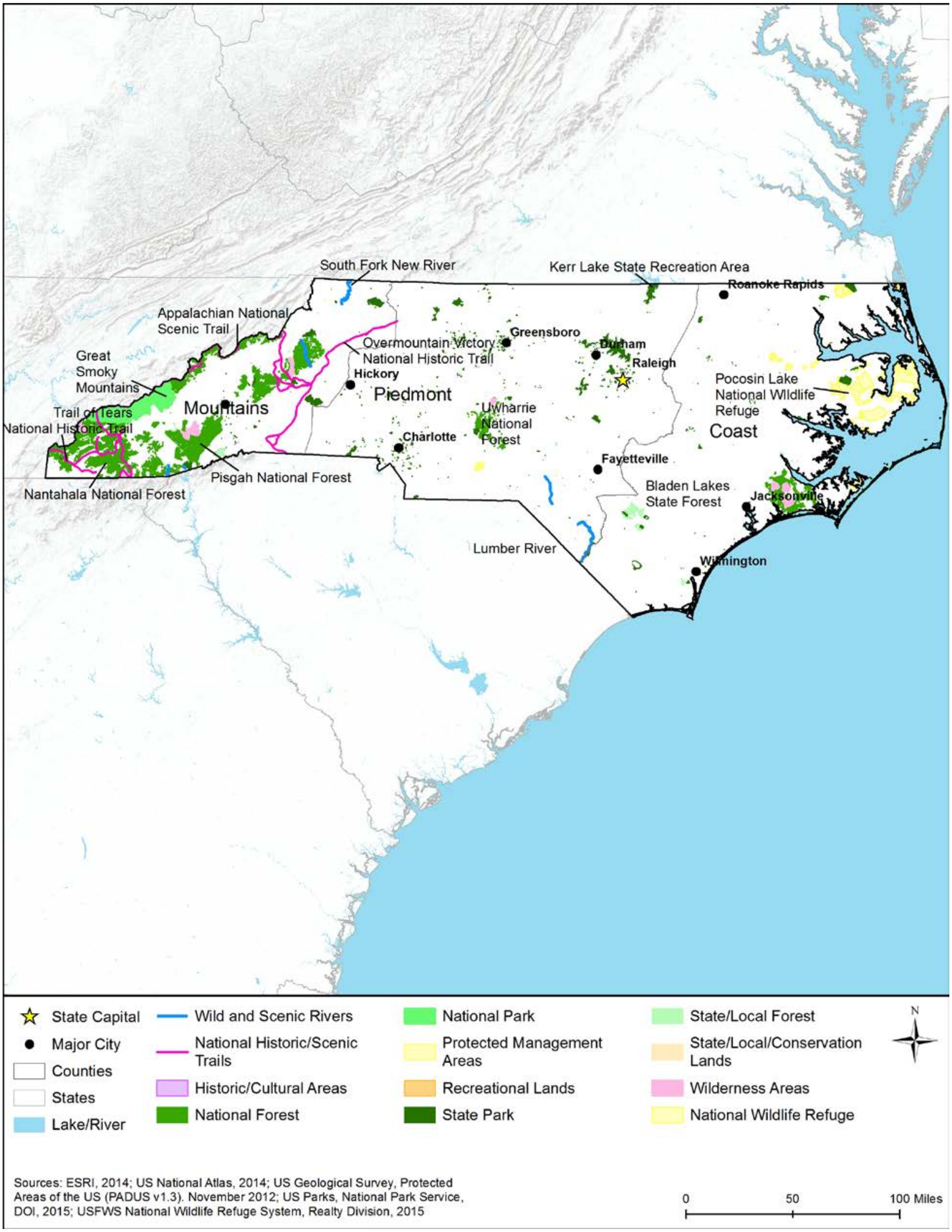


Figure 11.1.7-3: North Carolina Recreation Resources

Mountain Region

The Blue Ridge Mountains are the prominent natural feature of this region, with the Great Smoky Mountains and Tennessee's Cherokee National Forest on the western border. The state's Nantahala National Forest on the south is bordered by Georgia's Chattahoochee National Forest and South Carolina's Sumter National Forest. To the east is the Pisgah National Forest, and to the north is Virginia's Mt. Rogers National Recreation Area. Mountains, forests, streams, rivers and lakes dominate this region's landscape. Outdoor enthusiasts flock to this region for its impressive variety of recreational opportunities including hiking, camping, bicycle, OHV, horse, and snowmobile riding, skiing, swimming, rock climbing, boating, fishing, and hunting.

The Great Smoky Mountains National Park splits its expanse almost equally between North Carolina and Tennessee, and is the most visited National Park in the U.S. (NPS, 2015c). The Blue Ridge National Heritage Area is designated to preserve and present natural, agricultural, Cherokee Indian, historic, craft, and music heritage unique to this region. There are currently over 130 different attractions or destinations for visitors to explore along its "Heritage Trail." (Blue Ridge Natural Heritage Area, 2015) The 469-mile Blue Ridge Parkway is popular to both sightseers and bicyclists (NPS, 2015d), and the Appalachian National Scenic Trail passes through this region. Transylvania County boasts of being the "land of waterfalls" and has a guidebook with 250 cascades for sightseers, picnickers, swimmers, boaters, and anglers to visit (Transylvania County Tourism Development Authority, 2012).

This region is rural with small cities and towns. Asheville is the largest city, with popular attractions being the Biltmore Estate, the French Broad River, its downtown arts and live music districts, and nearby Chimney Rock. Located in the Blue Ridge Mountain "High Country," Boone hosts visitors to four different ski resorts in its vicinity. (Visit North Carolina, 2015b)

Piedmont Region

This region derives its name from the topography in this area that developed as the ancient Appalachian Mountain Range to the west repeatedly rose and eroded, depositing itself in a gentle downhill slope stretching towards the Atlantic coastal plain. The state's largest cities are in the Piedmont Region. Charlotte, is the largest, and has a full urban mix of cultural opportunities such as science centers, museums, galleries, theaters, and ballet, orchestra, and symphony centers. Motorsport racing fans consider this city the heart of NASCAR, and the speedways and NASCAR Hall of Fame cater to them. The U.S. National Whitewater Center is also located here. The Greensboro and Winston-Salem area has similar cultural attractions, and additional ones that highlight Revolutionary and Civil War historical sites, and the area's fame as the country's furniture-making "capital." The Raleigh, Durham, and Chapel Hill metropolis is known for its educational, research, science, and technology institutions. Arts, entertainment, museums, and recreation venues are abundant. The historic tobacco house district has been transformed into a vibrant dining, shopping, and nightlife destination. In the central portion of the Piedmont Region, two communities have specialized in providing singular leisure attractions. Pinehurst chose golfing and Southern Pines has become a renowned equestrian center. (Visit North Carolina, 2015c)

Charlotte and the Raleigh metro area both have large lakes adjacent to their city (Lake Norman, Jordan Lake and Falls Lake) providing plentiful opportunities for residents and visitors to enjoy water-based recreation, picnicking, and camping. The Uwharrie National Forest and the chain of lakes on its western border provide over 51,000 acres for recreational activities (USFS, 2015a).

Coast Region

The Coast region includes the inner coastal plain to the west, Virginia to the north, Atlantic Ocean sounds, bays, and the Outer Banks islands to the east, and South Carolina, the Brunswick Islands, and Wilmington to the south. Farming communities and towns are dominant on the coastal plains providing abundant agritourism opportunities for visitors such as produce markets, craft breweries, and wineries. Revolutionary and Civil War historical sites are also scattered across this region. Bladen County to the south has three rivers, seven lakes, two state parks, and the Bladen Lake State Forest that are heavily visited by residents and tourists. Halifax County to the north has similar water-based recreational opportunities that are centered on Lake Gaston, Roanoke Rapids Lake, and the Roanoke River.

The creeks, tidal rivers, swamps, estuaries, bays, Intercoastal Waterway, Albemarle and Pamlico Sounds, and beaches of this region provide large opportunities for boarding, paddling, sailing, boating, fishing, and hunting. Preserves, reserves, refuges, wetland trails, boardwalks, and canals support birding and wildlife viewing. The Croatan National Forest is unique in being the only authentic coastal forest in the Eastern U.S. (USFS, 2015b). Small towns with especially unique histories that have resulted in popular visitor attractions include Aurora, with its marine fossil museum, Bath's notoriety as the home of the pirate "Blackbeard," and New Bern being the birthplace of Pepsi Cola Kill Devil Hills was where the Wright brothers flew their plane, and Rodanthe was where the U.S. Coast Guard was founded (Visit North Carolina, 2015d).

The Outer Banks area is best known for its Cape Hatteras and Cape Lookout National Seashores. These chains of barrier islands have a combined total of over 125 miles of beaches that are pristine and perfect for walking, seashell searching, sunbathing, swimming, kayaking, canoeing, fishing, crabbing, hunting, lighthouse climbing, and birding. Cape Hatteras also has excellent surf fishing, kiteboarding, and surfing. Cape Lookout islands have additional opportunities for camping and OHV-riding. (NPS, 2015c) The barrier islands that stretch from Nags Head to Currituck are popular for the same type of activities, becoming more remote and less crowded northward. The "Crystal Coast" from Cape Lookout to Emerald Isle and the "Topsail" area to the southeast are also quieter beach destinations along Onslow Bay. North Carolina's "Golf Coast" is in the Brunswick County area, southwest of Wilmington, where there are 35 golf courses and 45 miles of beaches. Wilmington's scenic Riverwalk and easy access to Wrightsville, Carolina, Wilmington, and Kure Beaches makes it a very popular destination for those seeking a full mixture of urban, cultural, performing arts, historical, and natural sites leisure activities. (Visit North Carolina, 2015e)

11.1.7.5. Airspace

The FAA uses the NAS to provide for aviation safety. The NAS includes Special Use Airspace (SUA) consisting of Restricted Areas, Warning Areas, and Military Operation Areas (MOAs).

The FAA controls the use of the NAS with various procedures and practices (such as established flight rules and regulations, airspace management actions, and air traffic control procedures) to ensure the safety of aircraft and protection of the public.

Airspace Categories

There are two categories of airspace or airspace areas:

1. Regulatory airspace consists of controlled airspace (Class A, B, C, D, and E airspace areas in descending order of restrictive operating rules), and restricted and prohibited areas.
2. Non-regulatory airspace consists of MOAs, warning areas, alert areas, and controlled firing areas.

Within each of these two categories, there are four types of airspace: controlled, uncontrolled, special use, and other airspace. The categories and types of airspace are dictated by the complexity or density of aircraft movements, the nature of the operations conducted within the airspace, the level of safety required, and the national and public interest. Figure 11.1.7-4 depicts the different classifications and dimensions for controlled airspace. Air Traffic Control (ATC)[92] service is based on the airspace classification (FAA, 2008).

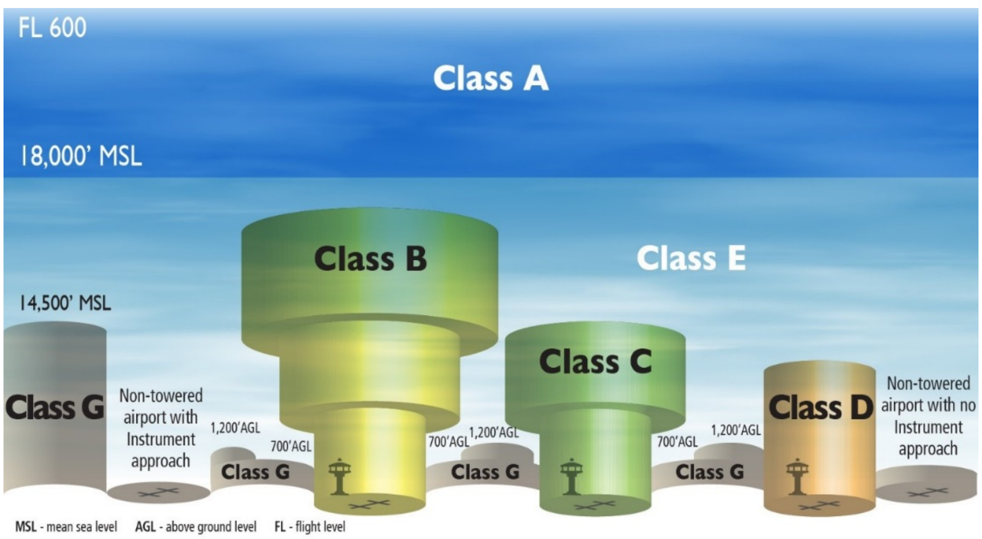


Figure 11.1.7-4: National Air Space Classification Profile

Source: Derived from (FAA, 2008)

Controlled Airspace

- **Class A:** Airspace from 18,000 feet to 60,000 feet Mean Sea Level (MSL)[93]. Includes the airspace over waters off the U.S. coastlines (48 contiguous States and Alaska) within 12

[92] ATC – Approved authority service to provide safe, orderly and expeditious flow of air traffic operations. (FAA, 2015c)

[93] MSL – The average level of for the surface of the ocean; "The height of the surface of the sea midway between the average high and low tides." (Merriam Webster Dictionary, 2015b)

Nautical Miles (NM). All operations must be conducted under Instrument Flight Rules (IFR).[94]

- **Class B:** Airspace from the surface up to 10,000 feet MSL near the busiest airports with heavy traffic operations. The airspace is tailored to the specific airport in several layers. An ATC clearance is required for all aircraft to operate in this area.
- **Class C:** Airspace from the surface to 4,000 feet above the airport elevation surrounding the airport. Applies to airports with an operational control tower, serviced by a radar approach control, and certain number of IFR operations or total number of passengers boarding aircrafts. Airspace is tailored in layers, but usually extends out to 10 NM from 1,200 feet to 4,000 feet above the airport elevation. Entering Class C airspace requires radio contact with the controlling ATC authority, and an ATC clearance is ultimately required for landing.
- **Class D:** Airspace from the surface to 2,500 feet above the airport elevation surrounding airports with an operational control tower. Airspace area is tailored. Aircraft entering the airspace must establish and maintain radio contact with the controlling ATC.
- **Class E:** Controlled airspace not designated as Class A, B, C, or D. Class E airspace extends upward from the surface or a designated altitude to the overlying or adjacent controlled airspace (FAA, 2008).

Uncontrolled Airspace

Class G: No specific definition. Refers generally to airspace not designated as Class A, B, C, D, or E. Class G airspace is from the surface to the base of Class E airspace.

Special Use Airspace

SUA designates specific airspace that confines or imposes limitations on aircraft activities (see Table 11.1.7-6).

Table 11.1.7-6: SUA Designations

SUA Type	Definition
Prohibited Areas	"Airspace of defined dimensions identified by an area on the surface of the earth within which the flight of aircraft is prohibited. Such areas are established for security or other reasons associated with the national welfare. These areas are published in the Federal Register and are depicted on aeronautical charts."
Restricted Areas	"Airspace identified by an area on the surface of the earth within which the flight of aircraft, while not wholly prohibited, is subject to restrictions. Activities within these areas must be confined because of their nature or limitations imposed upon aircraft operations that are not a part of those activities or both. Restricted areas denote the existence of unusual, often invisible, hazards to aircraft such as artillery firing, aerial gunnery, or guided missiles. Penetration of restricted areas without authorization from the using or controlling agency may be extremely hazardous to the aircraft and its occupants. Restricted areas are published in the Federal Register and constitute 14 CFR Part 73."

[94] IFR – Rules for the conduct of flights under instrument meteorological conditions. (FAA, 2015f)

SUA Type	Definition
Warning Areas	"Airspace of defined dimensions, extending from three NM from the U.S. coast, which contains activity that may be hazardous to nonparticipating aircraft. The purpose of such warning areas is to warn non-participating pilots of the potential danger. A warning area may be located over domestic or international waters or both."
MOAs	"Airspace of defined vertical and lateral limits established for separating certain military activities (e.g., air combat maneuvers, air intercepts, testing, etc.) from IFR traffic. Whenever an MOA is in use, non-participating IFR traffic may be cleared through a MOA if IFR separation can be provided by ATC. Otherwise, ATC will reroute or restrict nonparticipating IFR traffic."
Alert Areas	"Depicted on aeronautical charts to inform non-participating pilots of areas that may contain a high volume of pilot training or an unusual type of aerial activity. Pilots should be particularly alert when flying in these areas. All activity within an alert area must be conducted in accordance with CFRs, without waiver, and pilots of participating aircraft and pilots transiting the area are responsible for collision avoidance."
Controlled Firing Areas (CFAs)	"Activities that, if not conducted in a controlled environment, could be hazardous to nonparticipating aircraft. The distinguishing feature of the CFA, as compared to other special use airspace, is that its activities are suspended immediately when spotter aircraft, radar, or ground lookout positions indicate an aircraft might be approaching the area. There is no need to chart CFAs since they do not cause a nonparticipating aircraft to change its flight path."
National Security Areas (NSA)	"Airspace of defined vertical and lateral dimensions established at locations where there is a requirement for increased security and safety of ground facilities. Pilots are requested to voluntarily avoid flying through the depicted NSA. When it is necessary to provide a greater level of security and safety, flight in NSAs may be temporarily prohibited by regulation under the provisions of 14 CFR Section 99.7. Regulatory prohibitions are issued by System Operations, System Operations Airspace and Aeronautical Information Manual Office, Airspace and Rules, and disseminated via Notices to Airmen (NOTAM). Inquiries about NSAs should be directed to Airspace and Rules."

Source: (FAA, 2015c) (FAA, 2008)

Other Airspace Areas

Other airspace areas, explained in Table 11.1.7-7, include Airport Advisory, Military Training Routes (MTRs), Temporary Flight Restrictions (TFRs), Parachute Jump Aircraft Operations, published Visual Flight Rules (VFR) and IFRs, and Terminal Radar Service Areas.

Table 11.1.7-7: Other Airspace Designations

Type	Definition
Airport Advisory	There are three types: • Local Airport Advisory – Operated within 10 statute miles (5,280 feet/mile) of an airport where there is a Flight Service Station (FSS) located on an airport, but no operational control tower. The FSS advises the arriving and departing aircraft on particular conditions. • Remote Airport Advisory – Operated within 10 statute miles for specific high activity airports with no operational control tower. • Remote Airport Information Service – Used for short-term special events.
MTRs	MTRs are for use by the military for training, specifically low level combat tactics where low altitudes and high speed are needed.

Type	Definition
TFRs	TFRs are established to: • Protect people and property from a hazard; • Provide safety for disaster relief aircraft during operations; • Avoid unsafe aircraft congestion associated with an incident or public interest event; • Protect the U.S. President, Vice President, and other public figures; • Provide safety for space operations; and • Protect in the state of Hawaii declared national disasters for humanitarian reasons. Only those TFRs annotated with an ending date and time of "permanent" are included in this Draft PEIS, since it indicates a longer, standing condition of the airspace. Other TFRs are typically a shorter duration of for a one-time specific event.
Parachute Jump Aircraft Operations	Parachute jump area procedures are in 14 CFR Part 105, while the U.S. parachute jump areas are contained in the regional Airport/Facility Directory.
Published VFRs and IRs	These are established routes for moving around and through complex airspace, like Class B airspace. VFRs are procedures used to conduct flights under visual conditions. IFRs are procedures used to conduct flights with instruments and meteorological conditions.
Terminal Radar Service Areas	Airspace areas that are not one of the established U.S. airspace classes. These areas provide additional radar services to pilots.

Source: (FAA, 2015c) (FAA, 2008)

Aerial System Considerations

Unmanned Aerial Systems

Unmanned Aerial Systems (UASs) are widely used by the military, private entities, public service, educational institutions, federal/state/local governments, and other agencies. The FAA's Unmanned Aircraft Systems Integration Office integrates UAS into the NAS. The *Integration of Civil Unmanned Aircraft Systems (UAS) in the National Airspace System (NAS) Roadmap of 2013* addresses the actions and considerations needed to integrate UAS into the NAS "without reducing existing capacity, decreasing safety, negatively impacting current operators, or increasing the risk to airspace users or persons and property on the ground any more than the integration of comparable new and novel technologies" (FAA, 2013).

UAS at airports is a complex operational challenge with the need to separate UAS flight operations from mainstream air traffic. Separation can be achieved with specific UAS launch windows, special airports, or off-airport locations that allow the UAS to easily launch and recover. Special aviation procedures are applied to UAS flights. There must be the capability of Sense and Avoid (SAA) and Control and Communication (C2) during UAS operations. An Unmanned Aircraft (UA) must be able to see (or sense) other aircraft in the area and avoid the aircraft through corrected flight path changes. General equipment and operational requirements can include aircraft anti-collision lights, an altitude encoding transponder, cameras, sensors, and collision avoidance maneuvers. The C2 of the UA occurs with the pilot/operator, the UAS control station, and ATC. Research efforts, a component of the FAA's UAS roadmap, continue to mature the technology for both SAA and C2 capabilities.

Balloons

Moored balloons and unmanned free balloons cannot be operated in a prohibited or restricted area unless approval is obtained from the controlling agency. Balloons also cannot be operated if they pose a hazard to people and their property.

Obstructions to Airspace Considerations

The Airports Division of the FAA is responsible for the evaluation and analysis of proposed construction or alterations on airports. The FAA Air Traffic Office is responsible for determining obstructions to air navigation because of construction off airports that may affect the safe and efficient use of navigable airspace and the operation of planned or existing air navigation and communication facilities. Such facilities include air navigation aids, communication equipment, airports, federal airways, instrument approach or departure procedures, and approved off-airway routes. An Obstruction Evaluation and Airport Airspace Analysis (OE/AAA) is required when there is the potential for airport construction/alteration of a facility that may impinge upon the NAS. Per 14 CFR Part 77.9, the FAA is to be notified about construction or alterations when:

- "Any construction or alteration exceeding 200 ft. above ground level
- Any construction or alteration:
  - within 20,000 ft. of a public use or military airport which exceeds a 100:1 surface from any point on the runway of each airport with its longest runway more than 3,200 ft.
  - within 10,000 ft. of a public use or military airport which exceeds a 50:1 surface from any point on the runway of each airport with its longest runway no more than 3,200 ft.
  - within 5,000 ft. of a public use heliport which exceeds a 25:1 surface
- Any highway, railroad, or other traverse way whose prescribed adjusted height would exceed the above noted standards
- When requested by the FAA
- Any construction or alteration located on a public use airport or heliport regardless of height or location" (FAA, 2015d).

Construction or alternative facilities (such as towers) that are subject to FCC licensing requirements are also required to have an OE/AAA performed by the FAA Airport Division.

North Carolina Airspace

The North Carolina Aviation Division is a component of the NCDOT. The Division is responsible "for all aviation functions regarding state system planning, airport and aviation system development. It also provides funding to communities for constructing and improving airports throughout the state" (NCDOT, 2015b). There are two FAA FSDOs for North Carolina in Charlotte and Greensboro (FAA, 2015b).

North Carolina airports are classified as those included in the State Aviation System Plan (SASP) and those that are not part of the SASP. The SASP addresses the strategic planning and future development for the State's airport system, as well as addressing key associated with their airports (NASAO, 2015). Figure 11.1.7-5 presents the different aviation airports/facilities residing in North Carolina, while Figure 11.1.7-6 and Figure 11.1.7-7 present the breakout by public and private airports/facilities. There are approximately 463 airports/facilities within North Carolina as presented in Table 11.1.7-8, Figure 11.1.7-6, and Figure 11.1.7-7 (USDOT, 2015).

Table 11.1.7-8: Type and Number of North Carolina Airports/Facilities

Type of Airport or Facility	Public	Private
Airport	109	236
Heliport	3	108
Seaplane	0	1
Ultralight	0	4
Balloonport	0	1
Gliderport	0	1
Total	**112**	**351**

Source: (USDOT, 2015)

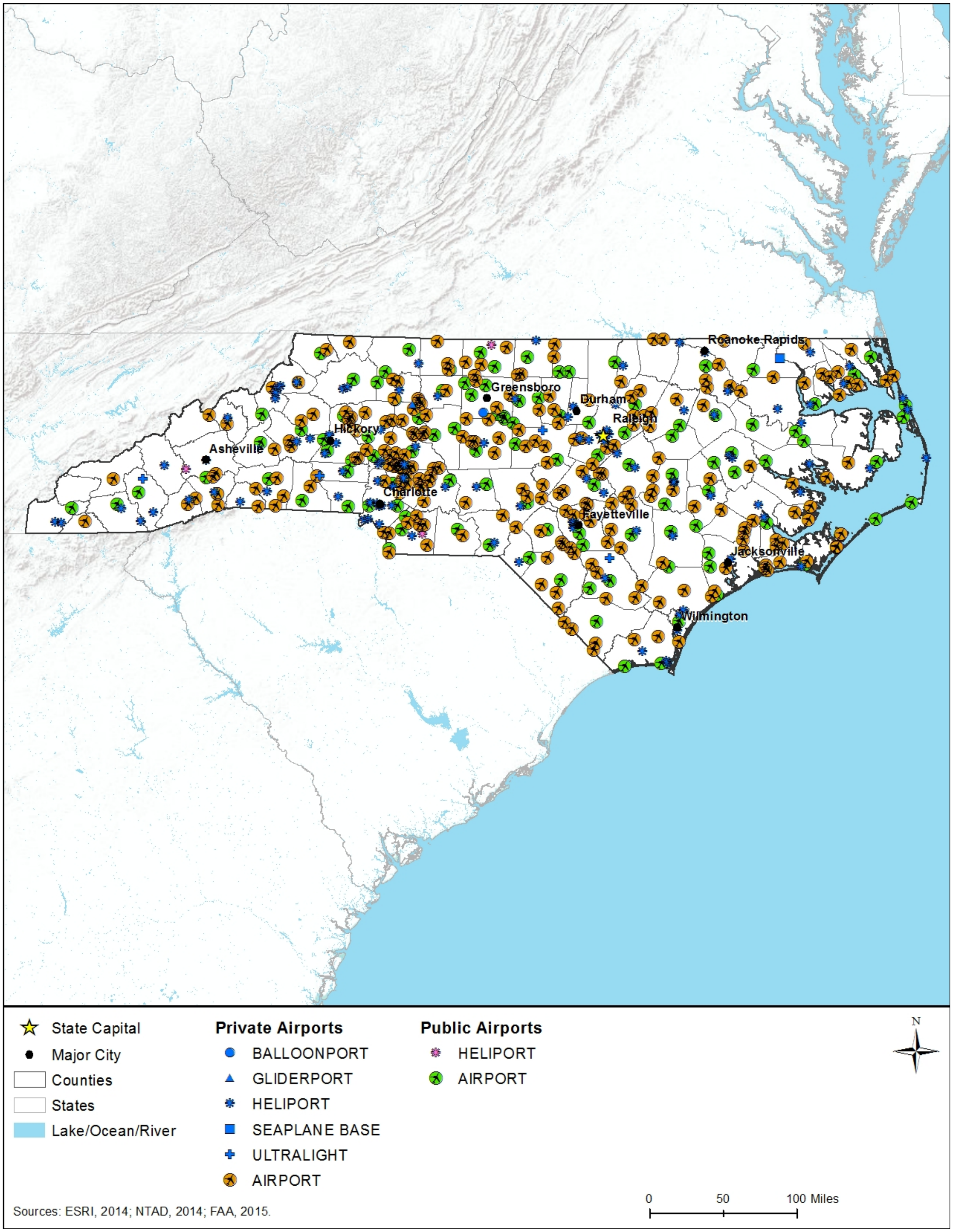


Figure 11.1.7-5: Composite of North Carolina Airports/Facilities

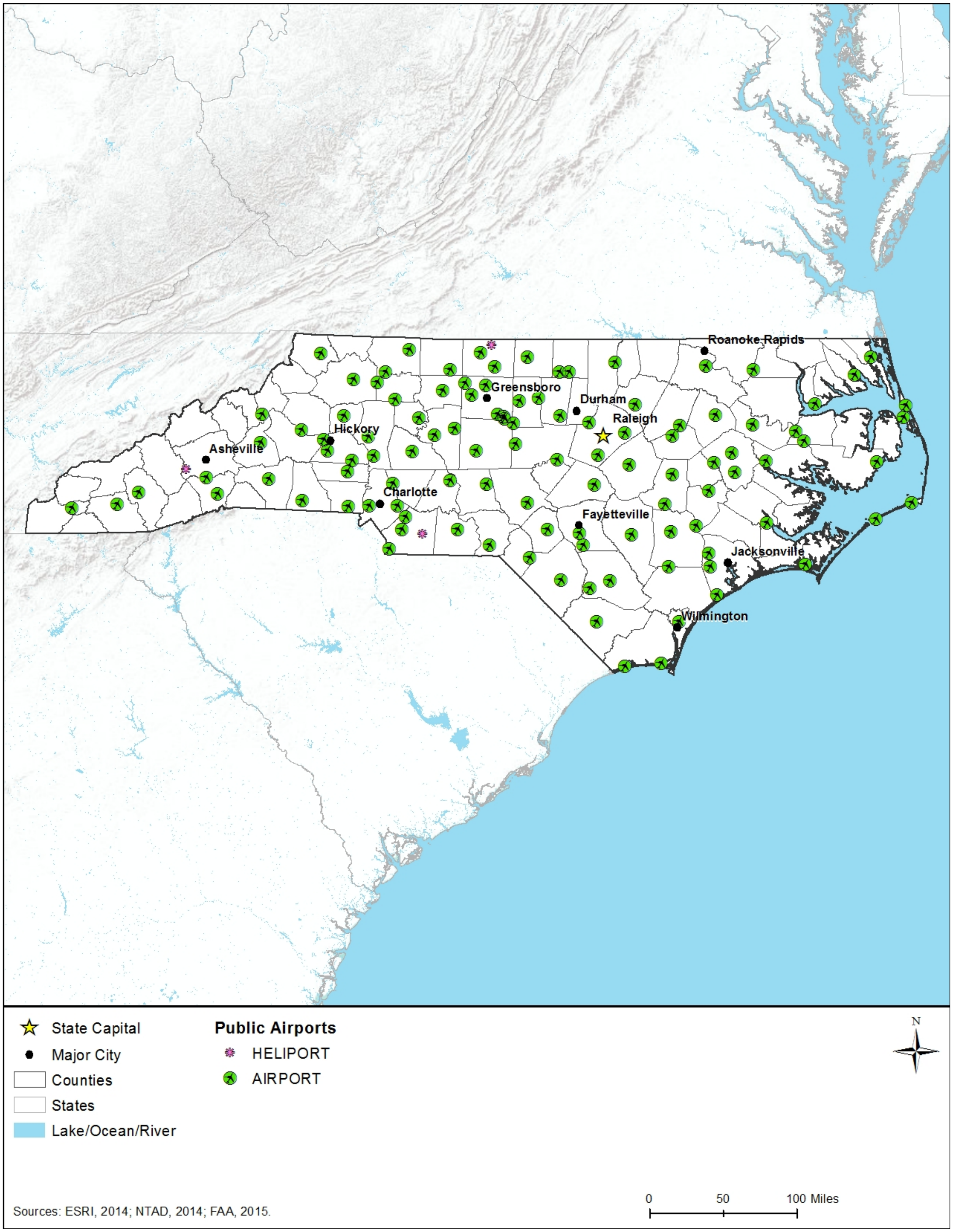


Figure 11.1.7-6: Public North Carolina Airports/Facilities

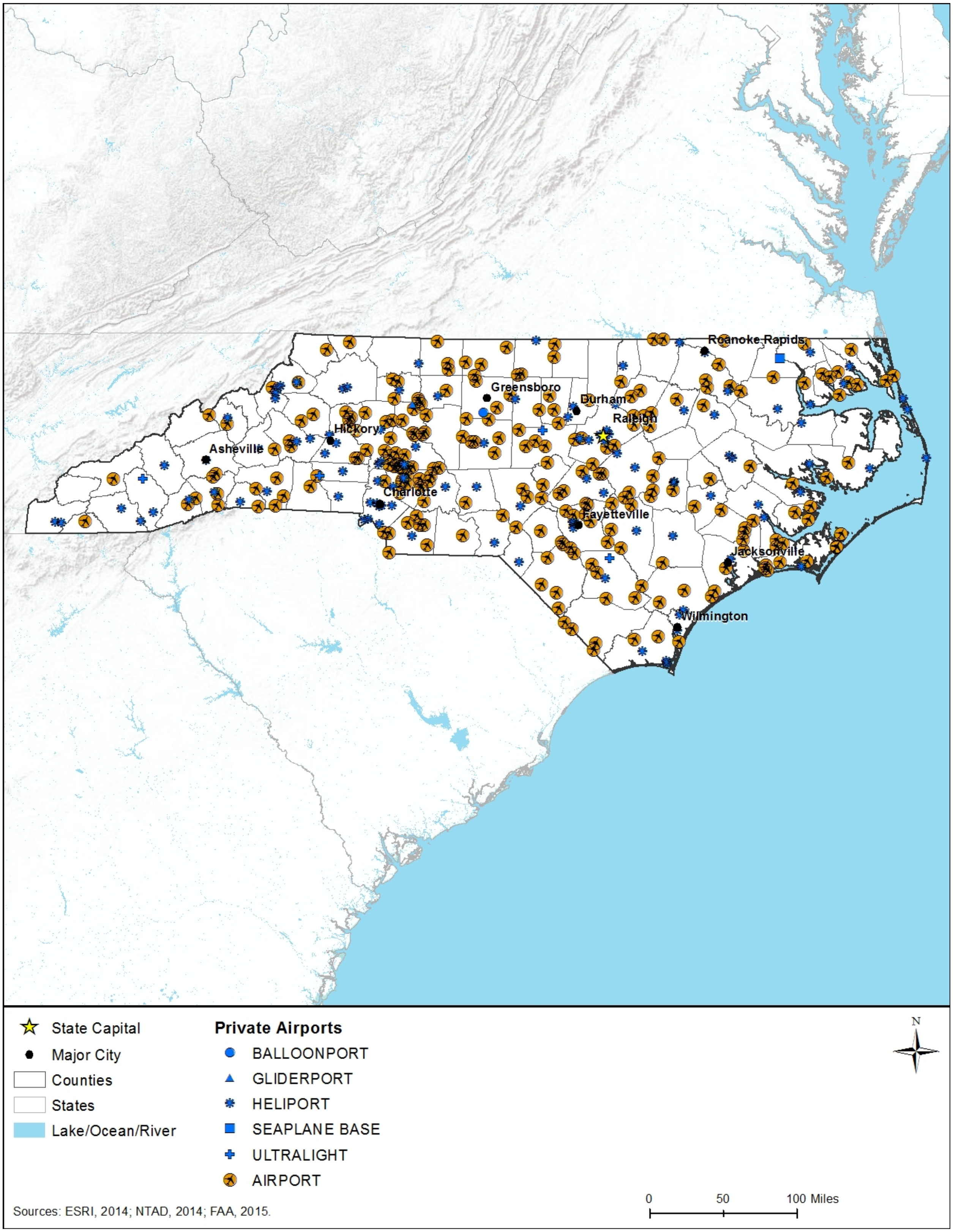


Figure 11.1.7-7: Private North Carolina Airports/Facilities

There are Class B, Class C, and Class D controlled airports for North Carolina as follows:

One Class B –

- Charlotte/Douglas International, Charlotte.

Five Class C

- Asheville Regional, Asheville;
- Fayetteville Regional/Grannis Field, Fayetteville;
- Piedmont Triad International, Greensboro;
- Pope Army Airfield, Fayetteville; and
- Raleigh-Durham International.

Fifteen Class D

- Stanly County, Albemarle;
- Bogue Field Marine Corps Auxiliary Landing Field, Bogue;
- Cherry Point Marine Corps Air Station (MCAS), Cherry Point;
- Concord Regional, Concord;
- Elizabeth City Coast Guard Air Station/Regional, Elizabeth City;
- Seymour Johnson Air Force Base, Goldsboro;
- Hickory Regional, Hickory;
- Jacksonville, New River MCAS, Jacksonville;
- Kinston Regional Jetport at Stallings Field, Kinston;
- Mackall Army Airfield (AAF), Camp Mackall;
- Craven County Regional Airport, New Bern;
- Marine Corps Outlying Landing Facility Airport, Oak Grove;
- Simmons AAF, Fort Bragg;
- Wilmington, New Hanover International, Wilmington; and
- Winston-Salem, Smith Reynolds, Winston-Salem.

SUAs (i.e., 29 restricted areas, 14 MOAs, 2 two alert areas) located in North Carolina are:

Albemarle Sound (Restricted)

- R-5301 - Surface to 14,000 feet MSL;
- Harvey Point (Restricted);
- R-5302A Harvey Point, NC – Surface to 14,000 feet MSL;
- R-5302B Harvey Point, NC –100 feet Above Ground Level (AGL) to 14,000 feet MSL; and
- R-5302C Harvey Point, NC –100 feet AGL to 3,000 feet MSL.

Camp Lejeune (Restricted)

- R-5303A – Surface to, but not including, 7,000 feet MSL; Excluding the airspace 1,500 feet AGL and below within a three NM radius of Sky Manor airport;
- R-5303B – 7,000 feet MSL to, but not including, 10,000 feet MSL;
- R-5303C – 10,000 feet MSL to, but not including, FL 180;
- R-5304A – Surface to, but not including, 7,000 feet MSL; Excluding the airspace 1,500 feet AGL and below within a three NM radius of Holly Ridge airport;
- R-5304B – 7,000 feet MSL to, but not including, 10,000 feet MSL;
- R-5304C – 10,000 feet MSL to, but not including, FL180;

Cherry Point (Restricted)
- R-5306A – Surface to, but not including, FL 180;
- R-5306C – From 1,200 feet MSL to, but not including, FL 180;
- R-5306D – Surface to, but not including, FL 180; and
- R-5306E – Surface to, but not including, FL 180.

Fort Bragg (Restricted)
- R-5311A – Surface to but not including, 7,000 feet MSL;
- R-5311B – From 7,000 feet MSL to, but not including, 12,000 feet MSL; and
- R-5311C – From 12,000 feet MSL but, not including, FL 290.

Long Shoal Point (Restricted)
- R-5313A – Surface to 18,000 feet MSL;
- R-5313B – 100 feet AGL to 13,000 feet MSL;
- R-5313C – 100 feet AGL to 13,000 feet MSL; and
- R-5313D – 500 feet AGL to 13,000 feet MSL.

Dare County (Restricted)
- R-5314A – Surface to FL 205;
- R-5314B – 500 feet above the surface to FL 205;
- R-5314C – 200 feet above the surface to 15,000 feet MSL;
- R-5314D – Surface to FL 205;
- R-5314E – 500 feet above the surface to FL 205;
- R-5314F – 200 feet above the surface to 15,000 feet MSL;
- R-5314H – 500 feet above the surface to 10,000 feet MSL; and
- R-5314J – 1,000 feet above the surface to 6,000 feet MSL.

The fourteen MOAs for North Carolina are as follows:

Core – 3,000 feet MSL up to, but not including, FL 180.

Fort Bragg –
- North Area A MOA – 500 feet AGL to and including 6,000 feet MSL;
- North Area B MOA – 4,000 feet MSL to and including 6,000 feet MSL;
- South Area A MOA – 500 feet AGL to and including 6,000 feet MSL; and
- South Area B MOA – 1,500 feet AGL to and including 6,000 feet MSL.

Gamecock A – 7,000 feet MSL to, but not including, FL 180.

Hatteras F – 3,000 feet to 13,000 feet MSL.

Pamlico –
- A – 8,000 feet MSL to, but not including, FL 180; and
- B – 8,000 feet MSL to, but not including, FL 180.

Phelps –
- A – 6,000 feet MSL to, but not including, FL 180;
- B – 10,000 feet MSL to, but not including, FL 180; and
- C – 15,000 feet MSL to, but not including, FL 180.

Seymour Johnson –
- Echo – 7,000 feet MSL to, but not including, FL 180.

Stumpy Point – Surface to, but not including, 8,000feet MSL

The two Alert Areas for North Carolina are as follows:

- Cherry Point –
  - A-530 – Surface to, but not including, FL180.
- Albemarle –
  - A-531 – 200 feet AGL to 1,500 feet AGL.

The Snowbird MOA (11,000 feet MSL to, but not including, FL 180) of Tennessee extends into the southwestern portion of North Carolina (west of Asheville). The SUAs for North Carolina are presented in Figure 11.1.7-8. There are no TFRs (see Figure 11.1.7-8) (FAA, 2015e). MTRs in North Carolina, presented in Figure 11.1.7-9, consist of 29 Visual Routes, 19 Instrument Routes, and 5 Slow Routes.

UAS Considerations

The NPS signed a policy memorandum on June 24, 2014 that "directs superintendents nationwide to prohibit launching, landing, or operating unmanned aircraft on lands or waters administered by the National Park Service" (NPS, 2014a). There are 10 national park units in North Carolina that have to comply with this agency directive (NPS, 2014b).

Obstructions to Airspace Considerations

Chapter 63 – Aeronautics, Article 4 – Model Airport Zoning Act of the North Carolina General Statutes regulates airspace hazard considerations (North Carolina Secretary of State, 2015). As defined in §63-30, an airport hazard "endangers the lives and property of users of the airport and of occupants of land in its vicinity, and also, if of the obstruction type, in effect reduces the size of the area available for the landing, taking off and maneuvering of aircraft, thus tending to destroy or impair the utility of the airport and the public investment therein, and is therefore not in the interest of the public health, public safety, or general welfare. (North Carolina Secretary of State, 2015)" Chapter 4-§63-32, Permits, new structures, etc., and variances, provides the authority to regulate structures, as it obtains to potential impacts to navigable airspace.

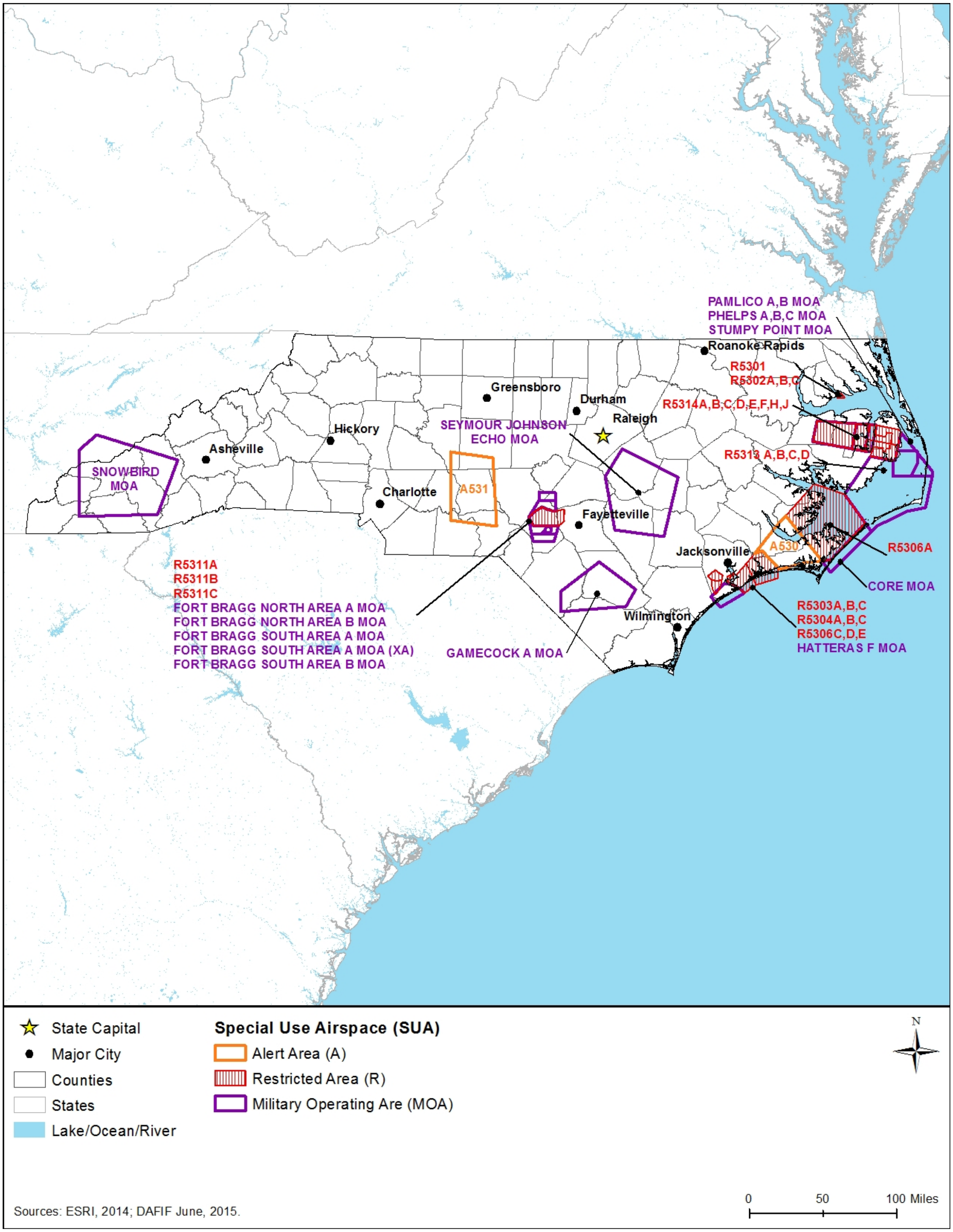


Figure 11.1.7-8: SUAs in North Carolina

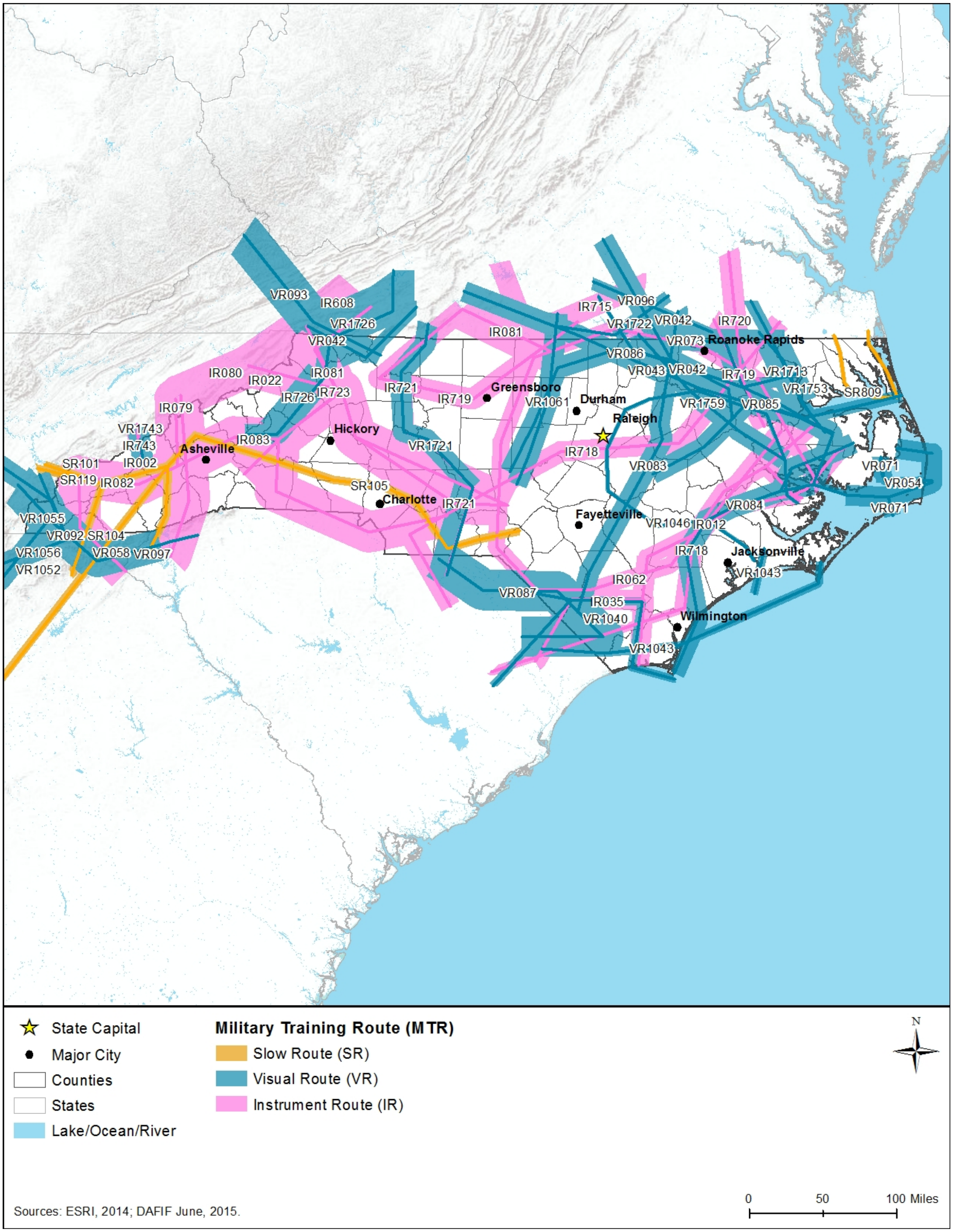


Figure 11.1.7-9: MTRs in North Carolina

11.1.8. Visual Resources

11.1.8.1. Definition of the Resource

Visual resources influence the human experience of a landscape. Various aspects combine to create visual resources, such as color, contrast, texture, line, and form. Features such as mountain ranges, city skylines, ocean views, unique geological formations, rivers, and constructed landmarks such as bridges, memorials, cultural resources, or statues are considered visual resources. For some, cityscapes are valued visual resources; for others, views of natural areas are valued visual resources. While many aspects of visual resources are subjective, evaluating potential impacts on the character and continuity of the landscape is a consideration when evaluating proposed actions for NEPA and National Historic Preservation Act (NHPA) compliance. The federal government does not have a single definition of what constitutes a visual resource; therefore, this PEIS will use the general definition of visual resources used by the Bureau of Land Management (BLM), "the visible physical features on a landscape (e.g., land, water, vegetation, animals, structures, and other features)" (BLM, 1984).

11.1.8.2. Specific Regulatory Considerations

Table 11.1.8-1 presents state and local laws and regulations that relate to visual resources.

Table 11.1.8-1: Relevant North Carolina Visual Resources Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
§ 113A-1. North Carolina Environmental Policy Act of 1971	NCDEQ	"….encourage the wise, productive, and beneficial use of the natural resources of the State without damage to the environment, maintain a healthy and pleasant environment, and preserve the natural beauty of the State…" (North Carolina General Assembly, 1971a)
§ 113A-30. Natural and Scenic Rivers Act of 1971	NCDEQ	"…retaining the natural and scenic conditions in some of the State's valuable rivers by maintaining them in a free-flowing state and to protect their water quality and adjacent lands by retaining these natural and scenic conditions." (North Carolina General Assembly, 1971b)
§ 136-122. Preservation, etc., of Scenic Beauty of Areas along Highways	NCDOT	"Department of Transportation may acquire the fee or any lesser interest or right in real property in order to restore, preserve, and enhance natural or scenic beauty of areas traversed by the highways of the State highway system." (North Carolina General Assembly, 1977)
§ 113A-90. Scenic easements within right-of-way	North Carolina Department of Administration (NCDOA)	"North Carolina Department of Administration may acquire, on behalf of the State of North Carolina, lands in fee title, or interest in land in the form of scenic easements, cooperative agreements, easements of surface ingress and egress running with the land, leases, or less than fee estates." (North Carolina General Assembly, 1973)

In addition to the state laws and regulations, local zoning laws may apply related to visual resources. Viewsheds and scenic vistas are increasingly important to the state's towns and cities as they look at the future planning of their municipalities.

11.1.8.3. Character and Visual Quality of the Existing Landscape

North Carolina is a classic eastern state with the Appalachian/Blue Ridge Mountains on the west, gradually sloping east to rolling, forested foothills, down to coastal plains and beaches along the Atlantic Ocean. On the coast, there are long, sandy beaches, quaint harbor towns, historic lighthouses, swamps, and the outer banks where the Wright Brothers first took flight. The central Piedmont region is the most populated landscape with several of the state's major cities (i.e., Raleigh, Durham, and Greensboro); however, this region also is rich in historic battlefields, deciduous forests, farmlands, vineyards, and rolling hills. To the west within the Appalachian Mountain chain are the Blue Ridge and Smoky Mountains and the Smoky Mountain National Park with peaks above 6,600 feet. This area contains scenic vistas, cascading streams, lush forests, and historic homesteads.

One aspect of importance for visual resources is to maintain the character of the area. For example, in a farm community, keeping the character of the town consistent with farm-style houses, barns, and silos would be key in maintaining the character of the community. In a more metropolitan area, there may be many different visual styles within each neighborhood, but keeping the character of the neighborhood is important to maintain if new development were to occur. Section 11.1.7, Land Use, Recreation, and Airspace discusses land use and contains further descriptions of land cover within the state.

North Carolina has considered the management and protection of scenic resources in many of their land use and planning policies (Table 11.1.8-1). While the state and many municipalities have some regulation of scenic and visual resources, not all scenic areas within the state have been identified or have policy or regulations for management or protection by the state. The areas listed below have some measure of management, significance, or protection through state or federal policy, as well as being identified as a visually significant area.

11.1.8.4. Visually Important Historic Properties and Cultural Resources

Visual and aesthetic qualities of historic properties can contribute to the overall importance of a particular site. Such qualities relate to the integrity of the appearance and setting of these properties or resources. Viewsheds (the natural and manmade environment visible from one or more viewing points) can also contribute to the significance of historic properties or cultural resources (NASA, 2013). Viewsheds containing historic properties and cultural resources may be considered important because of their presence in the landscape.

The Secretary of the Interior's Standards for the Treatment of Historic Properties addresses four aspects: preservation, rehabilitation, restoration, and reconstruction, whereas The Guidelines for the Treatment of Cultural Landscapes, both authored by the NPS, provides guidance for applying protections to all aspects of the historic and cultural landscape, such as forests, gardens, trails, structures, ponds, and farming areas, to meet the Standards (NPS 1995). The Standards "require retention of the greatest amount of historic fabric, including the landscape's historic form, features, and details as they have evolved over time," which directly protects historic properties and the visual resources therein (NPS 1995).

The National Register of Historic Places (NRHP) includes areas that may be considered visually sensitive. In North Carolina, there are 2,880 NRHP listed sites, which include 38 National Historic Landmarks, 1 National Battlefield, 1 National Military Park, 2 National Historic Sites, and 1 National Memorial (NPS, 2015e) (see Figure 11.1.8-2). Some state historic sites, state heritage areas, and state historic districts may also be included in the NRHP, whereas others are not designated at this time.

World Heritage Sites

Sites are designated World Heritage sites if they reflect "the world's cultural and natural diversity of outstanding universal value" (UNESCO, 2015a). To be included on the World Heritage List, sites must meet 1 of 10 criteria reflecting cultural, natural, or artistic significance (UNESCO, 2015b). World Heritage sites are diverse and range from archaeological remains, national parks, islands, buildings, city centers, and cities. The importance of World Heritage-designated properties can be attributed to cultural or natural qualities that may be considered visual resources or are visually sensitive at these sites. In North Carolina, the Great Smoky Mountains National Park is a designated natural World Heritage site (UNESCO, 2015a).

Figure 11.1.8-1: Autumn in the Great Smoky Mountains National Park

Source: (NPS, 2015g)

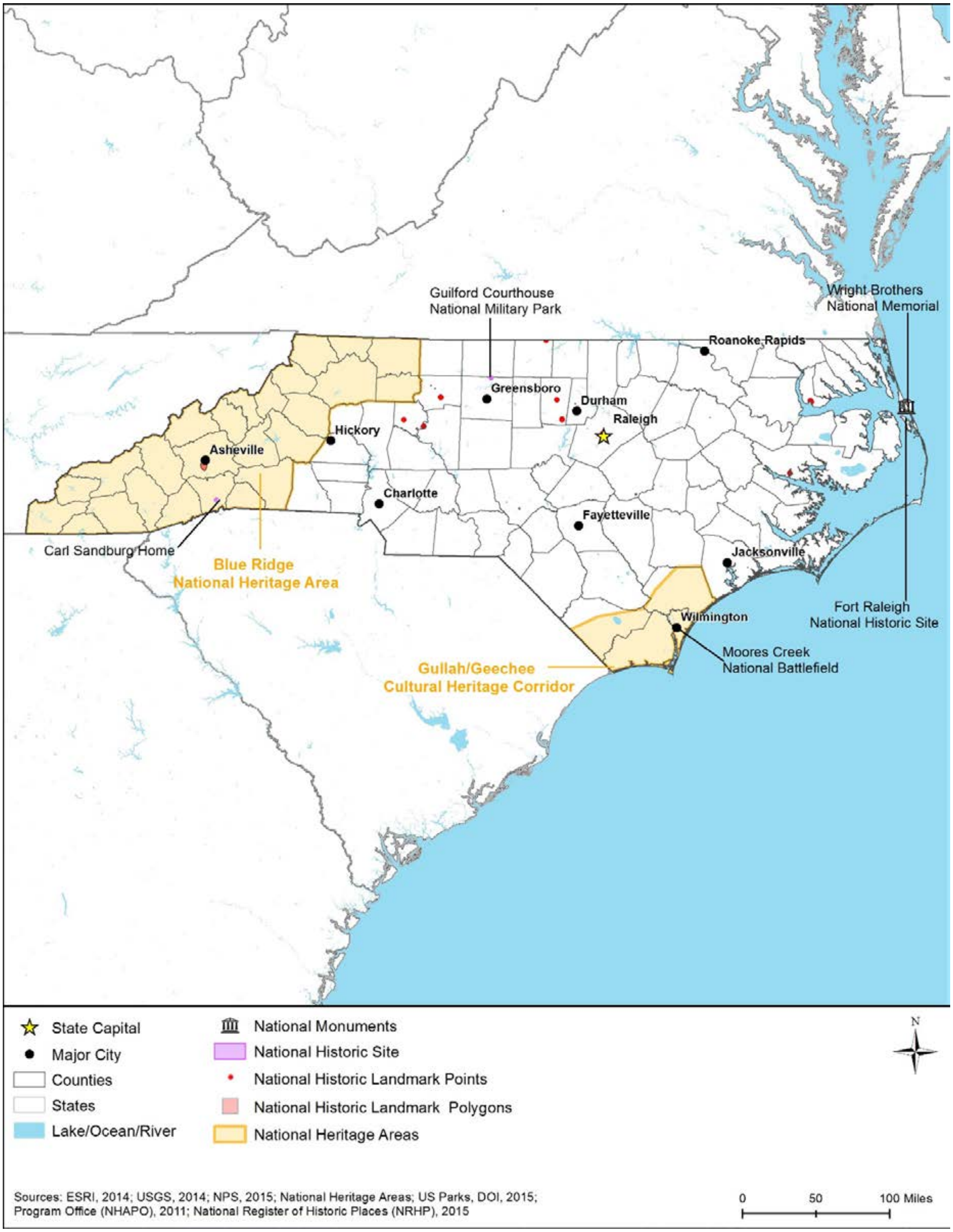


Figure 11.1.8-2: Representative Sample of Some Historic and Cultural Resources that May be Visually Sensitive

National Historic Landmarks

National Historic Landmarks (NHLs) are defined as "nationally significant historic places designated by the U.S. Secretary of the Interior because they possess exceptional value or quality in illustrating or interpreting the heritage of the United States" (NPS, 2015h). In North Carolina, NHLs may include "historic buildings such as residences, churches, taverns, and institutional buildings." (NPS, 2016b). Other types of historic properties include forts, battlefields, historic districts, and plantations. The importance of NHL-designated properties can be attributed to scenic or aesthetic qualities, among other attributes, that may be considered visual resources or visually sensitive at these sites. The scenic and visual resources of these landmarks and surrounding areas are managed for consistency with the historic resource and aesthetics of the landscape. There are 38 NHLs in North Carolina, which include a variety of historic structures and historic locations. By comparison, there are over 2,500 NHLs in the United States (NPS 2015b). Figure 11.1.8-1 provides a representative sample of some historic and cultural resources that may be visually sensitive.

The following sites have been designated as NHLs in North Carolina:

- Bentonville Battlefield
- Bethabara
- Bethania Historic District
- Biltmore Estate
- Blackwell, W.T., and Company Tobacco Factory
- Blandwood
- Cape Hatteras Light Station
- Chowan County Courthouse
- Christ Episcopal Church
- Connemara, The Carl Sandburg Farm
- Cooleemee
- Coolmore
- Cupola House
- Daniels, Josephus, House
- Duke Homestead and Tobacco Factory
- Fort Fisher
- Guilford Court House Battlefield
- Hardaway Site
- Hayes Plantation
- Helper, Hinton Rowan, House
- Market House
- Monitor
- Nash-Hooper House
- North Carolina (USS)
- North Carolina Mutual Life Insurance
- Old East
- Old Salem Historic District
- Palmer-Marsh House
- Pinehurst Historic District
- Playmakers Theatre
- Reed Gold Mine.
- Salem Tavern
- Single Brothers' House
- State Capitol
- Town Creek Indian Mound
- Union Tavern
- Wolfe, Thomas, House
- Wright Brothers National Memorial Visitor Center

Source: (NPS, 2015e)

National Historic Sites

There are two National Historic Sites in North Carolina, Fort Raleigh, and the Carl Sandburg Home. Fort Raleigh covers 355.45 acres on Roanoke Island, along the Cape Hatteras National Seashore, and offers views of the Albemarle Sound, miles of shoreline, and the historic fort (NPS, 2015i). The Carl Sandburg Home is located within 267 acres of forest, pastures, and gardens. Visual resources include about 200 acres of forest, rock outcrops, ponds, the historic home and other farm buildings onsite (NPS, 2015h).

National Heritage Areas

National Heritage Areas (NHA) are “places where natural, cultural, and historic resources combine to form a cohesive, nationally important landscape” (NPS, 2011). These areas help tell the history of the United States. Based on this criteria, NHAs in North Carolina may contain scenic or aesthetic areas considered visual resources or visually sensitive. NHAs are not national parks or under NPS ownership, but the NPS does provide funding and support to the NHAs. North Carolina has two National Heritage Areas: the Blue Ridge NHA and the Gullah/Geechee Cultural Heritage Corridor (Figure 11.1.8-2). (NPS, 2012b)

The Blue Ridge NHA represents the mixed cultural aspects and the natural landscapes of the Blue Ridge Mountains. The Blue Ridge NHA spans 25 counties within the mountain range showcasing the numerous scenic resources of the area. (NPS, 2015j)

The Gullah/Geechee Heritage Corridor “recognizes the important contributions made to American culture and history by Africans and African Americans known as the Gullah and the Geechee who settled in the coastal counties of South Carolina, Georgia, the southeast coast of North Carolina, and the northeast coast of Florida.” (NPS, 2015k). This cultural region encompasses coastal lands with vistas of shorelines, wetlands, ocean views, historic, heritage, and cultural sites. (NPS, 2015l). Section 11.1.11 provides additional details about North Carolina’s heritage and NRHPs with Figure 11.1.11-3 identifying NRHPs in the state.

National Historic Trails

National Historic Trails are defined under Section 5 of the National Trails System Act (16 U.S.C. 1241-1251, as amended) as extended trails that “follow as closely as possible and practicable the original trails or routes of travel of national historic significance” (NPS, 2012c). There are two National Historic Trails in North Carolina, the Trail of Tears, and Overmountain Victory. The scenic resources along the trails may be protected within the various agencies’ jurisdictions. (NPS, 2012d).

The Trail of Tears National Historic Trail follows the 2,200 mile route taken by the Cherokee people from nine states (Alabama, Arkansas, Georgia, Illinois, Kentucky, Missouri, North Carolina, Oklahoma, and Tennessee) as they were forced to settle in Indian Territory (Oklahoma today). In North Carolina, the trail starts in the mountains south of Great Smoky Mountains National Park. Visual resources along the trail include historic sites, geologic features, mountains, lush forests, and rushing streams. (NPS, 2015m)

The Overmountain Victory National Historic Trail crosses four states (North Carolina, South Carolina, Tennessee, and Virginia). The 300-mile trail can be driven, or hiked for 87 miles. The trail winds through the western foothills into peaks of the Blue Ridge Mountains, with scenic vistas of forested hillsides, waterfalls, and historic sites. (NPS, 2015n)

Other NPS Historic Sites

Wright Brothers National Memorial is a 428-acre site on the Outer Banks along the Atlantic Ocean (Figure 11.1.8-3). Wide-open scenic views of the shore, sea, and sky from this Memorial are some of the many scenic resources. (NPS, 2006b)

Figure 11.1.8-3: Wright Brothers National Memorial

Source: (NPS, 2015o)

Moores Creek National Battlefield is a Revolutionary War site within deciduous forest, with creeks, open battlefields, and historic sites (NPS, 2014b). Guilford Courthouse National Military Park memorializes about 250 acres of the original Revolutionary War battlefield; the site contains open, park-like areas, mature, deciduous forest, and historic structures (NPS, 2014e).

State Historic Sites

There are 27 State Historic Sites throughout North Carolina. Most of these sites have historic homes, structures, or historic features from the Revolutionary War, Civil War, and American Indians. The landscapes surrounding these sites contain ocean views, manicured gardens, rolling hills, forests, and open parkland. (North Carolina Natural and Cultural Resources, 2015)

11.1.8.5. Parks and Recreation Areas

Parks and recreation areas include national parks, national seashores, forest service, or other public lands; state parks, forests, or trails; and other protected areas used for recreational activities. Public lands under federal ownership are subject to NEPA, and visual and aesthetic resources are considered in the NEPA analysis. Public lands, parks and recreation areas often contain scenic resources and are visited because of their associated visual or aesthetic qualities. Figure 11.1.7-3 in Section 11.1.7, Land Use, Recreation, and Airspace, identifies parks and recreational resources that may be visually sensitive in North Carolina. Figure 11.1.8-4 displays natural areas that may be visually sensitive, including park and recreation areas.[95]

[95] The natural areas data were retrieved from the Protected Areas Database of the United States (PAD-US), produced by USGS (http://gapanalysis.usgs.gov/padus/). This dataset categorizes lands across the U.S. by conservation, land management, planning, recreation, and ownership, as well as other uses. It is an extensive data set that contains large quantities of information relevant to the Proposed Action. The data was queried and further combined by the Primary Designation Type into classifications that fit the multiple types of land applicable for Natural Areas. For this map, recognizable symbols (e.g., varying shades of green for National Parks and Forests) were used as PAD-US does not have a standard symbolization for natural areas. The PADUS 1.3 geodatabase was downloaded in the summer of 2015, and used consistently throughout all these maps for each state and D.C.

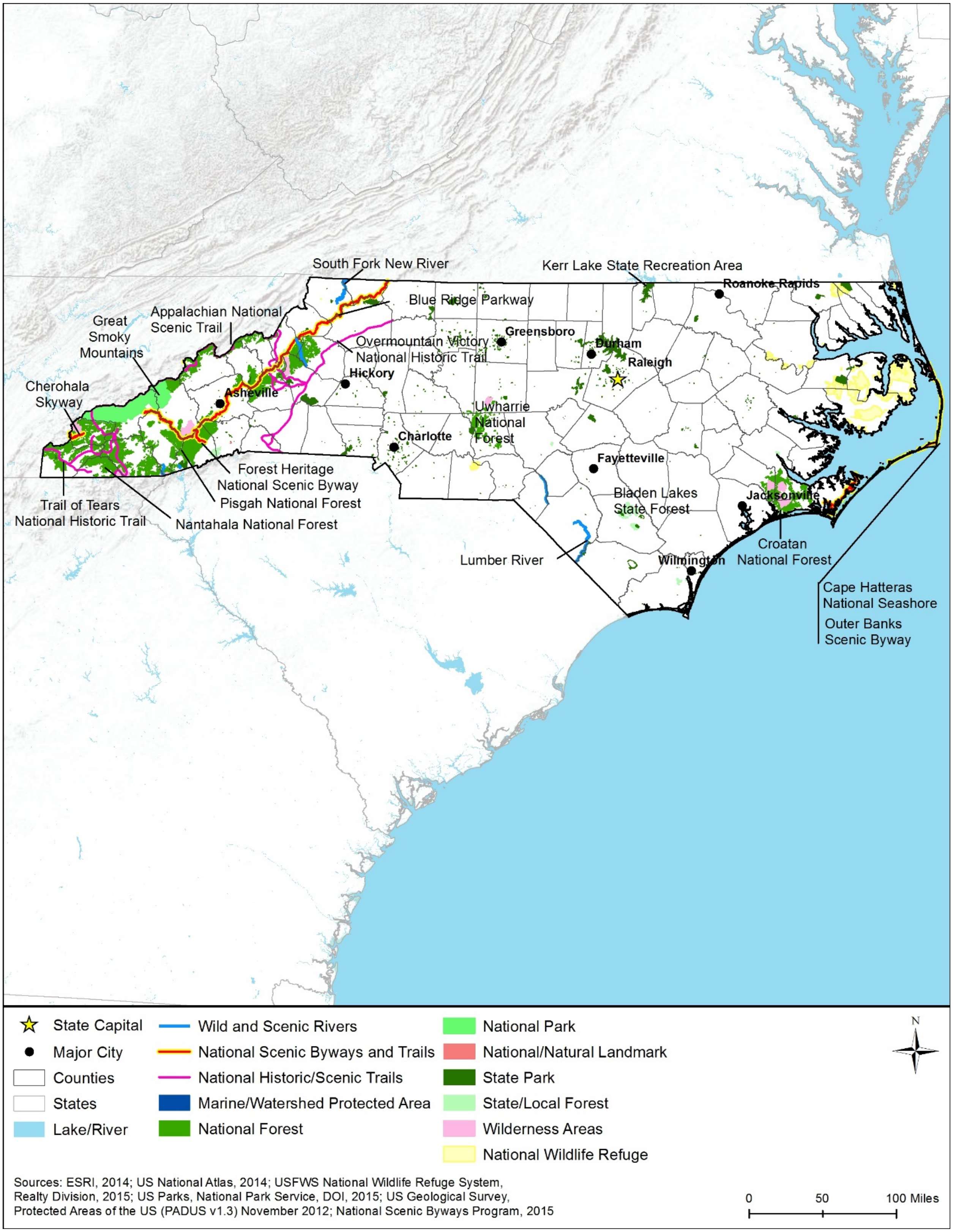


Figure 11.1.8-4: Natural Areas that May be Visually Significant

National Park Service

National parks are managed by the NPS, contain natural, historic, cultural, visual, ecological, and recreational resources of significance to the nation, and are maintained for the public's use. In North Carolina, there are 10[96] NPS units in addition to other NPS affiliated areas, such as National Historic Trails. There national park units and areas include a National Scenic Trail, 2 National Seashores, 2 National Historic Sites, a National Park, a National Military Park, a National Battlefield, 2 National Historic Trails, 2 National Heritage Areas, a Cultural Heritage Corridor, and a National Memorial.

The scenic resources of Great Smoky Mountain National Park are world-renowned. As identified in Section 11.1.8, Visual Resources, the Great Smoky Mountain National Park is a designated natural World Heritage Site and is considered a natural treasure with universal value (NPS, 2015p). The 522,427-acre Great Smoky Mountain National Park is the most visited National Park in the U.S. The park is rich in visual resources, including waterfalls, hardwood forest, cascading streams, mountain peaks above 6,600 feet, mountaintop views, and historic structures. (NPS, 2015q)

The 24,470 acre Cape Hatteras National Seashore is the nation's first National Seashore (Figure 11.1.8-5). The scenic resources of the seashore include ocean vistas, marshland, beaches, sand dunes, maritime forest, and views of the inland coastline and wildlife. (NPS, 2015r)

Figure 11.1.8-5: Cormorants on Cape Hatteras National Seashore

Source: (NPS, 2015s)

Cape Lookout National Seashore covers 56 miles of barrier islands off the coast of North Carolina. The seashore has no roads and may only be accessed by boat, providing a scenic experience en route. Ocean views, sandy beaches, and historic sites are among the visual resources of the seashore. (NPS, 2015t)

[96] This count is based on the NPS website "by the numbers" current as of 9/30/2014 (NPS 2015c). Actual lists of parks and NPS affiliated areas may vary here depending on when areas are designated by Congress.

U.S. Forest Service

There are four National Forests managed by the USFS in North Carolina covering over 1.25 million acres (Table 11.1.8-2) (USFS, 2015c). The USFS conducts inventories of the forest lands and assigns scenic resource categories from which they manage for scenic and visual resources in their land and resource planning efforts (about every 10 to 15 years) (USFS, 1995). The scenic inventories are used to manage the forest landscape and to protect areas of high scenic integrity (USFS, 1995).

Table 11.1.8-2: U.S. Forest Service Lands in North Carolina

National Forests	Acres	Scenic Values
Croatan	160,000	Coastline, rivers, longleaf pine forest, wetlands, bogs
Nantahala	531,148	Mountain, forest, valley
Pisgah	500,000+	High mountain peaks, waterfalls, forest, rivers
Uwharrie	50,645	Deciduous forest, mountains, streams, river valleys

Source: (USFS, 2015c)

Army Corps of Engineers

There are 23 USACE recreation areas, facilities, and flood risk management areas within the state (Recreation.gov, 2015). These areas are specifically managed by the USACE for scenic and aesthetic qualities in their planning guidance in addition to managing risks for floods (USACE, 1997).

Tennessee Valley Authority

The TVA is the land and water steward for six reservoirs in North Carolina including Appalachia Lake, Blue Ridge Lake, Chatuge Lake, Hiwassee Lake, Nottley Lake, and Ocoee Lakes 1, 2, and 3. The TVA considers the impacts of activities on the environment "to ensure the unique and beautiful Valley resources [are] preserved" (TVA, 2008) (Recreation.gov, 2014). The TVA "manages public lands for multiple benefits" and "protects natural resources while providing recreational opportunities across the Valley" (TVA, 2008). In addition, the TVA manages recreational, natural, and cultural resources in these areas to improve water quality, shoreline conditions, recreation, and biodiversity (TVA, 2015). For additional information regarding parks and recreation areas, see Section 11.1.7, Land Use, Recreation, and Airspace.

Federal and State Trail Systems

Designated under Section 5 of the National Trails System Act (16 U.S.C. 1241-1251, as amended), National Scenic Trails (NST) are defined as extended trails that "provide for maximum outdoor recreation potential and for the conservation and enjoyment of the nationally significant scenic, historic, natural, or cultural qualities of the areas though which they pass" (NPS, 2012c). One National Scenic Trail passes through North Carolina, the Appalachian Trail, with approximately 95.7 miles passing through the state (Appalachian Trail Conservancy, 2016). The Appalachian Trail spans 2,185 miles from Georgia to Maine and passes through 12 other states along the way. The trail is designated by Congress under the National Trails System Act (16 U.S.C. 1241-1251, as amended), and is protected under those provisions (NPS, 2012e).

Scenic resources along the trail in North Carolina are some of the finest in the state. The trail passes through Great Smoky Mountains National Park and the Blue Ridge Mountains, showcasing high, mountaintop vistas, rich forests, waterfalls, meadows, and historic structures. (NPS, 2014b)

There are 37 National Recreation Trails in North Carolina (National Recreation Trails, 2015a). "National Recreation Trails may be designated by the Secretary of Interior or the Secretary of Agriculture to recognize exemplary trails of local and regional significance in response to an application from the trail's managing agency or organization" (National Recreation Trails, 2015b). In North Carolina, 538 miles of trails are managed by several federal agencies or local governments.

One unique state trail, the North Carolina Mountains-to-Sea Trail, is not completely included in the National Recreation Trails list. This scenic trail connects the Outer Banks to the Great Smoky Mountains, currently covering 600 miles through the state, with plans to expand the trail upwards to 1,000 miles. Visual resources along this trail include coastal sand dunes, central hardwood forests, and the Blue Ridge Mountains. (North Carolina Division of Parks and Recreation, 2015c)

State Parks

North Carolina manages 35 state parks, 4 state recreation areas, and 20 natural areas that encompass the wide range of scenic resources available throughout the state. Each location features scenic resources ranging from sandy beaches, to pristine mountain ranges, or wide-open vistas of rivers, lakes, sounds, and the Atlantic Ocean. State parks in North Carolina include:

- Bay Tree State Park
- Bald Island State Natural Area
- Bear Paw State Natural Area
- Beech Creek Bog State Natural Area
- Bullhead Mountain State Natural Area
- Bushy Lake State Natural Area
- Carolina Beach State Park
- Carvers Creek State Park
- Chowan Swamp State Natural Area
- Cliffs of the Neuse State Park
- Crowders Mountain State Park
- Dismal Swamp State Park
- Elk Knob State Park
- Eno River State Park
- Falls Lake State Recreation Area
- Fort Fisher State Recreation Area
- Fort Macon State Park
- Goose Creek State Park
- Gorges State Park
- Grandfather Mountain State Park
- Lake Waccamaw State Park
- Lea Island State Natural Area
- Lower Haw River State Natural Area
- Lumber River State Park
- Masonboro Island State Natural Area
- Mayo River State Park
- Medoc Mountain State Park
- Merchants Millpond State Park
- Mitchell's Mill State Natural Area
- Morrow Mountain State Park
- Mount Jefferson State Natural Area
- Mount Mitchell State Park
- New River State Park
- Occoneechee Mountain State Natural Area
- Pettigrew State Park
- Pilot Mountain State Park
- Pineola Bog State Natural Area
- Raven Rock State Park
- Run Hill State Natural Area
- Sandy Run Savannas State Natural Area

- Hammocks Beach State Park
- Hanging Rock State Park
- Haw River State Park
- Hemlock Bluffs State Natural Area
- Jockey’s Ridge State Park
- Jones Lake State Park
- Jordan Lake State Recreation Area
- Kerr Lake State Recreation Area
- Lake James State Park
- Lake Norman State Park
- Singletary Lake State Park
- South Mountains State Park
- Stone Mountain State Park
- Sugar Mountain Bog State Natural Area
- Theodore Roosevelt State Natural Area
- Weymouth Woods-Sandhills Nature Preserve
- William B. Umstead State Park
- Yellow Mountain State Natural Area

Source: (NC Division of Parks and Recreation, 2015)

North Carolina has many county and city managed parks and recreation areas that contain scenic resources. The Wake County Consolidated Open Space Program is working towards protecting 30 percent (165,000 acres) of land as permanent open space. These lands will be left undeveloped to protect habitat, watershed, and aesthetics, and to provide open space and recreational opportunities. (WakeGOV: Parks and Recreation , 2015)

State Forests

The North Carolina Forest Service manages nine forests throughout the state (Table 11.1.8-3) (NCFS, 2015b). These forests are open for public use for hiking and other recreational activities, depending on the forest. These state forests are protected by the North Carolina Forest Service “to protect, manage and develop the forest resources of the state.” (NCFS, 2015c)

Table 11.1.8-3: North Carolina State Forests

State Forests	Acres
Bladen Lakes State Forest	32,700
Clemmons Educational State Forest	825
DuPont State Recreational Forest	10,473
Holmes Educational State Forest	235
Jordan Lake Educational State Forest	900
Mountain Island Educational State Forest	2,000
Rendezvous Mountain Educational State Forest	3,316
Turnbull Creek Educational State Forest	890
Tuttle Educational State Forest	288
Total	**51,627**

Source: (NCFS, 2015d)

11.1.8.6. Natural Areas

The abundance of natural areas varies by state depending on the amount of public or state lands managed within each state. Although many natural areas may not be managed specifically for visual resources, these areas are allowed protection for their natural resources and the resulting management protects these scenic resources. Figure 11.1.8-4 identifies natural areas that may have sensitive visual resources.

Rivers Designated as National or State Wild, Scenic or Recreational

North Carolina has 144.5 miles of rivers designated as wild, scenic, and recreational on the Chattooga, Horsepasture, Lumber, and New Rivers and Wilson Creek (National Wild and Scenic Rivers System, 2015g). National wild, scenic, or recreational rivers are those rivers designated by Congress or the Secretary of the Interior in accordance with the Wild and Scenic Rivers Act of 1968 (16 U.S.C. 1271-1287). The scenic resources of these rivers are protected by the federal designations.

- The 58.7 miles of designated sections of the Chattooga River contain all three classifications of wild (41.6 miles), scenic (2.5 miles), and recreational (14.6 miles) (National Wild and Scenic Rivers System, 2015a).
- The Horsepasture River has 4.2 total miles of designated scenic (3.6 miles) and recreational (0.6 miles) (National Wild and Scenic Rivers System, 2015b).
- The Lumber River has 81.0 total miles of designated scenic (60 miles) and recreational (21.0 miles) (National Wild and Scenic Rivers System, 2015c).
- The South Fork of the New River has 26.5 miles of designated scenic waters (National Wild and Scenic Rivers System, 2015d).
- The 23.3 miles of designated sections of Wilson Creek contain all three classifications of wild (4.6 miles), scenic (2.9 miles), and recreational (15.8 miles) (National Wild and Scenic Rivers System, 2015e).

North Carolina has a state Natural and Scenic Rivers System with designated river sections similar to the National System, and currently consists of primarily nationally designated river sections. (North Carolina Division of Parks and Recreation, 2015d)

National Wildlife Refuges

National Wildlife Refuges (NWRs) are a network of lands and waters managed by the USFWS. These lands and waters are "set aside for the conservation, management and, where appropriate, restoration of fish, wildlife, and plant resources and their habitats" (USFWS, 2015a). There are 11 NWRs in North Carolina:

- Alligator River NWR
- Cedar Island NWR
- Currituck NWR
- Mackay Island NWR
- Mattamuskeet NWR
- Mountain Bogs
- Pea Island NWR
- Pee Dee NWR
- Pocosin Lakes NWR
- Roanoke River NWR
- Swanquarter NWR

Most of these refuges are along the coast, consisting of fresh and saltwater marshlands, mud and salt flats, and coastline; however, other areas are inland forests, such as the Pee Dee NWR. These refuges protect hundreds of thousands of acres of habitat and the visual resources within and surrounding the refuges. (USFWS, 2015cc)

National Estuarine Research Reserve System

The 10,568 acre North Carolina Estuarine Research Reserve is one of only 28 sites in the country managed "as a partnership between the National Oceanic and Atmospheric Administration (NOAA) and the coastal states and territories." The lead managing agency is the NCDEQ. The National Estuarine Research Reserve System (NERRS) was "established by Section 315 of the Coastal Zone Management Act (CZMA) of 1972 as amended, to preserve, protect, develop, and where possible, to restore or enhance, the resources of the Nation's coastal zone for this and succeeding generations." These research reserves protect the scenic resources within, such as wetlands, estuary, sand dunes, and tidal creeks. (Fear, 2008)

National Natural Landmarks

NNLs are sites designated by the U.S. Secretary of the Interior that "contain outstanding biological and/or geological resources, regardless of land ownership, and are selected for their outstanding condition, illustrative value, rarity, diversity, and value to science and education" (NPS, 2014c). These landmarks may be considered visual resources or visually sensitive. There are 13 NNLs in North Carolina covering over 38,000 acres and owned by a variety of federal, state, and private entities. Table 11.1.8-4 displays a list of NNLs, their size, and some of the scenic resources protected within these areas. (NPS, 2012f)

Table 11.1.8-4: National Natural Landmarks with Scenic Resources

National Natural Landmarks	Acres	Visual Resources
Bear Island	11	Coastline, beach, ocean, sand dunes
Goose Creek State Park Natural Area	351	Swamps, marshes, forest, creeks
Green Swamp	16,176	Swamp, wetland, forest
Long Hope Creek Spruce Bog	685	Unique plant community, forest, meadow
Mount Jefferson State Park	506	Forest, hills, mountaintop views
Mount Mitchell State Park	1,410	Forest, mountaintop views
Nags Head Woods and Jockey Ridge	1,951	Sand dunes, beach, forest
Orbicular Diorite	65	Unique rock form, geology
Piedmont Beech Natural Area	61	Unique forest area
Pilot Mountain	911	Unique geologic formation, forest, mountaintop vistas
Salyer's Ridge Natural Area	157	Swamp, forest, wetland
Smith Island	15,469	Barrier island, ocean, beach, dunes, marsh, streams
Stone Mountain	413	Unique geologic formation, forest, unique vegetation
Total	**38,166**	

Source: (NPS, 2012f)

National Wilderness Areas

There are 12 designated wilderness areas covering over 100,000 acres throughout the state; all but one are managed under the jurisdiction of the USFS (Table 11.1.8-5) (Wilderness.net, 2015). In 1964, Congress enacted the Wilderness Act of 1964 as "an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. A designation as a National Wilderness Area is the highest level of conservation protection given by Congress to federal lands. This Act defined wilderness as land untouched by man and primarily affected only by the "forces of nature" and as that which "may also contain ecological, geological, or other features of scientific, education, scenic, or historical value" (NPS, 2015u). Over 106 million acres of federal public lands across the U.S. have been designated as wilderness areas. Twenty-five percent of these federal lands are in 47 national parks (44 million acres) and are part of the National Park System. These designated wilderness areas are managed by USFS, BLM, USFWS, and NPS (NPS, 2015u).

Table 11.1.8-5: Congressionally Designated Wilderness in North Carolina

Wilderness Areas	Acres
Birkhead Mountains Wilderness	5,068
Catfish Lake South Wilderness	8,491
Ellicott Rock Wilderness	3,416
Joyce Kilmer-Slickrock Wilderness	13,590
Linville Gorge Wilderness	11,651
Middle Prong Wilderness	7,482
Pocosin Wilderness	11,801
Pond Pine Wilderness	1,693
Sheep Ridge Wilderness	9,315
Shining Rock Wilderness	18,479
Southern Nantahala Wilderness	11,732
Swanquarter Wilderness (USFWS)	8,785
Total	**111,503**

Source: (Wilderness.net, 2015)

11.1.8.7. Additional Areas

National and State Scenic Byways

National Scenic Byways are resources designated specifically for scenic or aesthetic areas or qualities which would be considered visual resources or visually sensitive. The National Scenic Byways Program is managed by the U.S. Department of Transportation's FHWA (FHWA, 2015d). There are four nationally recognized byways in North Carolina:

- Blue Ridge Parkway (469 miles);
- Cherohala Skyway (43 miles);
- Forest Heritage National Scenic Byway (17.6 miles); and
- Outer Banks Scenic Byway (137.8 miles) (FHWA, 2015e).

These scenic byways and parkways contain the stunning range of visual resources from the sea to the mountaintops, and everything in between.

The Blue Ridge Parkway is also a designated All-American Road. All-American Road designations are the most scenic byways as they must contain features not found elsewhere in the nation and are unique to be tourist destinations on their own. The Blue Ridge Parkway travels through 469 miles through Great Smoky Mountains National Park, Pisgah National Forest, the Blue Ridge Mountains with high mountain vistas and overlooks, rich forests, cascading waterfalls, lush valleys, and historic homesteads and sites (Figure 11.1.8-6) (NPS, 2014b).

Figure 11.1.8-6: Vista along the Blue Ridge Scenic Byway

Source: (NPS, 2015v)

North Carolina has 51 state designated scenic byways "to give visitors and residents a chance to experience North Carolina's history, geography, and culture, while also raising awareness for the protection and preservation of these treasures." These routes cover the entire state and are meant to highlight scenic resources of the three regions of the state: the coast, the central Piedmont, and the Blue Ridge Mountains (NCDOT, 2008).

North Carolina Coastal Areas of Environmental Concern

Coastal AECs are designated by the Coastal Resources Commission "to protect them from uncontrolled development, which may cause irreversible damage to property, public health or the environment, thereby diminishing their value to the entire state." These areas are maintained by the North Carolina Division of Coastal Management, which is responsible for what types of development may be in these areas. Scenic resources in these areas may be protected from disturbance and development depending on the size and scale of the project. (NCDEQ, 2015b)

11.1.9. Socioeconomics

11.1.9.1. Definition of the Resource

NEPA requires consideration of socioeconomics in NEPA analysis; specifically, Section 102(A) of NEPA requires federal agencies to "insure the integrated use of the natural and social sciences…in planning and in decision making" (42 U.S.C. § 4332(A)).[97] Socioeconomics refers to a broad, social science-based approach to understanding a region's social and economic conditions. It typically includes population, demographic descriptors, economic activity indicators, housing characteristics, property values, and public revenues and expenditures (BLM, 2005). When applicable, it includes qualitative factors such as community cohesion. Socioeconomics provides important context for analysis of FirstNet Proposed Actions, and in addition, FirstNet Proposed Actions may affect the socioeconomic conditions of a region.

The choice of socioeconomic topics and depth of their treatment depends on the relevance of potential topics to the types of federal actions under consideration. FirstNet's mission is to provide public safety broadband and interoperable emergency communications coverage throughout the nation. Relevant socioeconomic topics include population density and growth, economic activity, housing, property values, and state and local taxes.

The financial arrangements for deployment and operation of the FirstNet network may have socioeconomic implications. Section 1.1 frames some of the public expenditure and public revenue considerations specific to FirstNet; however, this is not intended to be either descriptive or prescriptive of FirstNet's financial model or anticipated total expenditures and revenues associated with the deployment of the Nationwide Public Safety Broadband Network (NPSBN). This socioeconomics section provides some additional, broad context, including data and discussion of state and local government revenue sources that FirstNet may affect.

Environmental justice is a related topic that specifically addresses the presence of minority populations (defined by race and Hispanic ethnicity) and low-income populations, in order to give special attention to potential impacts on those populations, per Executive Order 12898.[98] This PEIS addresses environmental justice in a separate section (Section 11.1.10). This PEIS also addresses the following topics, sometimes included within socioeconomics, in separate sections: land use, recreation, and airspace (Section 11.1.7), infrastructure and public services (Section 11.1.1), and visual resources (Section 11.1.8).

Wherever possible, this section draws on nationwide datasets from federal sources such as the U.S. Census Bureau (Census Bureau)[99] and U.S. Bureau of Labor Statistics (BLS). This ensures

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[97] See https://www.law.cornell.edu/uscode/text/42/4332.

[98] See https://www.epa.gov/laws-regulations/summary-executive-order-12898-federal-actions-address-environmental-justice.

[99] For U.S. Census Bureau sources, a URL (see references section) that begins with "http://factfinder.census.gov" indicates that the American FactFinder (AFF) interactive tool can be used to retrieve the original source data via the following procedure. If the reference's URL begins with "http://dataferrett.census.gov," significant socioeconomic expertise is required to navigate this interactive tool to the specific data. However, the data can usually be found using AFF. As of May 24, 2016, the AFF procedure is as follows: 1) Go to http://factfinder.census.gov. 2) Select "Advanced Search," then "Show Me All." 3) Select from "Topics" choices, select "Dataset," then select the dataset indicated in the reference; e.g., "American Community Survey, 2013 1-Year

consistency of data and analyses across the states examined in this PEIS. In all cases, this section uses the most recent data available for each geography at the time of writing. At the county, state, region, and United States levels, the data are typically for 2013 or 2014. For smaller geographic areas, this section uses data from the Census Bureau's American Community Survey (ACS). The ACS is the Census Bureau's flagship demographic estimates program for years other than the decennial census years. This PEIS uses the 2009-2013 ACS, which is based on surveys (population samples) taken across that five-year period; thus, it is not appropriate to attribute its data values to a specific year. It is a valuable source because it provides the most accurate and consistent socioeconomic data across the nation at the sub-county level. (U.S. Census Bureau, 2014)

The remainder of this section addresses the following subjects: regulatory considerations specific to socioeconomics in the state, communities and populations, economic activity, housing, property values, and taxes.

11.1.9.2. Specific Regulatory Considerations

Research for this section did not identify any specific state, local, or tribal laws or regulations that are directly relevant to socioeconomics for this PEIS.

11.1.9.3. Communities and Populations

This section discusses the population and major communities of North Carolina (NC) and includes the following topics:

- Recent and projected statewide population growth;
- Current distribution of the population across the state; and
- Identification of the largest population concentrations in the state.

Estimates" or "2012 Census of Governments." Click "Close." Note: ACS is the abbreviation in the AFF for the American Community Survey. SF is the abbreviation used with the 2000 and 2010 "Summary Files." For references to the "2009-2013 5-Year Summary File," choose "2013 ACS 5-year estimates" in the AFF. 4) Click the "Geographies" box. Under "Select a geographic type," choose the appropriate type; e.g., "United States – 010" or "State – 040" or "..... County – 050" then select the desired area or areas of interest. Click "Add to Your Selections," then "Close." For Population Concentration data, select "Urban Area - 400" as the geographic type, then select 2010 under "Select a version" and then choose the desired area or areas. Alternatively, do not choose a version, and select "All Urban Areas within United States." Regional values cannot be viewed in the AFF because the regions for this PEIS do not match Census Bureau regions. All regional values were developed by downloading state data and using the most mathematically appropriate calculations (e.g., sums of state values, weighted averages, etc.) for the specific data. 5) In "Refine your search results," type the table number indicated in the reference; e.g., "DP04" or "LGF001." The dialogue box should auto-populate with the name of the table(s) to allow the user to select the table number/name. Click "Go." 6) In the resulting window, click the desired table under "Table, File, or Document Title" to view the results. If multiple geographies were selected, it is often easiest to view the data by clicking the "Download" button above the on-screen data table. Choose the desired comma-delimited format or presentation-ready format (includes a Microsoft Excel option). In some cases, the structure of the resulting file may be easier to work with under one format or another. Note that in most cases, the on-screen or downloaded data contains additional parameters besides those used in the FirstNet PEIS report table. Readers must locate the FirstNet PEIS-specific data within the Census Bureau tables. Additionally, the data contained in the FirstNet tables may incorporate data from multiple sources and may not be readily available in one table on the Census site.

Statewide Population and Population Growth

Table 11.1.9-1 presents the estimated 2014 population and population density of North Carolina in comparison to the south region[100] and the nation. The estimated population of North Carolina in 2014 was 9,943,964. The population density was 205 persons per square mile (sq. mi.), which was higher than the population density of both the region (114 persons/sq. mi.) and the nation (90 persons/sq. mi.). In 2014, North Carolina was the ninth largest state by population among the 50 states and the District of Columbia, 29th largest by land area, and had the 16th greatest population density (U.S. Census Bureau, 2015e; U.S. Census Bureau, 2015f).

Table 11.1.9-1: Land Area, Population, and Population Density of North Carolina

Geography	2010 Land Area (sq. mi.)	Estimated Population 2014	Population Density 2014 (persons/sq. mi.)
North Carolina	48,618	9,943,964	205
South Region	914,471	104,109,977	114
United States	3,531,905	318,857,056	90

Sources: (U.S. Census Bureau, 2015e; U.S. Census Bureau, 2015f)

Population growth is an important subject for this PEIS given FirstNet's mission. Table 11.1.9-2 presents the population growth trends of North Carolina from 2000 to 2014 in comparison to the south region and the nation. The state's annual growth rate decreased in the 2010 to 2014 period compared to 2000 to 2010, from 1.71 percent to 1.05 percent. The growth rate of North Carolina in the latter period was slightly lower than the growth rate of the region, at 1.14 percent. Both geographies showed higher growth rates in both periods compared to the nation's growth rate (0.93 percent during 2000 to 2010; 0.81 percent during 2010 to 2014).

Table 11.1.9-2: Recent Population Growth of North Carolina

Geography	Population			Numerical Population Change		Rate of Population Change (AARC) [a]	
	2000	2010	2014 (estimated)	2000 to 2010	2010 to 2014 (estimated)	2000 to 2010	2010 to 2014 (estimated)
North Carolina	8,049,313	9,535,483	9,943,964	1,486,170	408,481	1.71%	1.05%
South Region	86,516,862	99,487,696	104,109,977	12,970,834	4,622,281	1.41%	1.14%
United States	281,421,906	308,745,538	318,857,056	27,323,632	10,111,518	0.93%	0.81%

[a] AARC = Average Annual Rate of Change (compound growth rate)
Sources: (U.S. Census Bureau, 2015g; U.S. Census Bureau, 2015e)

Demographers prepare future population projections using various population growth modeling methodologies. For this nationwide PEIS, it is important to use population projections that apply the same methodology across the nation. It is also useful to consider projections that use

[100] The south region is comprised of the states of Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, New Mexico, Oklahoma, South Carolina, Tennessee, and Texas. Throughout the socioeconomics section, figures for the south region represent the sum of the values for all states in the region, or an average for the region based on summing the component parameters. For instance, the population density of the south region is the sum of the populations of all its states, divided by the sum of the land areas of all its states.

different methodologies, since no methodology is a perfect predictor of the future. The Census Bureau does not prepare population projections for the states. Therefore, Table 11.1.9-3 presents projections of the 2030 population from two sources that are national in scope and use different methodologies: the University of Virginia's Weldon Cooper Center for Public Service and ProximityOne, a private sector demographic and economic data and analysis service (UVA Weldon Cooper Center, 2015) (ProximityOne, 2015). The table provides figures for numerical change, percentage change, and annual growth rate based on averaging the projections from the two sources. The average projection indicates North Carolina's population will increase by nearly 1.8 million people, or 18.0 percent, from 2014 to 2030. This reflects an average annual projected growth rate of 1.04 percent, which is very similar to the historical growth rate from 2010 to 2014 of 1.05 percent. The projected growth rate of the state is higher than that of the region (0.97 percent) and the nation (0.80 percent).

Table 11.1.9-3: Projected Population Growth of North Carolina

Geography	Population 2014 (estimated)	Projected 2030 Population			Change Based on Average Projection		
		UVA Weldon Cooper Center Projection	Proximity One Projection	Average Projection	Numerical Change 2014 to 2030	Percent Change 2014 to 2030	Rate of Change (AARC) [a] 2014 to 2030
North Carolina	9,943,964	11,886,768	11,589,035	11,737,902	1,793,938	18.0%	1.04%
South Region	104,109,977	122,323,551	120,794,020	121,558,786	17,448,809	16.8%	0.97%
United States	318,857,056	360,978,449	363,686,916	362,332,683	43,475,627	13.6%	0.80%

[a] AARC = Average Annual Rate of Change (compound growth rate)
Sources: (U.S. Census Bureau, 2015e; ProximityOne, 2015; UVA Weldon Cooper Center, 2015)

Population Distribution and Communities

Table 11.1.9-1 presents the distribution and relative density of the population of North Carolina. Each brown dot represents 500 people, and massing of dots indicates areas of higher population density – therefore, areas that are solid in color are particularly high in population density. The map uses ACS estimates based on samples taken from 2009 to 2013 (U.S. Census Bureau, 2015h). This map also presents the 10 largest population concentrations in the state, outlined in purple. These population concentrations reflect contiguous, densely developed areas as defined by the Census Bureau based on the 2010 census (U.S. Census Bureau, 2012; U.S. Census Bureau, 2015i). These population concentrations often include multiple incorporated areas as well as some unincorporated areas. Other groupings of brown dots on the map represent additional, but smaller, population concentrations. Dispersed dots indicate dispersed population across the less densely settled areas of the state.

Table 11.1.9-4 provides the populations of the 10 largest population concentrations in North Carolina, based on the 2010 census. It also shows the changes in population for these areas between the 2000 and 2010 censuses.[101] In 2010, the largest population concentration was the North Carolina portion of the Charlotte area, which had nearly 1.2 million people. The state had no other population concentrations over 1 million. It had one area with a population between 500,000 and 1 million (Raleigh) and eight areas with populations between 200,000 and 400,000. The smallest of these 10 population concentrations was the Hickory area, with a 2010 population of 212,195. The fastest growing area, by average annual rate of change from 2000 to 2010, was the Concord area, with an annual growth rate of 6.45 percent. However, this growth rate reflects a large increase in the area definition. This area expansion may have taken in some existing populations; thus, the growth rate of this area may reflect this factor as well as organic growth (net in-migration and/or births exceeding deaths). All 10 areas had growth rates over 1.00 percent, and four areas had growth rates over 3.00 percent.

Table 11.1.9-4 also shows that the top 10 population concentrations in North Carolina accounted for 45.7 percent of the state's population in 2010. Further, population growth in the 10 areas from 2000 to 2010 amounted to 84.8 percent of the entire state's growth. These figures indicate that the populations within these 10 areas are growing at a faster rate than the population in the remainder of the state.

[101] Census Bureau boundaries for these areas are not fixed. Area changes from 2000 to 2010 may include accretion of newly developed areas into the population concentration, Census Bureau classification of a subarea as no longer qualifying as a concentrated population due to population losses, and reclassification by the Census Bureau of a subarea into a different population concentration. Thus, population change from 2000 to 2010 reflects change within the constant area and change as the overall area boundary changes. Differences in boundaries in some cases introduce anomalies in comparing the 2000 and 2010 populations and in calculation of the growth rate presented in the table.

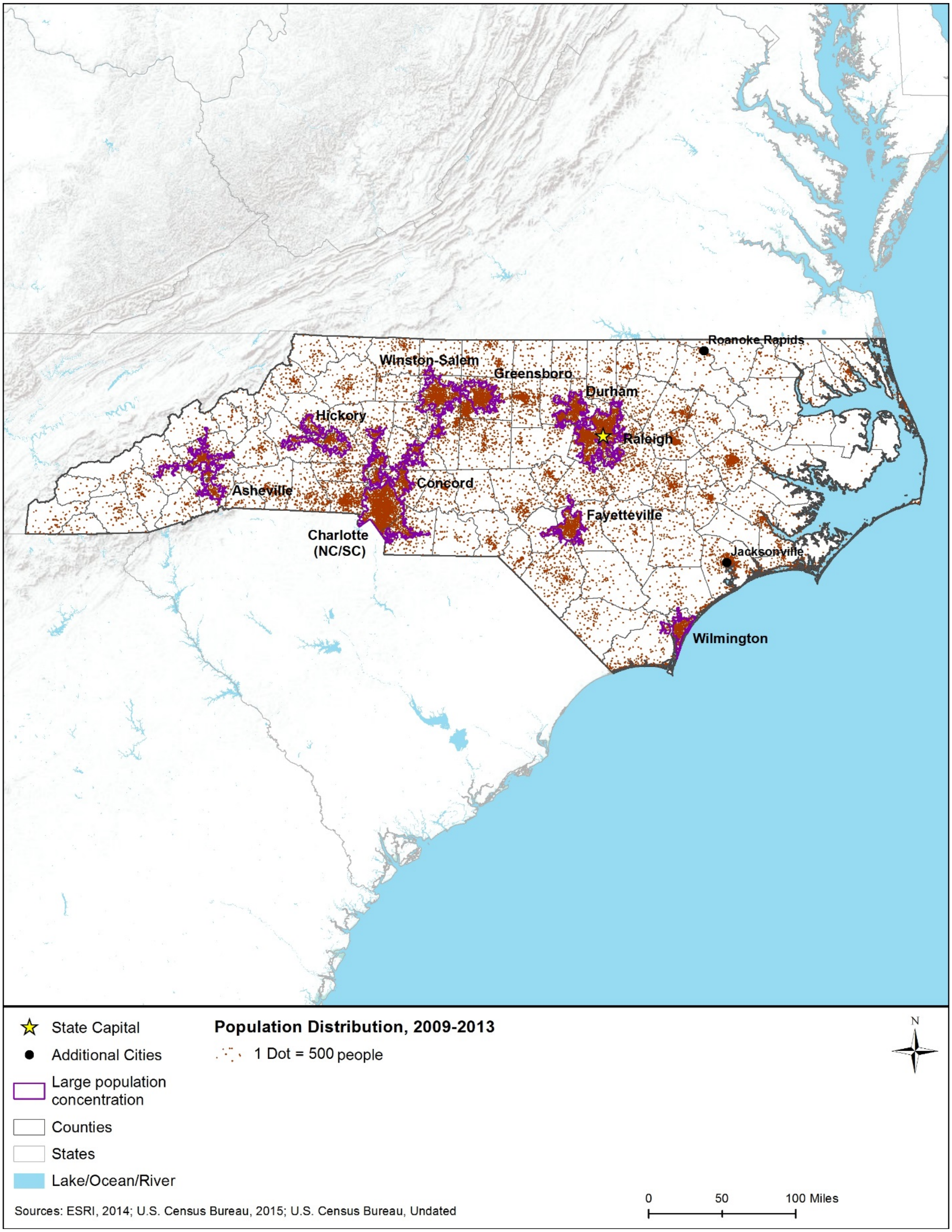

Figure 11.1.9-1: Population Distribution in North Carolina, 2009–2013

Table 11.1.9-4: Population of the 10 Largest Population Concentrations in North Carolina

Area	Population				Population Change 2000 to 2010	
	2000	2010	2009–2013	Rank in 2010	Numerical Change	Rate (AARC) [a]
Asheville	221,570	280,648	282,113	7	59,078	2.39%
Charlotte (NC/SC) (NC Portion) [b]	734,778	1,180,484	1,214,793	1	445,706	4.86%
Concord [c]	115,057	214,881	215,600	9	99,824	6.45%
Durham	287,796	347,602	356,093	4	59,806	1.91%
Fayetteville	276,368	310,282	314,030	6	33,914	1.16%
Greensboro	267,884	311,810	315,602	5	43,926	1.53%
Hickory	187,808	212,195	211,951	10	24,387	1.23%
Raleigh [d]	541,527	884,891	910,999	2	343,364	5.03%
Wilmington	161,149	219,957	224,936	8	58,808	3.16%
Winston-Salem	299,290	391,024	394,581	3	91,734	2.71%
Total for Top 10 Population Concentrations	**3,093,227**	**4,353,774**	**4,440,698**	**NA**	**1,260,547**	**3.48%**
North Carolina (statewide)	8,049,313	9,535,483	9,651,380	NA	1,486,170	1.71%
Top 10 Total as Percentage of State	**38.4%**	**45.7%**	**46.0%**	**NA**	**84.8%**	**NA**

[a] AARC = Average Annual Rate of Change (compound growth rate).
[b] The large population increases from 2000 to 2010 for the Charlotte (NC Portion) area reflect correspondingly large increases in the area definition for this areas.
[c] The large population increases from 2000 to 2010 for the Concord area reflect correspondingly large increases in the area definition for this area.
[d] The large population increases from 2000 to 2010 for the Raleigh area reflect correspondingly large increases in the area definition for this areas.
NA = Not Applicable
Sources: (U.S. Census Bureau, 2015j; U.S. Census Bureau, 2015k) (U.S. Census Bureau, 2012)

11.1.9.4. Economic Activity, Housing, Property Values, and Government Revenues

This section addresses other socioeconomic topics that are potentially relevant to FirstNet. These topics include:

- Economic activity;
- Housing;
- Property values; and
- Government revenues.

Social institutions – educational, family, political, public service, military, and religious – are present throughout the state. The institutions most relevant to FirstNet Proposed Actions are public services such as medical and emergency medical services and facilities. This PEIS addresses public services in Section 11.1.1, Infrastructure. Project-level NEPA analyses may need to examine other institutions, depending on specific locations and specific types of actions.

Economic Activity

Table 11.1.9-5 compares several economic indicators for North Carolina to the South region and the nation. The table presents two indicators of income[102] – per capita and median household – as income is a good measure of general economic health of a region.

Per capita income is total income divided by the total population. As a mathematical average, the very high incomes of a relatively small number of people tend to bias per capita income figures upwards. Nonetheless, per capita income is useful as an indicator of the relative income level across two or more areas. As shown in Table 11.1.9-5, the per capita income in North Carolina in 2013 ($25,377) was $366 higher than that of the region ($25,011), and $2,807 lower than that of the nation ($28,184).

Household income is a useful measure, and often used instead of family income, because in modern society there are many single-person households and households composed of non-related individuals. Median household income (MHI) is the income at which half of all households have higher income, and half have lower income. Table 11.1.9-5 shows that in 2013, the MHI in North Carolina ($45,946) was $616 lower than that of the region ($46,562), and $6,304 lower than that of the nation ($52,250).

Employment status is a key socioeconomic parameter because employment is essential to the income of a large portion of the adult population. The federal government calculates the unemployment rate as the number of unemployed individuals who are looking for work divided by the total number of individuals in the labor force. Table 11.1.9-5 compares the unemployment rate in North Carolina to the South region and the nation. In 2014, North Carolina's statewide unemployment rate of 6.1 percent was very similar to the rates for both the region (6.1 percent) and the nation (6.2 percent)[103].

Table 11.1.9-5: Selected Economic Indicators for North Carolina

Geography	Per Capita Income 2013	Median Household Income 2013	Average Annual Unemployment Rate 2014
North Carolina	$25,377	$45,906	6.3%
South Region	$25,011	$46,562	6.1%
United States	$28,184	$52,250	6.2%

Sources: (BLS, 2015b; U.S. Census Bureau, 2015l; U.S. Census Bureau, 2015m; U.S. Census Bureau, 2015n)

[102] The Census Bureau defines income as follows: "'Total income' is the sum of the amounts reported separately for wage or salary income; net self-employment income; interest, dividends, or net rental or royalty income or income from estates and trusts; Social Security or Railroad Retirement income; Supplemental Security Income (SSI); public assistance or welfare payments; retirement, survivor, or disability pensions; and all other income. Receipts from the following sources are not included as income: capital gains, money received from the sale of property (unless the recipient was engaged in the business of selling such property); the value of income "in kind" from food stamps, public housing subsidies, medical care, employer contributions for individuals, etc.; withdrawal of bank deposits; money borrowed; tax refunds; exchange of money between relatives living in the same household; gifts and lump-sum inheritances, insurance payments, and other types of lump-sum receipts" (U.S. Department of Veteran Affairs, 2015).

[103] The timeframe for unemployment rates can change quarterly.

Figure 11.1.9-2 and Figure 11.1.9-3 show how MHI in 2013 (U.S. Census Bureau, 2015l) and unemployment in 2014 (BLS, 2015b) varied by county across the state. These maps also incorporate the same population concentration data as Figure 11.1.9-1 (U.S. Census Bureau, 2012; U.S. Census Bureau, 2015i). Following these two maps, Table 11.1.9-6 presents MHI and unemployment for the 10 largest population concentrations in the state. The table reflects survey data taken from 2009 to 2013. Thus, its figures are not directly comparable to those on the maps. Nonetheless, both the maps and the table help portray differences in income and unemployment across North Carolina.

Figure 11.1.9-2 shows that, in general, counties with a MHI above the national median were in the Raleigh, Durham, Charlotte, and Concord areas, and in the northeast corner of the state. The remainder of the state had MHI levels below the national average. Table 11.1.9-6 shows that MHI in the Charlotte (North Carolina portion), Durham, Raleigh, and Wilmington areas was above the state average. MHI in all other population concentrations was below the state average. MHI was lowest in the Hickory area, which is also the smallest of the areas shown in the table.

Figure 11.1.9-3, as shown below, presents variations in the 2014 unemployment rate across the state, by county. It shows a variable distribution of unemployment rates across the state. Counties with unemployment rates below the national average (that is, better employment performance) were frequently in and around large population concentrations, such as Raleigh, Durham, Charlotte, and Asheville, but also occurred in counties outside of these population concentrations. The highest unemployment rates occurred in several counties located between Raleigh and Roanoke Rapids, four counties to the south of the Fayetteville area, three counties along the northeast coast, and two counties along the southwest border with Tennessee. When comparing unemployment in the population concentrations to the state average (Table 11.1.9-6, below), most of the population concentrations has unemployment rates below the state average; only the Concord, Fayetteville, and Hickory areas had 2009–2013 unemployment rates that were higher than the state average.

Table 11.1.9-7, as shown below, provides figures on employment percentages by type of worker and by industry based on surveys conducted in 2013 by the Census Bureau. By class of worker (type of worker: private industry, government, self-employed, etc.), the percentage of private wage and salary workers North Carolina was similar to the percentage in the South region and the nation. The percentage of government workers was slightly higher in the state than in the region and nation. Self-employed workers were a slightly lower percentage in the state compared to the region and nation.

By industry, North Carolina has a mixed economic base. The only notable difference between the state and the region or nation was for the “manufacturing” industry. North Carolina in 2013 had a percentage of persons working in “manufacturing” that was substantially higher (two percentage points or more) than the percentages for the region and the nation.

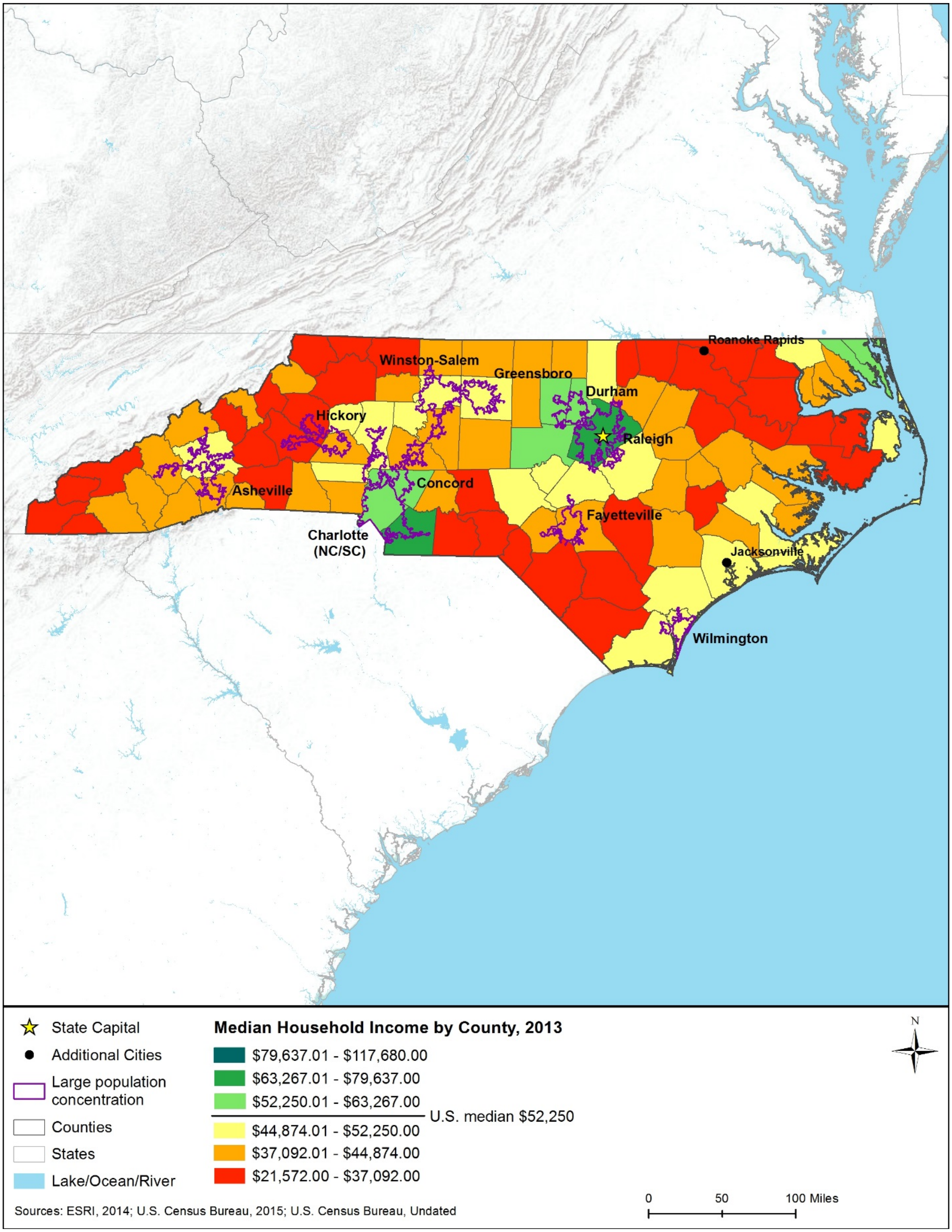

Figure 11.1.9-2: Median Household Income in North Carolina, by County, 2013

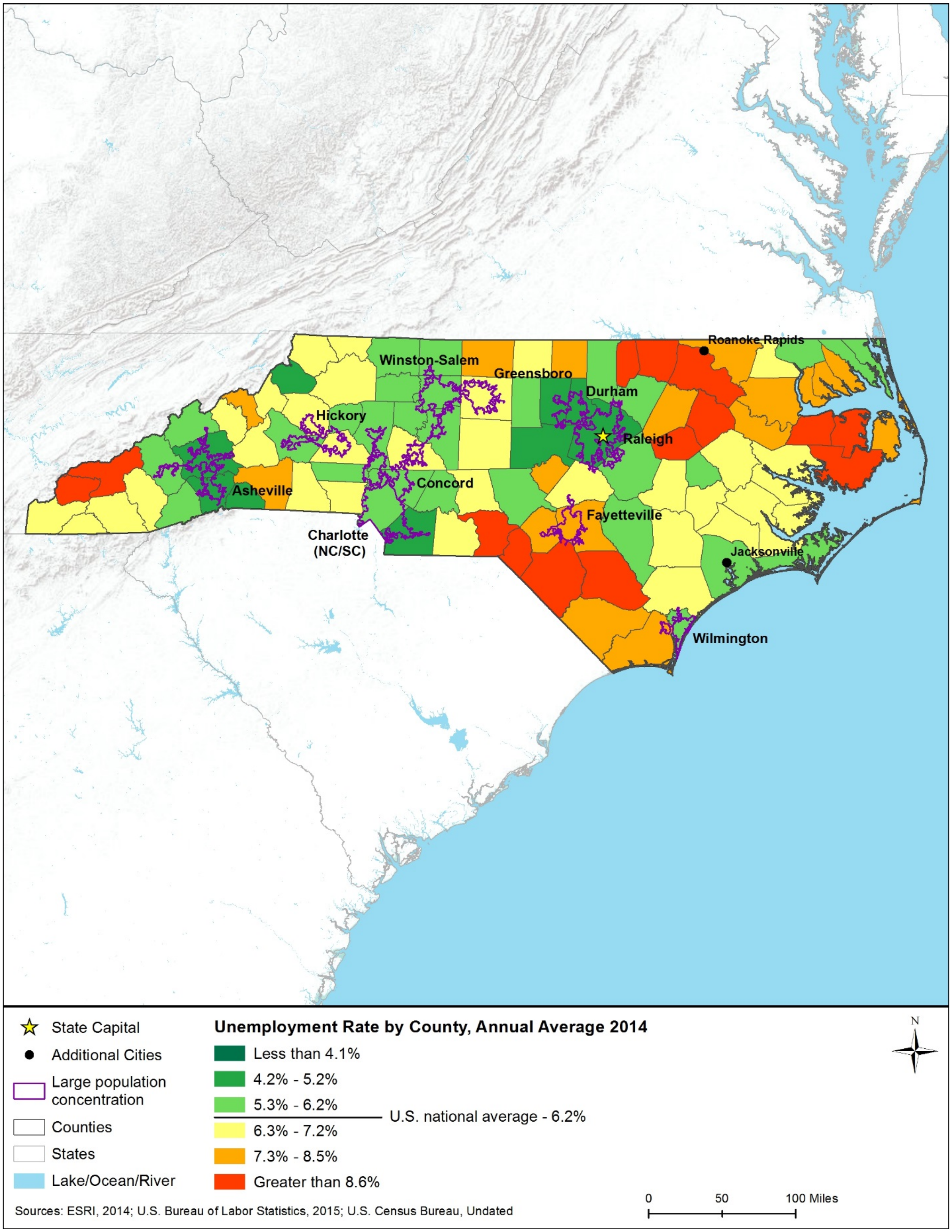

Figure 11.1.9-3: Unemployment Rates in North Carolina, by County, 2014

Table 11.1.9-6: Selected Economic Indicators for the 10 Largest Population Concentrations in North Carolina, 2009–2013

Area	Median Household Income	Average Annual Unemployment Rate
Asheville	$42,881	8.8%
Charlotte (NC/SC) (NC Portion)	$57,331	10.6%
Concord	$45,718	12.8%
Durham	$51,174	8.2%
Fayetteville	$44,984	14.0%
Greensboro	$43,668	10.3%
Hickory	$37,950	12.7%
Raleigh	$65,924	7.8%
Wilmington	$50,369	10.3%
Winston-Salem	$45,191	10.7%
North Carolina (statewide)	$46,334	11.1%

Source: (U.S. Census Bureau, 2015o)

Table 11.1.9-7: Employment by Class of Worker and by Industry, 2013

Class of Worker and Industry	North Carolina	South Region	United States
Civilian Employed Population 16 Years and Over	4,355,481	45,145,155	145,128,676
Percentage by Class of Worker			
Private wage and salary workers	79.4%	79.4%	79.7%
Government workers	14.8%	14.8%	14.1%
Self-employed in own not incorporated business workers	5.6%	5.6%	6.0%
Unpaid family workers	0.2%	0.2%	0.2%
Percentage by Industry			
Agriculture, forestry, fishing and hunting, and mining	1.3%	2.4%	2.0%
Construction	6.5%	6.9%	6.2%
Manufacturing	12.5%	9.9%	10.5%
Wholesale trade	2.6%	2.8%	2.7%
Retail trade	11.8%	12.1%	11.6%
Transportation and warehousing, and utilities	4.3%	5.2%	4.9%
Information	1.8%	1.9%	2.1%
Finance and insurance, and real estate and rental and leasing	6.3%	6.3%	6.6%
Professional, scientific, management, administrative, and waste management services	10.3%	10.5%	11.1%
Educational services, and health care and social assistance	23.4%	22.0%	23.0%
Arts, entertainment, recreation, and accommodation/food services	9.8%	9.9%	9.7%
Other services, except public administration	5.0%	5.2%	5.0%
Public administration	4.4%	4.8%	4.7%

Source: (U.S. Census Bureau, 2015m)

Table 11.1.9-8 presents employment shares for selected industries for the 10 largest population concentrations in the state. The table reflects survey data taken by the Census Bureau from 2009 to 2013. Thus, its figures for the state are slightly different from those in Table 11.1.9-7 for 2013.

Table 11.1.9-8: Employment by Selected Industries for the 10 Largest Population Concentrations in North Carolina, 2009–2013

Area	Construction	Transportation and Warehousing, and Utilities	Information	Professional, Scientific, Management, Administrative and Waste Management Services
Asheville	6.2%	2.4%	1.3%	10.2%
Charlotte (NC/SC) (NC Portion)	6.4%	5.1%	2.6%	12.6%
Concord	7.4%	5.4%	1.6%	9.1%
Durham	5.4%	2.3%	2.1%	14.4%
Fayetteville	5.0%	3.7%	1.6%	7.5%
Greensboro	4.8%	4.7%	2.3%	9.2%
Hickory	4.7%	3.8%	0.9%	5.8%
Raleigh	5.7%	3.5%	2.8%	17.4%
Wilmington	7.4%	3.9%	2.7%	11.7%
Winston-Salem	5.1%	4.2%	1.8%	10.1%
North Carolina (statewide)	6.8%	4.3%	1.8%	9.9%

Source: (U.S. Census Bureau, 2015o)

Housing

The housing stock is an important socioeconomic component of communities. The type, availability, and cost of housing in an area reflect economic conditions and affect quality of life. Table 11.1.9-9 compares North Carolina to the South region and nation on several common housing indicators.

As shown in Table 11.1.9-9, in 2013, North Carolina had a similar percentage of housing units that were occupied (85.5 percent) compared to the region (85.2 percent) and a lower percentage than the nation (87.6 percent). Of the occupied units, North Carolina had a percentage of owner-occupied units (64.3 percent) that was similar to that of the region (64.6 percent) and somewhat higher than that of the nation (63.5 percent). The percentage of detached single-unit housing (also known as single-family homes) for North Carolina in 2013 (65.3 percent) was higher than it was for the region (63.8 percent) and nation (61.5 percent). The homeowner vacancy rate in North Carolina (2.3 percent) was slightly higher than the rates for the region (2.2 percent) and nation (1.9 percent). This rate reflects “vacant units that are ‘for sale only’” (U.S. Census

Bureau, 2015p). The vacancy rate among rental units in North Carolina (7.5 percent) was lower than in the region (8.5 percent) and higher than in the nation (6.5 percent).

Table 11.1.9-9: Selected Housing Indicators for North Carolina, 2013

Geography	Total Housing Units	Housing Occupancy & Tenure				Units in Structure
		Occupied Housing	Owner-Occupied	Homeowner Vacancy Rate	Rental Vacancy Rate	1-Unit, Detached
North Carolina	4,394,515	85.5%	64.3%	2.3%	7.5%	65.3%
South Region	44,126,724	85.2%	64.6%	2.2%	8.5%	63.8%
United States	132,808,137	87.6%	63.5%	1.9%	6.5%	61.5%

Source: (U.S. Census Bureau, 2015q)

Table 11.1.9-10 provides housing indicators for the largest population concentrations in the state. The table reflects survey data taken from 2009 to 2013. Thus, its figures are not directly comparable to the more recent data in the previous table. However, it does present variation in these indicators for population concentrations across the state and compared to the state average for the 2009 to 2013 period. Table 11.1.9-10 shows that during this period, the percentage of occupied housing units in most of the 10 areas was higher than the state percentage (85.4 percent).

Table 11.1.9-10: Selected Housing Indicators for the 10 Largest Population Concentrations in North Carolina, 2009–2013

Area	Total Housing Units	Housing Occupancy & Tenure				Units in Structure
		Occupied Housing	Owner-Occupied	Homeowner Vacancy Rate	Rental Vacancy Rate	1-Unit, Detached
Asheville	136,811	87.5%	63.6%	2.3%	6.1%	61.5%
Charlotte (NC/SC) (NC Portion)	502,126	90.9%	63.1%	2.5%	7.1%	64.3%
Concord	90,341	87.5%	65.0%	3.1%	10.6%	72.7%
Durham	154,461	91.5%	52.4%	2.6%	7.3%	53.3%
Fayetteville	133,422	87.4%	52.3%	3.1%	8.7%	63.7%
Greensboro	142,458	89.1%	57.3%	3.1%	11.9%	58.5%
Hickory	93,092	86.4%	66.4%	2.4%	12.2%	67.0%
Raleigh	370,918	92.2%	64.6%	1.9%	7.6%	60.7%
Wilmington	110,301	85.0%	60.4%	3.2%	8.0%	62.2%
Winston-Salem	175,803	88.9%	64.1%	3.2%	12.2%	67.2%
North Carolina (statewide)	4,349,023	85.4%	66.4%	2.5%	8.7%	65.4%

Source: (U.S. Census Bureau, 2015r)

Property Values

Property values have important relationships to both the wealth and affordability of communities.

Table 11.1.9-11 provides indicators of residential property values for North Carolina and compares these values to values for the South region and nation. The figures on median value of owner-occupied units are from the Census Bureau's ACS, based on owner estimates of how much their property (housing unit and land) would sell for if it were for sale (U.S. Census Bureau, 2015p).

The table shows that the median value of owner-occupied units in North Carolina in 2013 ($154,300) was higher than the corresponding value for the South region ($137,752) and lower than that for the nation ($173,900).

Table 11.1.9-11: Residential Property Values in North Carolina, 2013

Geography	Median Value of Owner-Occupied Units
North Carolina	$154,300
South Region	$137,752
United States	$173,900

Source: (U.S. Census Bureau, 2015q)

Table 11.1.9-12 presents residential property values for the largest population concentrations in the state. The table reflects survey data taken from 2009 to 2013. Thus, its figures are not directly comparable to the more recent data in the previous table. However, it does show variation in property values for population concentrations across the state and compared to the state average for the 2009 to 2013 period. Of the 10 population concentrations, six had median values higher than the state median value of $153,600. These areas were the Asheville, Charlotte (North Carolina portion), Durham, Greensboro, Raleigh, and Wilmington areas. All other population concentrations had property values below the state value. The lowest values were in the Fayetteville and Hickory areas, which also had relatively low median household incomes (Table 11.1.9-6).

Table 11.1.9-12: Residential Property Values for the 10 Largest Population Concentrations in North Carolina, 2009–2013

Area	Median Value of Owner-Occupied Units
Asheville	$182,000
Charlotte (NC/SC) (NC Portion)	$188,300
Concord	$142,400
Durham	$199,700
Fayetteville	$130,400
Greensboro	$155,200
Hickory	$122,700
Raleigh	$226,000

Area	Median Value of Owner-Occupied Units
Wilmington	$211,800
Winston-Salem	$149,700
North Carolina (statewide)	$153,600

Source: (U.S. Census Bureau, 2015r)

Government Revenues

State and local governments obtain revenues from many sources. FirstNet Proposed Actions may affect flows of revenue sources between different levels of government due to program financing and intergovernmental agreements for system development and operation. Public utility taxes are a subcategory of selective sales taxes that includes taxes on providers of land and mobile telephone, telegraph, cable, and internet services (U.S. Census Bureau, 2006). These service providers may obtain new taxable revenues from operation of components of the public safety broadband network. These revenue streams are typically highly localized and therefore are best considered in the deployment phase of FirstNet.

Table 11.1.9-13 presents total and selected state and local government revenue sources as reported by the Census Bureau's 2012 Census of Governments. It provides both total dollar figures (in millions of dollars) and figures per capita (in dollars), based on total population for each geography. The per capita figures are particularly useful in comparing the importance of certain revenue sources in the state relative to other states in the region and the nation. State and local governments may obtain some additional revenues related to telecommunications infrastructure. General and selective sales taxes may change, reflecting expenditures during system development and maintenance.

Table 11.1.9-13 shows that state and local governments in North Carolina received more total revenue in 2012 on a per capita basis than their counterpart governments in the region, and less total revenue than did counterparts in the nation. Additionally, North Carolina state and local governments generally had lower or similar levels per capita of intergovernmental revenues[104]. The North Carolina state government obtained no revenue from property taxes. Local governments in North Carolina obtained lower levels of property taxes per capita than local governments in the region or nation. Similarly, for most sales and income taxes, North Carolina state and local governments received lower per capita revenues than counterparts in the region and nation. Notable exceptions are as follows. North Carolina local governments received slightly more per capita revenue from general sales taxes that counterparts in the nation. In comparison to counterparts in the region, the North Carolina state government received the same or higher per capita revenues from selective sales taxes, individual income taxes, and corporate income taxes. Individual income tax revenue, on a per capita basis, was also higher for the North Carolina state government than for state governments in the nation.

[104] Intergovernmental revenues are those revenues received by one level of government from another level of government, such as shared taxes, grants, or loans and advances (U.S. Census Bureau, 2006).

Table 11.1.9-13: State and Local Government Revenues, Selected Sources, 2012

Type of Revenue	North Carolina		Region		United States	
	State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount
Total Revenue ($M)	$56,470	$43,693	$524,374	$449,683	$1,907,027	$1,615,194
Per capita	$5,791	$4,480	$5,148	$4,414	$6,075	$5,145
Intergovernmental from Federal ($M)	$15,193	$2,150	$160,706	$18,171	$514,139	$70,360
Per capita	$1,558	$221	$1,578	$178	$1,638	$224
Intergovernmental from State ($M)	$0	$12,347	$0	$115,088	$0	$469,147
Per capita	$0	$1,266	$0	$1,130	$0	$1,495
Intergovernmental from Local ($M)	$306	$0	$2,815	$0	$19,518	$0
Per capita	$31	$0	$28	$0	$62	$0
Property Taxes ($M)	$0	$8,893	$2,073	$109,687	$13,111	$432,989
Per capita	$0	$912	$20	$1,077	$42	$1,379
General Sales Taxes ($M)	$5,574	$2,248	$82,651	$25,836	$245,446	$69,350
Per capita	$572	$230	$811	$254	$782	$221
Selective Sales Taxes ($M)	$3,966	$277	$41,447	$9,394	$133,098	$28,553
Per capita	$407	$28	$407	$92	$424	$91
Public Utilities Taxes ($M)	$382	$0	$5,101	$4,745	$14,564	$14,105
Per capita	$39	$0	$50	$47	$46	$45
Individual Income Taxes ($M)	$10,384	$0	$38,637	$1,226	$280,693	$26,642
Per capita	$1,065	$0	$379	$12	$894	$85
Corporate Income Taxes ($M)	$1,220	$0	$8,099	$114	$41,821	$7,210
Per capita	$125	$0	$80	$1	$133	$23

Sources: (U.S. Census Bureau, 2015s; U.S. Census Bureau, 2015t)
Note: This table does not include all sources of government revenue. Summation of the specific source rows does not equal total revenue.

11.1.10. Environmental Justice

11.1.10.1. Definition of the Resource

EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, issued in 1994, sets out principles of environmental justice and requirements that federal agencies should follow to comply with the EO (see Section 1.8, Overview of Relevant Federal Laws and Executive Orders).[105] The fundamental principle of environmental justice is "fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies" (USEPA, 2016a). Under the EO, each federal agency must "make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-

[105] See https://www.epa.gov/laws-regulations/summary-executive-order-12898-federal-actions-address-environmental-justice.

income populations" (Executive Office of the President, 1994). In response to the EO, the Department of Commerce developed an Environmental Justice Strategy in 1995, and published an updated strategy in 2013 (USDOC, 2013b).

In 1997, the Council on Environmental Quality (CEQ) issued *Environmental Justice: Guidance under the National Environmental Policy Act (NEPA)* to assist federal agencies in meeting the requirements of the EO (CEQ, 1997a). Additionally, the USEPA's Office of Environmental Justice (USEPA, 2015f) offers guidance on Environmental Justice issues and provides an "environmental justice screening and mapping tool," EJSCREEN (USEPA, 2015g).

The CEQ guidance provides several important definitions and clarifications that this PEIS utilizes:

- Minority populations consist of "Individual(s) who are members of the following population groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic."
- Low-income populations consist of individuals living in poverty, as defined by the U.S. Census Bureau (Census Bureau).
- Environmental effects include social and economic effects. Specifically, "Such effects may include ecological, cultural, human health, economic, or social impacts on minority communities, low-income communities, or Indian tribes when those impacts are interrelated to impacts on the natural or physical environment" (CEQ, 1997a).

11.1.10.2. Specific Regulatory Considerations

The NCDEQ (previously known as the Department of Environment and Natural Resources [DENR]) issued an Environmental Equity Policy in 2000 that set forth several goals for the agency, as follows:

- "To ensure that agency programs substantially affecting human health or the environment operate without discrimination,
- To provide information for citizens and neighborhood groups to allow meaningful participation in regulatory processes,
- To respond in a meaningful manner to allegations of environmental injustice,
- To provide a link for communication and information between the community, industries and the government,
- To increase awareness of environmental conditions in minority and low-income communities." (NCDEQ, 2000)

Federal laws relevant to environmental justice are described in Section 1.8, Overview of Relevant Federal Laws and Executive Orders.

11.1.10.3. Environmental Setting: Minority and Low-Income Populations

Table 11.1.10-1presents 2013 data on the composition of North Carolina's population by race and by Hispanic origin. The state's population has a higher percentage of individuals who identify as Black/African American (21.5 percent) than the populations of the South region (18.4 percent) and the nation (12.6 percent). For all other minority racial groups, North Carolina's population has similar percentages to those of the South region. The state has a smaller percentage of persons identifying as White (69.2 percent) than the South region (72.3 percent) or the nation (73.7 percent).

The percentage of the population in North Carolina that identifies as Hispanic (8.8 percent) is considerably smaller than in the South region (18.8 percent) and the nation (17.1 percent). Hispanic origin is a different category than race; persons of any race may identify as also being of Hispanic origin. The category All Minorities consists of all persons who consider themselves Hispanic or of any race other than White. North Carolina's All Minorities population percentage (35.8 percent) is lower than that of the South region (42.3 percent) or the nation (37.6 percent).

Table 11.1.10-2 presents the percentage of the population living in poverty in 2013, for the state, region, and nation. The figure for North Carolina (17.9 percent) is slightly lower than that for the South region (18.2 percent) and higher than the figure for the nation (15.8 percent).

Table 11.1.10-1: Population by Race and Hispanic Status, 2013

Geography	Total Population (estimated)	Race							Hispanic	All Minorities
		White	Black/ African Am	Am. Indian/ Alaska Native	Asian	Native Hawaiian /Pacific Islander	Some Other Race	Two or More Races		
North Carolina	9,848,060	69.2%	21.5%	1.1%	2.4%	0.1%	3.3%	2.4%	8.8%	35.8%
South Region	102,853,019	72.3%	18.4%	0.9%	2.6%	0.1%	3.3%	2.4%	18.8%	42.3%
United States	316,128,839	73.7%	12.6%	0.8%	5.1%	0.2%	4.7%	3.0%	17.1%	37.6%

Source: (U.S. Census Bureau, 2015u)
"All Minorities" is defined as all persons who consider themselves Hispanic or of any race other than White. Because some Hispanics identify as both Hispanic and of a non-White race, "All Minorities" is less than the sum of Hispanics and non-White races.

Table 11.1.10-2: Percentage of Population (Individuals) in Poverty, 2013

Geography	Percent Below Poverty Level
North Carolina	17.9%
South Region	18.2%
United States	15.8%

Source: (U.S. Census Bureau, 2015v)

11.1.10.4. Environmental Justice Screening Results

Analysis of environmental justice in a NEPA document typically begins by identifying potential environmental justice populations in the project area. Appendix D, Environmental Justice Methodology, presents the methodology used in this PEIS to screen each state for the presence of potential environmental justice populations. The methodology builds on CEQ guidance and best practices used for environmental justice analysis. It uses data at the census-block group level; block groups are the smallest geographic units for which regularly updated socioeconomic data are readily available at the time of writing. Figure 11.1.10-1 visually portrays the results of the environmental justice population screening analysis for North Carolina. The analysis used block group data from the Census Bureau's American Community Survey 2009-2013 5-Year Estimates (U.S. Census Bureau, 2015w) (U.S. Census Bureau, 2015x) (U.S. Census Bureau, 2015y; U.S. Census Bureau, 2015z) and Census Bureau urban classification data (U.S. Census Bureau, 2012; U.S. Census Bureau, 2015i).

Figure 11.1.10-1 shows that a very large proportion of North Carolina has high potential for environmental justice populations. The distribution of these high potential areas is somewhat uneven across the state, with more high potential areas in the eastern half of the state. High potential environmental justice areas occur both within and outside of the 10 largest population concentrations. Areas with moderate and low potential for environmental justice populations are somewhat more prevalent in the western part of the state.

It is important to understand how the data behind Figure 11.1.10-1 affect the visual impact of this map. Block groups have similar populations (hundreds to a few thousand individuals) regardless of population density. In sparsely populated areas, a single block group may cover tens or even hundreds of square miles, while in densely populated areas, block groups each cover much less than a single square mile. Thus, while large portions of the state outside the areas defined as large population concentrations show moderate or high potential for environmental justice populations, these low density areas reflect modest numbers of minority or low-income individuals compared to the potential environmental justice populations within densely populated areas. The overall effect of this relative density phenomenon is that the map visually shows large areas of the state having environmental justice potential, but this over-represents the presence of environmental justice populations.

It is also very important to note that Figure 11.1.10-1 does not definitively identify environmental justice populations. It indicates *degrees of likelihood of the presence* of populations of potential concern from an environmental justice perspective. Two caveats are important. First, environmental justice communities are often highly localized. Block group data may under or over-represent the presence of these localized communities. For instance, in the large block groups in sparsely populated regions of the state, the data may represent dispersed individuals of minority or low-income status rather than discrete, place-based communities. Second, the definition of the moderate potential category draws a wide net for potential environmental justice populations. As discussed in Appendix D, the definition includes some commonly used thresholds for environmental justice screening that tend to over-identify environmental justice potential. Before FirstNet deploys Proposed Actions, additional site-specific analyses to identify specific, localized environmental justice populations may be warranted. Such analyses could tier-off the methodology of this PEIS.

This map also does not indicate whether FirstNet Proposed Actions would have actual impacts on environmental justice populations. An environmental justice effect on minority or low-income populations only occurs if the effect is harmful, significant (according to significance criteria), and "appreciably exceeds or is likely to appreciably exceed the risk or rate to the general population or other appropriate comparison group" (CEQ, 1997a). Section 11.2, Environmental Consequences addresses the potential for disproportionately high and adverse environmental or human health impacts on environmental justice populations.

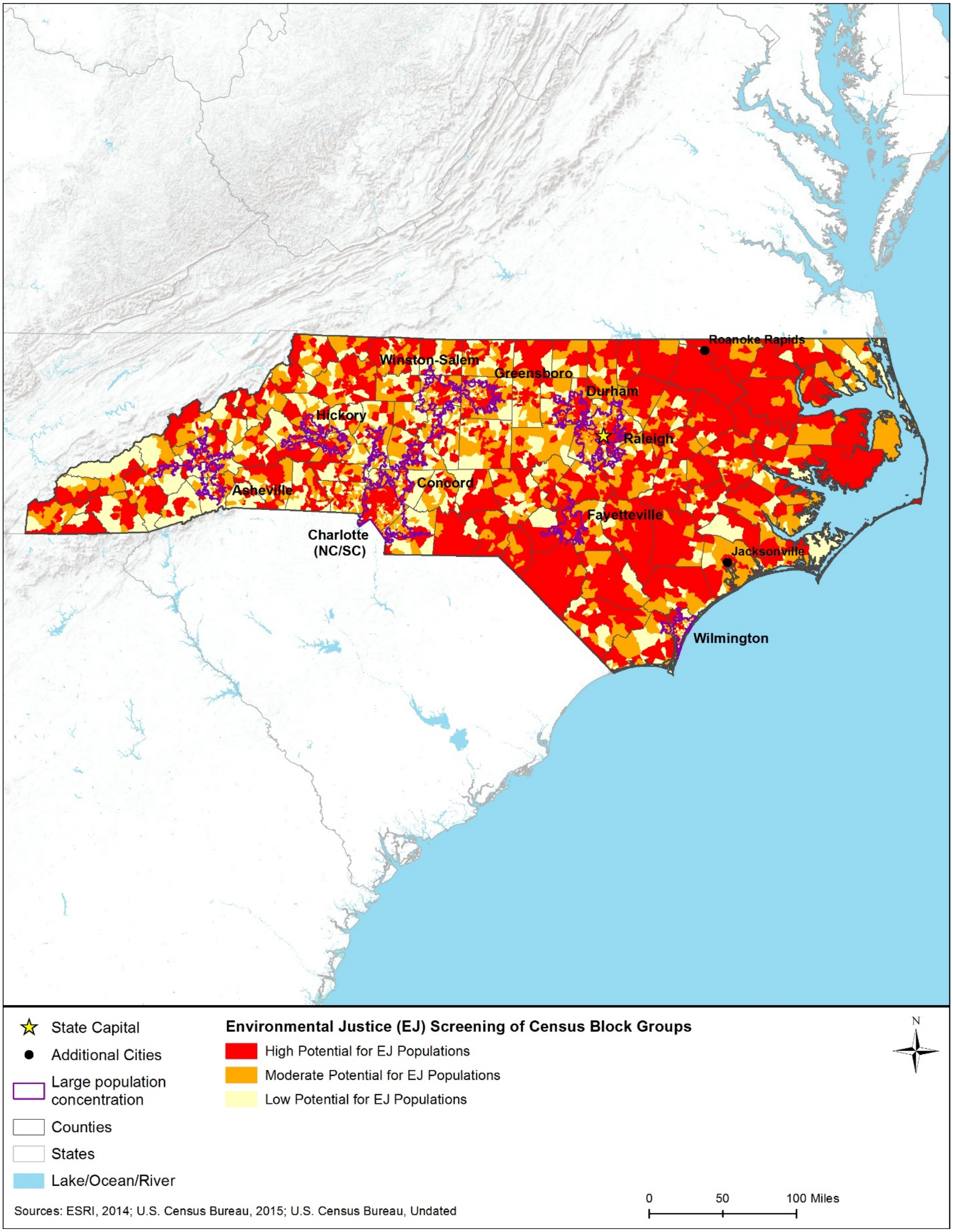

Figure 11.1.10-1: Potential for Environmental Justice Populations in North Carolina, 2009–2013

11.1.11. Cultural Resources

11.1.11.1. Definition of Resource

For the purposes of this PEIS, Cultural Resources are defined as:

> Natural or manmade structures, objects, features, locations with scientific, historic, and cultural value, including those with traditional religious or cultural importance and any prehistoric or historic district, site, or building included in, or eligible for inclusion in, the NRHP.

This definition is consistent with the how cultural resources are defined in the:

- Statutory language and implementing regulations for Section 106 of the NHPA, as amended, formerly 16 U.S.C. 470a(d)(6)(A) (now 54 U.S.C. 306131(b)) and 36 CFR 800.16(l)(1);
- Statutory language and Implementing regulations for the Archaeological Resources Protection Act of 1979 (ARPA), 16 U.S.C. 470cc(c) and 43 CFR 7.3(a);
- Statutory language and implementing regulations for the Native American Graves Protection and Repatriation Act (NAGPRA), 25 U.S.C. 3001(3)(D) and 43 CFR 10.2(d);
- NPS's program support of public and private efforts to identify, evaluate, and protect America's historic and archeological resources (NPS, 2015aa); and
- Advisory Council on Historic Preservation's (ACHP) guidance for protection and preservation of sites and artifacts with traditional religious and cultural importance to American Indian tribes or Native Hawaiian organizations (Advisory Council on Historic Preservation, 2004).

11.1.11.2. Specific Regulatory Considerations

The Proposed Action must meet the requirements of NEPA and other applicable laws and regulations. Applicable federal laws and regulations that apply to Cultural Resources such as the NHPA (detailed in section 1.8, Overview of Relevant Federal Laws and Executive Orders), the American Indian Religious Freedom Act (AIRFA), ARPA, and NAGPRA. Appendix C summarizes these pertinent federal laws.

North Carolina has a state law and related regulations that are similar to the NHPA (refer to Table 11.1.11-1). However, federal laws and regulations supersede state laws and regulations. While federal agencies may take into account compatible state laws and regulations, their actions that are subject to federal environmental review under NEPA and NHPA are not subject to compliance with such state laws and regulations.

Table 11.1.11-1: Relevant North Carolina Cultural Resources Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Protection of Properties in the National Register North Carolina (General Statute 121-12(a))	North Carolina State Historic Preservation Office (SHPO)	This Statute mirrors the NHPA for state undertakings, requiring agencies to consult with SHPO regarding potential impacts to historic properties.

11.1.11.3. Cultural and Natural Setting

In North Carolina, there is evidence of American Indian occupation dating back as early as 12000 B.C. After the last ice age, the climate began to change, which created an environment that was conducive to human habitation throughout the North Carolina (McWeeney & Kellogg, 2001; Coe, 1979; Tankersley, 1998). The state is geographically associated with the southeastern United States lying between the Continental Margin and Coastal Plain physiographic provinces. There are many waterways and drainage areas throughout the state, which provided the means for past cultures to adapt and flourish. The rivers and streams that existed before or developed during and after the last ice age provided a means for transportation allowing trade to develop. These waterbodies also provided a natural abundance of food sources that were exploited by early humans in the region. Eventually the abundance of water in the region led to agricultural practices that are still prevalent to this day (NPS, 2015w).

The geology of the region provided an abundance of raw materials that American Indians used to make tools, which furthered their ability to flourish in the region. Since the beginning of human settlement in North Carolina, the advancement of tool technology was crucial in the development of prehistoric societies (NPS, 2015w).

The climate in North Carolina is humid and temperate like most of the southeast, which is conducive to a diverse array of biological species of plants and animals. Due to the abundance of natural food sources in the region, people were able to thrive and develop into complex societies.

In addition to the hundreds of archaeological sites listed in the state's inventory, there are 28 archaeological sites listed on the NRHP: 13 are either historic, historic military, or aboriginal in origin; the other 15 sites are prehistoric in origin (NPS, 2014b).

Archaeologists typically divide large areas into regions to concentrate their studies. As depicted in Figure 11.1.3-1, there are two physiographic region in North Carolina: the Appalachian Highlands and Atlantic Plain. The Atlantic Plain encompasses the eastern half of the state and consists of the Coastal Plain province. The Appalachian Highlands spans the western half of North Carolina and contains two provinces. The majority of the region is Piedmont except for the western most area of the state, which contains the Blue Ridge province.

The following sections provide additional detail about North Carolina's prehistoric periods (approximately 11500 B.C. to A.D. 1500) and the historic period since European colonization in the 1500s. Section 11.1.11.4 presents an overview of the initial human habitation in Florida and the cultural development that occurred before European contact. Section 11.1.11.5 discusses the federally recognized American Indian tribes with a cultural affiliation to the state. Section 11.1.11.6 provides a current list of significant archaeological sites in Florida and tools that the state has developed to ensure their preservation. Section 11.1.11.7 document the historic context of the state since European contact, and Section 11.1.11.8 summarizes the architectural context of the state during the historic period.

11.1.11.4. Prehistoric Setting

There are four distinct periods associated with the prehistoric human populations that inhabited present day North Carolina: The Paleoindian period (11500 to 7000 B.C.), Archaic (7000 to 1000 B.C.), Woodland (1000 B.C. to A.D. 1100), and Mississippian (A.D. 1100 to 1500). Figure 11.1.11-1 shows a timeline representing these periods of early human habitation in North Carolina. It is important to note that there is potential for undiscovered archaeological remains representing every prehistoric period throughout the state. Evidence of human occupation has been discovered in every physiographic region of North Carolina (Anderson, 1995).

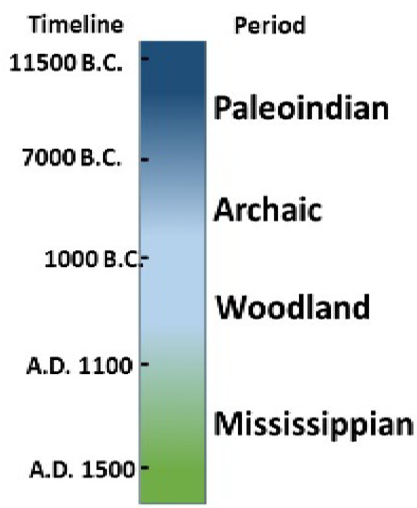

Figure 11.1.11-1: Timeline of Prehistoric Human Occupation in North Carolina
Source: (North Carolina Office of State Archeology, 2015) (Institute of Maritime History 2015)

Paleoindian Period (11500 – 7000 B.C.)

The Paleoindian Period represents the earliest human habitation of the southeast United States. During this period, the climate was neither as dry nor as warm as in present-day North Carolina. Evidence of early humans in North Carolina is based on the discovery of fluted projectile points, commonly called “arrowheads,” that are found on the surface, in shallow deposits, deep alluvial deposits, along the coast, and submerged. It is likely that the earliest people to occupy the state were small groups of nomadic hunters and gatherers that used a small inventory of chipped-stone tools known as “fluted javelin head” spear points or Clovis form spear point (another group of fluted points). Archaeologists have concluded that humans of the Paleoindian Period formed small bands, which ranged across the state as they followed migratory game. The people hunted various game including a number of species that are now extinct. It is believed that the Paleoindians lived in nomadic small family bands of around 30 to 40 people. The archaeological evidence indicates that they were related to people who spread into North America via a land bridge at the Bering Strait during the latter part of the last ice age (Late Pleistocene epoch (Pichardo, 2005; Coe, 1979; Tankersley, 1998)). (Anderson, et al., 2010; McWeeney & Kellogg, 2001; Daniel, Moore, & Pritchard, 2007; Tankersley, 1998).

Archaic Period (7000 – 1000 B.C.)

The temperatures became warmer during the Archaic Period and there were greater seasonal variations in the climate. By this time in North America, the continent was experiencing the final glacial retreat from the last ice age. The climate was becoming much more like the present, and various flora and fauna presently found in North Carolina began to be established. The Archaic Period in North Carolina is divided into the Early, Middle, and Late phases (Haag, 1961).

Much like the Paleoindians that preceded them, early Archaic Period people were hunter-gathers whose diet consisted of wild plants and animals. Their technology relied upon chipped stone from which arrow points and other tools such as drills, choppers, flake knives, scrapers, gouges, and hammerstones were manufactured. The people began to develop into permanent settlements around streams and rivers where potable water could be found. Based on the number of archaeological sites in the region, populations grew during the Archaic Period (Haag, 1961; NPS, 2015w). North Carolina and the east coast of the United States experienced dry and warming episodes during the early archaic, which created a more diversified environment (McWeeney & Kellogg, 2001).

By the middle of the Archaic Period, populations continued to increase and societies became more regionalized. Tools became more sophisticated, and the first sign of grinding implements that have been discovered date to this period; this is clear evidence that horticulture started to take hold (McWeeney & Kellogg, 2001).

People continued to hunt and exploit their environment for wild plants that were available for consumption. Shellfish exploitation along river valleys and the seacoast continued to increase during this period. A number of archaeological sites that date from the Middle Archaic include storage pits and the, remains of house floors, as well as associated burials are all indications that people were beginning to be less nomadic and more sedentary (NPS, 2015x; Alvey, 2005).

The Late Archaic period of North Carolina and much of the southeastern United States experienced an increasing trend towards regionalization and an increase in sedentary societies. The first sign of fiber-tempered fired and decorated ceramic technology becomes evident in the archaeological record at this time, preceding the Woodland and Mississippian cultures that would follow (McWeeney & Kellogg, 2001).

What is known as the Gulf Formational period occurred around 4,500 to 3,200 years ago in North Carolina, South Carolina, Georgia, northern Florida, middle Tennessee, and eastern Mississippi. Fiber-tempered ceramic technology was invented because of “trade between the Stallings Island and Orange cultures of the South Atlantic coast and the Poverty Point culture of the lower Mississippi River Valley." At the end of the Archaic and throughout the Woodland period's pottery went from the plain type, then to fire-tempered, then fabric impressed and finally cord-marked sand-tempered ceramics (NPS, 2015w).

Woodland Period (1000 B.C. – ca. A.D. 1100)

Similar to the Archaic Period, the Woodland Period is divided into three sequential stages: Early, Middle, and Late. The three stages are defined by phases of cultural development, based on archaeological evidence at temporal (place in time) locations. During the course of the Woodland Period, there is a continuing shift from a semi-nomadic to lifestyles that are more sedentary and a continued expansion of horticulture among area cultures (NPS, 2015w).

Hunting and fishing was the predominant form of subsistence during the Early Woodland Stage. Maize, beans, and squash cultivation increased along with more variations in typed of this important subsistence. Although more deliberate attempts at farming began to be established, the collection of shellfish and wild plants also occured. The introduction of pottery manufacturing took place during this period, and most Early Woodland sites show evidence of this. Analyzing different types of pottery is how archaeologists often differentiate between early, middle, and late Woodland period archaeological sites (NPS, 2015w).

The practice of mound building continued throughout the Middle Woodland period. The ceremonial earthen mounds contained graves of elite individuals. Graves containing exotic gifts presumably to accompany the dead into the afterlife are prevalent throughout the state. Towards the end of the Early Woodland and into the Middle Woodland, there is evidence of long distance trade. One example of long distance trade is the exchange of items made with meteoritic iron used for various type of jewelry, beads, earspools, buttons, and headdresses, found within sites in northern North Carolina. (NPS, 2015w)

The Late Woodland is characterized by an extension of the Middle Woodland, with continued advancements in cultural productivity for hunting and housing. The bow and arrow also replaced the atlatl, which allowed for greater efficiency in hunting (NPS, 2015w). Housing and villages during the Late Woodland represent a shift to more significant kinship structures and a life style of environmental adaptation (Rodning & VanDerwarker, 2002).

Archaeological sites become smaller during this period; however, there is a significant increase in the numbers of preserved sites (NPS, 2015x).

Due to the limited access to and studies of the skeletal remains from burials of this period, it is unclear from them the types of physical stresses, diseases, and the overall health of these groups, as wel as how much intermarriage was occurring between the areas various groups. More research is needed to determine how the various cultures within this region were interacting with one another overall (Killgrove 2009).

Mississippian Period (A.D. 1100 – 1500)

Since 2009, there has been increasing research on the Mississippian culture due to new theories and tools. Most of the research conducted prior to 2009 was focused on the Chiefdom cultures that dominated most of the region. Some of the more recent research has focused on the cultures that existed outside of the chiefdoms (Blitz, 2010).

The Mississippian Period is considered to include the most complex cultures to understand in the prehistoric southeast, including North Carolina. Chiefdoms continued to become more elaborate, and “an ideological belief system called the Southeastern Ceremonial Complex” (Bense, 1996), was being practiced. They built “large platform mounds which were often concentrated in civic-ceremonial centers at the political capital of the chiefdoms” (Bense, 1996; Beck & Moore, 2002).

Maize cultivation was being practiced, but not in all of the Mississippian period societies in the southeast. However, techniques for the long-term storage of food were becoming more commonplace. Deer, fish, and nuts remained common foods. Large-scale maize farming allowed for the increased of abundance of food that could support the growing chiefdoms. Hunting, fishing, gathering of wild plants along bays and estuaries were predominant in the coastal regions of Florida. Agriculture and the exploitation of fisheries and coastal resources were important forms of subsistence. (Bense, 1996)

Prior to the Spanish exploration of the region, the Mississippian culture had expanded its presence throughout much of the southeast and the Ohio River Valley. A Mississippian site discovered in the upper Yadkin Valley of North Carolina includes the location of a possible public building and “one burial containing lavish goods” (Woodall, 1999).

11.1.11.5. Federally Recognized American Indian Tribes of North Carolina

According to the Bureau of Indian Affairs and the National Conference of State Legislators, the Eastern Band of Cherokee Indians of North Carolina is the only federally recognized American Indian tribe in North Carolina (NCSL, 2015; GPO, 2015). Figure 11.1.11-2 shows the general historic location of other American Indian tribes that were known to exist in this region of the United States, but are not officially federally recognized.

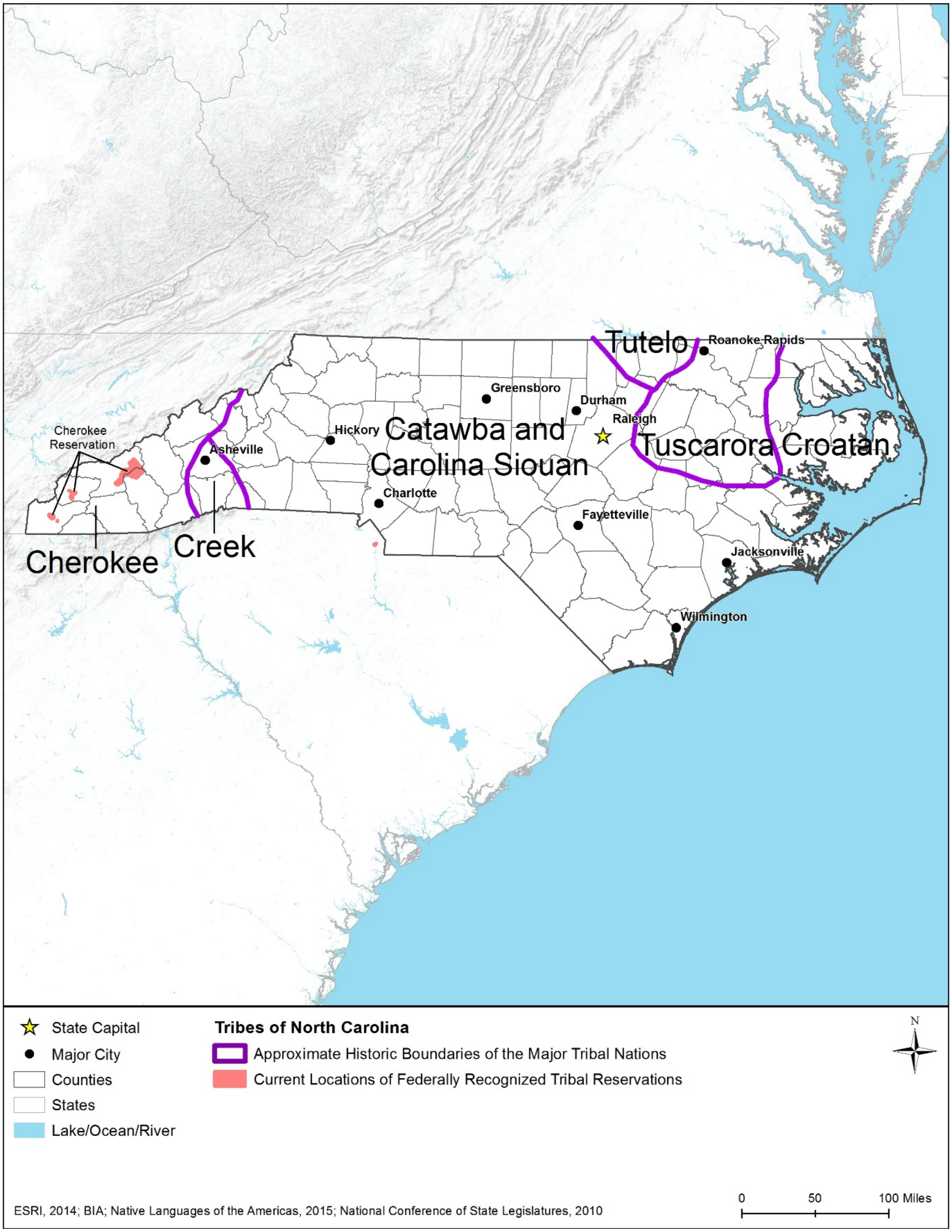

Figure 11.1.11-2: Historic Boundaries of Major Tribal Nations in North Carolina

11.1.11.6. Significant Archaeological Sites of North Carolina

There are 46 archaeological sites in North Carolina listed on the NRHP. Table 11.1.11-2 lists the names of the sites, the city they are closest to, and type of site. Both prehistoric and historic archaeological sites are listed. The number of archaeological sites increase as new sites are discovered. A current list of NRHP sites can be found on the NPS NRHP website at http://www.nps.gov/nr/ (NPS, 2015y).

North Carolina State Cultural Resources Database and Tools

North Carolina State Historic Preservation Office

The North Carolina State Historic Preservation Office operates as part of the North Carolina Division of Historical Resources (NDCR) and provides tools and resources for citizens and institutions to protect historically significant properties within the state. The website of the NCSPO gives users access to statewide surveys of historic locations, grant assistance for preservation efforts, and educational resources. The organization also publishes their own online newsletter *Worth Saving*, which details the latest activities relevant to the preservation community (NCDOT, 2015c).

North Carolina Preservation Consortium (NCPC)

The North Carolina Preservation Consortium is a privately operated, non-profit organization that exists to aid in the preservation of both historical properties and historical artifacts. The Consortium takes a proactive, community based approach to education by offering reasonably priced workshops as well as an annual conference centered on a specific aspect of preservation. The leadership of this organization is entirely volunteer driven and funds largely come from community sponsorship (NCDEQ, 2015b).

North Carolina Archaeological Society

Boasting a sixty-year history of preservation efforts and hundreds of members throughout the state, The North Carolina Archaeological Society exists to study archaeological resources and advocate for their proper care. The organization offers memberships that include access to meetings, workshops, and even opportunities to participate in excavations. The society also has their own journal publication, *North Carolina Archaeology,* which contains recent scholarly articles about archaeological research specifically pertaining to North Carolina (North Carolina Archaeological Society, 2015).

North Carolina Preservation Consortium

Preservation North Carolina, better known as the North Carolina Preservation Consortium, was founded in 1939. This nonprofit aims to “protect and promote buildings, landscapes, and sites important to the diverse heritage of North Carolina” (Preservation North Carolina, 2016). In total, this nonprofit “has saved more than 700 endangered historic properties, generating an estimatd $350 million in private investment” (Preservation North Carolina, 2016). Beyond generating investments, the work of this nonprofit has helped to raise awareness “about the value and promise of historic preservation to local communities” (Preservation North Carolina, 2016).

Table 11.1.11-2: Archaeological Sites on the National Register of Historic Places in North Carolina

Location (closest city)	Site Name	Type of Site
Alamance	Alamance Battleground State Historic Site	Military
Amelia	Hash, Bays, Site	Prehistoric
Asheboro	Mount Shepherd Pottery Site	Historic
Asheboro	Thayer Farm Site (31RD10)	Prehistoric
Atlantic Beach	Queen Anne’s Revenge	Shipwreck
Badin	Site 31Mg22	Prehistoric
Badin	Hardaway Site (31ST4)	Prehistoric
Cape Hatteras	E.M. CLARK (shipwreck and remains)	Shipwreck
Cape Hatteras	EMPIRE GEM (shipwreck and remains)	Shipwreck
Cape Hatteras	USS MONITOR	Shipwreck
Carolina Beach	Homesite (31Nh95**1)	Historic
Carolina Beach	Newton Homesite and Cemetery	Historic
Chapel Hill	Little Creek Site (31 DH 351)	Prehistoric
Chapel Hill	Hogan, Alexander, Plantation	Historic
Charlotte	Robinson Rock House Ruin and Plantation Site	Historic
Cherokee	Nununyi Mound and Village Site	Historic - Aboriginal, Prehistoric
Cherokee	Oconaluftee Archeological District	Historic - Aboriginal, Prehistoric
Crumpler	Alexander, Shubal V., Archeological District	Historic - Aboriginal, Prehistoric
Crumpler	Brinegar District	Prehistoric
Donnaha	Richmond Courthouse Site	Historic
East Bend	Donnaha Site	Prehistoric
Eden	Lower Sauratown Plantation	Historic
Eden	Site 31RK1	Prehistoric
Eden	Tanyard Shoal Sluice	Historic
Eden	Three Ledges Shoal Sluice	Historic
Eden	Wide Mouth Shoal Sluice	Historic
Fayetteville	Confederate Breastworks	Historic, Military
Fayetteville	North Carolina Arsenal Site	Historic, Military
Fort Fisher	U.S.S. PETERHOFF	Shipwreck
Franklin	Cowee--West’s Mill Historic District	Historic - Aboriginal, Prehistoric
Franklin	Nequasee	Historic - Aboriginal, Prehistoric
Greensboro	Caldwell, David, Log College Site	Historic
Greensboro	Guilford Courthouse National Military Park	Historic
Hamilton	Rhodes Site (31BR90)	Prehistoric
Hamilton	Fort Branch Site	Military
Hayesville	Spikebuck Town Mound and Village Site	Historic - Aboriginal, Prehistoric
Hickory	Yoder’s Mills Historic District	Historic
High Falls	Gordon Payne Site (31MR15)	Prehistoric
Jamestown	McCulloch’s Gold Mill	Historic
Jefferson	Poe Fish Weir	Historic, Prehistoric

Location (closest city)	Site Name	Type of Site
Kinston	CSS Neuse (Ironclad Gunboat)	Shipwreck
Madison	Cross Rock Rapid Sluice	Historic
Madison	Gravel Shoals Sluice	Historic
Madison	Jacob's Creek Landing	Historic
Madison	Mayo River Sluice	Historic
Madison	Roberson's Fish Trap Shoal Sluice	Historic
Madison	Slink Shoal Sluice and Wing Dams	Historic
Manteo	Fort Raleigh National Historic Site	Historic
Moncure	Newkirk State (Site 3lCH366)	Prehistoric
Monroeton	Troublesome Creek Ironworks	Historic, Military
Morgan's Corner	Newland Road Site	Historic
Mount Gilead	Town Creek Indian Mound	Prehistoric
Murfreesboro	Princeton Site	Historic, Historic - Aboriginal, Prehistoric
Nags Head	USS Huron	Shipwreck
New Haven	Gambill, J. C., Site	Prehistoric
Ocracoke	Dixie Arrow (shipwreck and remains)	Shipwreck
Poplar Branch	Baum Site	Prehistoric
Princeton	Bentonville Battleground State Historic Site	Military
Rutherfordton	Bechtler Mint Site	Historic
Snow Hill	Neoheroka Fort Site	Historic, Military
Statesville	Turner, Henry, House and Caldwell-Turner Mill Site	Historic
Tryon	Blockhouse Site	Historic
Wentworth	Dead Timber Ford Sluices	Historic
Wentworth	Eagle Falls Sluice	Historic
Wests Mill	Cowee Mound and Village Site	Historic, Historic - Aboriginal
Williamston	Biggs, Asa, House and Site	Historic
Wilmington	Wilmington Historic and Archeological District	Historic, Military
Wilmington Beach	Cape Fear Civil War Shipwreck Discontiguous District	Shipwreck
Wilsonville	New Hope Rural Historical Archeological District	Historic
Winston-Salem	Spach, Adam, Rock House Site	Historic - Aboriginal
Winston-Salem	Single Brothers Industrial Complex Site	Historic

Source: (NPS, 2015y)

11.1.11.7. Historic Context

In 1524, Giovanni de Verrazano became the first known European to explore present-day North Carolina. In 1540, with the Spanish king's approval, Hernando de Soto traveled through the western part of the state in search of gold. The Spanish military officer, Juan Pardo, followed with two expeditions from the Spanish colony of Santa Elena on the South Carolina coast (Parris Island) in 1566-67 and again in 1567-68 (USC, 1987). Beginning in 1584, with the permission of Queen Elizabeth I, Sir Walter Raleigh attempted to establish an English colony on Roanoke

Island, a barrier island that was at the time part of Virginia. The colony was abandoned before 1590 and the fate of the colonists remains unknown. In 1655, an English fur trader, Nathaniel Batts, became the state's first permanent settler. However, the first town in present-day North Carolina, Bath, was not established until 1705 (North Carolina Secretary of State, 2015).

Conflicts with the indigenous population were common during the 17th and early 18th centuries and most American Indian communities were forced out of the area that is now North Carolina (North Carolina Secretary of State, 2015). In 1729, North Carolina split away from South Carolina to form its own colony (UNC School of Education, 2015). In 1770, Tryon Palace, a large Georgian estate in New Bern, was completed and served as the first permanent capital. Tryon Palace burned in 1798, but was reconstructed in 1959 (Tryon Palace, 2015). Early North Carolina had many ethnicities comprising its population, with New Bern being settled by Swiss and German immigrants. In 1776, it was the first colony to vote for independence. After the American Revolution, the University of North Carolina was founded in 1789. In 1794, Raleigh became the state capital (North Carolina Secretary of State, 2015).

During the early 1800s, economic progress was slow in North Carolina (North Carolina Secretary of State, 2015). Agriculture dominated, with cotton, rice, corn, tobacco, and other crops being grown with the help of enslaved workers (UNC School of Education, 2015). At the onset of the Civil War, North Carolina seceded from the Union and joined the Confederacy. Approximately 40,000 Confederate soldiers from the state were killed during the Civil War, with the Battle of Bentonville in March 1865 being the worst battle to occur in the state. Following the assassination of President Lincoln, North Carolina-native Andrew Johnson became President and led the country into the initial phases of Reconstruction. North Carolina was readmitted to the Union on July 4, 1868 (North Carolina Secretary of State, 2015).

After the Civil War, newly freed African-American families became a staple of the sharecropping economy, and landless Caucasian sharecroppers moved into the workforce at textile factories to spin cotton grown in the state. The main industries in the state after the Civil War were tobacco, timber, and textiles (NCDCR, 2011). In 1903, the Wright brothers made the first successful flight in Kitty Hawk in the Outer Banks. In 1918, Fort Bragg was established during World War I (WWI) (originally Camp Bragg); today, it is one of the largest U.S. military installations (North Carolina Secretary of State, 2015). Bright leaf tobacco production became increasingly important during the early 20th century. During the Great Depression, farmers were hurt by falling prices and relied heavily on New Deal economic aid to subsidize their incomes (Walbert, 2015). 'Today, North Carolina is largely rural, with urbanization concentrated in a few areas, such as the Raleigh-Durham-Chapel Hill area, known as "The Triangle".

"North Carolina has 2,880 NRHP listed sites, as well as 38 NHLs (NPS, 2014b). North Carolina contains the Blue Ridge National Heritage Area (NHA) and a portion of the Gullah/Geechee National Heritage Corridor" (NPS, 2015z). Figure 11.1.11-3 shows the location of NHA and NRHP sites within North Carolina.[106]

[106] See Section 11.1.7, Land Use, Recreation, and Airspace, for a more in-depth discussion of additional historic resources as they relate to recreational resources.

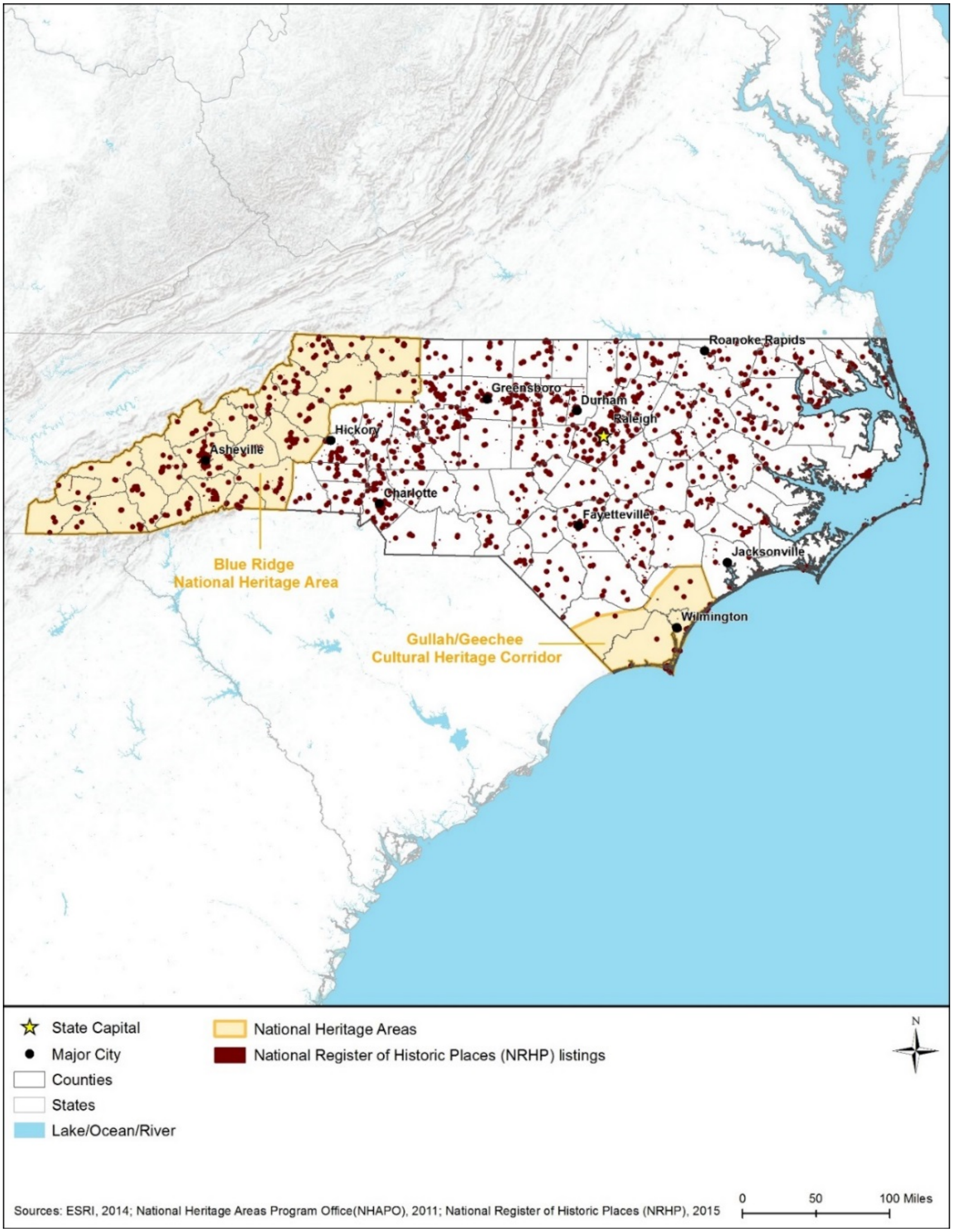

Figure 11.1.11-3: NHA and NHRP Sites in North Carolina[107]

[107] The oddly shaped polygons in this figure are artifacts of available data of NRHP district listings. The accuracy of the location data for these resources varies, resulting in variations in the appearance of each resource.

11.1.11.8. Architectural Context

North Carolina has traditionally been dominated by agriculture, and has developed fewer large cities and seaports than its immediate neighbors have. Late 17th and early 18th century buildings were built primarily of logs due to the ample supply of good lumber need for immediate shelter, and lack of highly skilled builders. In these early structures, dirt floors were common, as were wood chimneys and wood foundations (the latter of which were prone to rot and insect damage). Log houses continued to be built into the late 19th century in rural areas. Some wealthy settlers were able to construct brick homes, which have survived in greater numbers, such as the Newbold-White House (1730), in Perquimans County (Bishir, 2005).

In the early 18th century, Georgian architecture came into style. The Palmer-Marsh House (1740) in Bath, and Milford (1746) in Camden County, are two examples. Heavy timber framing or brick masonry were employed to construct houses. Many houses featured double-pitched gable roofs, some of which were built this way initially, and some of which were extended later covered rear additions or front piazza (porches). Porches were often two stories in height and were common in North Carolina due to the climate necessitating an outdoor living space. These architectural tendencies resemble those found in other coastal states like South Carolina and Georgia, as well as in the Caribbean, with whom the southern states traded both goods and ideas. Larger towns like Wilmington and New Bern have collections of high-style buildings, while architecture in rural areas is often more vernacular (Bishir, 2005).

Following the American Revolution, Federal style architecture became popular and, as with Georgian architecture, was applied to a variety of building types and sizes. Wealthier residents could employ master builders and, later, architects using contemporary pattern books to design elaborate houses, while local builders often interpreted styles themselves, resulting in more vernacular houses. Grace Reform Church (1795) in Rowan County is an example of a Lutheran Church built in the Federal style. As the state developed following the American Revolution, government projects were undertaken. The construction of lighthouses along the state’s barrier islands is a great example. Bald Head Island Lighthouse (1817) still stands today; fortifications, such as Fort Macon (1826-1834), and other civic buildings were built as well (Bishir, 2005).

Greek Revival architecture became popular in the second quarter of the 19th century. The North Carolina State Capitol (1833-1840) in Raleigh is a prominent example (Bishir, 2005). In Greensboro, John Motley Morehead, the former North Carolina Governor, employed famed 19th century architect Alexander Jackson Davis to create Blandwood, “the oldest example of Italianate architecture in the United States” (NC ECHO, 2016). Institutional buildings were built in the Greek Revival style as well, such as Smith Hall (1850-1852) at the University of North Carolina at Chapel Hill, and the Bank of Washington (1854) in the town of Washington. Plantation houses adopted this style, as did smaller farmsteads. Starting before the Civil War, and continuing afterwards, picturesque styles like Gothic Revival and Italianate became popular, with Gothic Revival being especially common in church architecture. This trend lasted into the 20th century (Bishir, 2005).

Following the Civil War, the recovery period brought a host of new building trends and styles. Government projects continued to be built, with Cape Hatteras Lighthouse (1867-870) being an example of a coastal project meant to aid navigation. In 1999, the entire lighthouse was moved further inland to prevent its collapse from the eroding coastline. Italianate buildings were still being built, as were Folk Victorian, Second Empire, Stick, and Queen Anne during the latter part of the 19th century and into the early 20th century. The Payne House (1890) in Buncombe County is an example from this period. Flue-cured tobacco barns were constructed in large numbers during the latter part of the 19th century and early 20th century, as Bright leaf tobacco production increased (Bishir, 2005).

Wealthy industrialists displayed their wealth through architecture, with George Washington Vanderbilt's Biltmore Estate (1890-1895) in Asheville serving as the nation's largest private residence ever built (Bishir, 2005). Industry increased during the early 20th century and associated resource like textile mills and rail yards were built. Recreational development expanded as well, particularly in the beach communities on barrier islands. Domestic housing followed popular trends, with revival styles like Colonial Revival and Tudor Revival being popular during the early 20th century. Bungalows with Craftsman details, as well as Prairie style houses were popular between WWI and WWII; minimal traditional houses and ranch houses were popular following WWII (Bishir, 2005). Modern styles were built as well, such as Art Deco, Art Modern, and International. Buildings of these styles were popular during the Great Depression, often as a part of work recovery programs (Bishir, 2005). As is the case with other states that have an agricultural history, suburbanization around major cities has continued to threaten rural historic resources, with many historic structures lost following WWII when suburban growth exploded during the 1950s and 1960s and before most federal, state and local historic preservation laws were enacted.

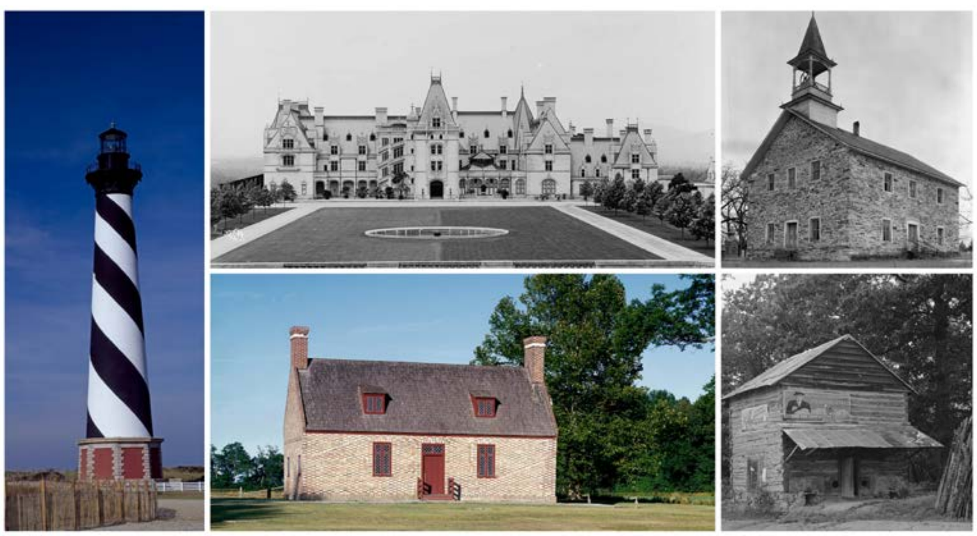

Figure 11.1.11-4: Representative Architectural Styles of North Carolina

- Left – Cape Hatteras Lighthouse (Cape Hatteras, NC) – (Highsmith 1980a)
- Top Middle – Biltmore House (Asheville, NC) – (Detroit Publishing Company 1902)
- Bottom Middle – Newbold-White House (Perquimans, NC) – (Highsmith, Newbold-White House, North Carolina's oldest brick house located in Perquimans County, North Carolina 1980b)
- Top Right – Grace Lower Stone Church (Rockwell, NC) – (Johnston 1938)
- Bottom Right – Tobacco Barn (Gordonton, NC) – (Lange 1939)

11.1.12. Air Quality

11.1.12.1. Definition of the Resource

Air Quality in a geographic area is determined by the type and amount of pollutants emitted into the atmosphere, the size, and topography[108] of the area, and the prevailing weather and climate conditions. The levels of pollutants and pollutant concentrations in the atmosphere are typically expressed in units of parts per million (ppm)[109] or micrograms per cubic meter (μg/m^3) determined over various periods (averaging time).[110] This section discusses the existing air quality in North Carolina. The USEPA designates areas within the United States as attainment,[111] nonattainment,[112] maintenance,[113] or unclassifiable[114] depending on the concentration of air pollution relative to ambient air quality standards. Information is presented regarding national and state ambient air quality standards and nonattainment areas that would be potentially more sensitive to impacts from implementation of the Proposed Action or Alternatives.

North Carolina has four separate and distinct air regulatory authorities that enforce federal, state and local regulations for protecting air quality – NCDEQ, Buncombe County (provided by the Western North Carolina (WNC) Air Quality Agency), the Forsyth County Office of Environmental Assistance and Protection (OEAP), and Mecklenburg County Air Quality Commission (MCAQC). The North Carolina DEQ is responsible for the entire state with exception of Buncombe County (covered by WNC Air Quality), Forsyth County, and Mecklenburg County. Each air regulatory authority maintains its own air regulations, state implementation plan (SIP) (except WNC Air Quality Agency), and ambient air quality standards.

11.1.12.2. Specific Regulatory Considerations for the North Carolina DEQ

National and State Ambient Air Quality Standards

The Clean Air Act (CAA) establishes National Ambient Air Quality Standards (NAAQS) for six criteria pollutants: Carbon monoxide (CO), lead, oxides of nitrogen (NO_2), particulate matter ($PM_{2.5}$ and PM_{10}), ozone (O_3), and oxides of sulfur (SO_2). The NAAQS establish various

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108 Topography: The unique features and shapes of the land (e.g., valleys and mountains).

109 Equivalent to 1 milligram per liter (mg/L).

110 Averaging Time: "The period over which data are averaged and used to verify proper operation of the pollution control approach or compliance with the emissions limitation or standard" (USEPA, 2015c).

111 Attainment areas: Any area that meets the national primary or secondary ambient air quality standard for the pollutant. (USEPA, 2015a)

112 Nonattainment areas: Any area that does not meet (or that contributes to ambient air quality in a nearby area that does not meet) the national primary or secondary ambient air quality standard for the pollutant (USEPA, 2015a).

113 Maintenance areas: An area that was previously nonattainment, but has met the national primary or secondary ambient air quality standards for the pollutant, and has been designated as attainment (USEPA, 2015a).

114 Unclassifiable areas: Any area that cannot be classified on the basis of available information as meeting the national primary or secondary air quality standard for a pollutant (USEPA, 2015a).

standards, either primary[115] or secondary,[116] for each pollutant with varying averaging times. Standards with short averaging times (e.g., 1-hour, 8-hour, and 24-hour) were developed to prevent the acute health effects from short-term exposure at high concentrations. Longer averaging periods (e.g., 3 months or annual) are intended to prevent chronic health effects from long-term exposure. A description of the NAAQS is presented in Appendix E, National Ambient Air Quality Standards.

In addition to the NAAQS, there are standards for hazardous air pollutants (HAP), which are those typically associated with specific industrial processes such as chromium electroplating (hexavalent chromium), dry cleaning (perchloroethylene), and solvent degreasing (halogenated solvents) (USEPA, 2016). HAPs can have severe adverse impacts on human health and the environment, including increased risk of cancer, reproductive issues, or birth defects. HAPs are federally regulated under the CAA via the National Emission Standards for Hazardous Air Pollutants (NESHAPs). USEPA developed the NESHAPs for sources and source categories emitting HAPs that pose a risk to human health. Appendix E presents a list of federally regulated HAPs.

In conjunction with the NAAQS, North Carolina maintains its own air quality standards, which are referred to as the North Carolina Ambient Air Quality Standards (NCAAQS). Table 11.1.12-1 presents an overview of the NCAAQS as defined by North Carolina DEQ regulations.

Table 11.1.12-1: North Carolina Ambient Air Quality Standards (NCAAQS)

Pollutant	Averaging Time	Primary Standard		Secondary Standard		Notes
		μg/m³	ppm	μg/m³	ppm	
CO	8-hour	10,000	9	-	-	Not to be exceeded more than once per year.
	1-hour	40,000	35	-	-	
Lead	3-month	0.15	-	-	-	---
NO_2	1-hour	-	0.1	-	-	---
	Annual	-	0.053	100	0.053	Arithmetic mean concentration.
PM_{10}	24-hour	150	-	-	-	No more than once per year on average over a three-year period.
$PM_{2.5}$	Annual	12	-	-	-	Annual arithmetic mean.
	24-hour	35	-	-	-	---
O_3	8-hour	-	0.075	-	-	---
	1-hour	-	0.075	-	-	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years.

115 Primary standard: The primary standard is set to provide public health protection, including protecting the health of sensitive populations such as asthmatics, children, and the elderly. (USEPA, 2014d)
116 Secondary standards: The secondary standard is set to provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. (USEPA, 2014d)

Pollutant	Averaging Time	Primary Standard		Secondary Standard		Notes
		µg/m³	ppm	µg/m³	ppm	
Sulfur Dioxide (SO_2)	Annual	80,000	0.03	-	-	Annual arithmetic mean.
	24-hour	365,000	0.14	-	-	Not to be exceeded more than once per year.
	3-hour	1,300,000	0.5	-	-	Not to be exceeded more than once per year.
Total Suspended Particulates	24-hour	150,000	-		-	Not to be exceeded more than once per year.
	Annual	75,000	-	-	-	Annual geometric mean.

Source: (North Carolina DAQ, 2015a)

Title V Operating Permits/State Operating Permits

The North Carolina Division of Air Quality (DAQ) has authorization to issue CAA Title V operating permits on behalf of the USEPA, as outlined in 40 CFR 70. The Title V program refers to Title V of the CAA that governs permitting requirements for major industrial air pollution sources and consolidates all CAA requirements for the facility into one permit (USEPA, 2015h). The overall goal of the Title V program is to "reduce violations of air pollution laws and improve enforcement of those laws" (USEPA, 2015h). North Carolina Administrative Code (NCAC) Title 15A NCAC 02Q.0500 (Air Quality Permit Procedures, Title V Procedures) describes the applicability of Title V operating permits. North Carolina requires Title V operating permits for any major source if it emits or has the potential to emit pollutants in excess of the major source thresholds (see Table 11.1.12-2). The permit issued to a facility contains both state and federal portions and incorporates a reporting schedule (USEPA, 2014b).

Table 11.1.12-2: Major Air Pollutant Source Thresholds

Pollutant	Tons Per Year (TPY)
Any Pollutant	100
Single HAP	10
Total/Cumulative HAPs	25

Source: (USEPA, 2014b)

Exempt Activities

North Carolina DAQ exempts the specific types of activities, unless a facility is required to have a permit under Section 3Q-0500. NCAC Title 15A NCAC 02Q.0903 exempts "emergency generators at a facility whose only sources that would require a permit are emergency generators and whose emergency generators consume less than:

- 322,000 gallons per calendar year of diesel fuel,
- 48,000,000 cubic feet per calendar year of natural gas,
- 1,200,000 gallons per calendar year of liquefied petroleum gas,
- 25,000 gallons per calendar year of gasoline for gasoline-powered generators, or

- Any combination of the fuels listed in this Paragraph provided the facility-wide actual emissions of each regulated air pollutant does not exceed 100 tons per calendar year." (North Carolina State, 2015)

Temporary Emissions Sources Permits

North Carolina Title 15A NCAC 02Q.0311 (Permitting of Facilities at Multiple Temporary Sites) allows the DAQ to issues permits for facilities or sources that will reside at multiple temporary sites. (North Carolina DAQ, 2015b)

State Preconstruction Permits

North Carolina DAQ under Title 15A NCAC 02Q.0301 requires any new, modified, or existing facility or source to first obtain a construction and operation permit before beginning construction or operation. (North Carolina DAQ, 2015b).

General Conformity

Established under Section 176(c)(4) of the CAA, "the General Conformity Rule ensures that the actions taken by federal agencies in nonattainment and maintenance areas do not interfere with a state's plans to meet national standards for air quality" outlined in the SIP (USEPA, 2013a). An action in designated nonattainment and maintenance areas would be evaluated for the emission of those particular pollutants under the General Conformity Rule through an applicability analysis. Pursuant to Title 40 CFR 93.153(d)(2) and (e), federal actions "in response to emergencies which are typically commenced on the order of hours or days after the emergency" and actions "which are part of part of a continuing response to emergency or disaster" that are taken up to 6 months after beginning response activities, will be exempt from any conformity determinations (GPO, 2010).

The estimated pollutant emissions are compared to *de minimis*[117] levels. These values are the minimum thresholds for which a conformity determination must be performed (see Table 11.1.12-3).

Table 11.1.12-3: *De Minimis* Levels

Pollutant	Area Type	TPY
Ozone (VOC or NO_2)	Serious Nonattainment	50
	Severe Nonattainment	25
	Extreme Nonattainment	10
	Other areas outside an Ozone Transport Region (OTR)	100
Ozone (NO_2)	Maintenance	100
VOC	Maintenance outside an OTR	100
CO, SO_2, NO_2	All Nonattainment and Maintenance	100
PM_{10}	Serious Nonattainment	70
	Moderate Nonattainment and Maintenance	100

[117] de minimis: USEPA states that "40 CFR 93 § 153 defines de minimis levels, that is, the minimum threshold for which a conformity determination must be performed, for various criteria pollutants in various areas." (USEPA, 2016)

Pollutant	Area Type	TPY
$PM_{2.5}$ (Direct Emissions) (SO_2) (NO_2 (unless determined not to be a significant precursor)) (VOC or ammonia (if determined to be significant precursors))	All Nonattainment and Maintenance	100
Lead	All Nonattainment and Maintenance	25

Source: (GPO, 2010)

If an action does not result in an emissions increase above the *de minimis* levels in Table 11.1.12-3, then a conformity determination is not required. If the applicability analysis shows that the total direct and indirect emissions are above the *de minimis* levels in Table 11.1.12-3, then the action must undergo a conformity determination. The federal agency must first show that the action would meet all SIP control requirements and that any new emissions would not cause a new violation of the NAAQS. To demonstrate conformity[118], the agency would have to fulfill one or more of the following:

- Show any emissions increase is specifically identified and accounted for in the respective state's SIP;
- Receive acknowledgement from the state that any increase in emissions would not exceed the SIP emission budget;
- Receive acknowledgement from the state to revise the SIP and include emissions from the action;
- Show the emissions would be fully offset by implementing reductions from another source in the same area; and
- Conduct air quality modeling that demonstrates the emissions would not cause or contribute to new violations of the NAAQS, or increase the frequency or severity of any existing violations of the NAAQS (USEPA, 2010).

SIP Requirements

The North Carolina SIP is composed of many related actions to ensure ambient air concentrations of the six criteria pollutants comply with the NAAQS. North Carolina's SIP is a conglomeration of separate actions taken for each of the pollutants. All of North Carolina's SIP actions are codified under 40 CFR Part 52 Subpart II. A list of all SIP actions for all six criteria pollutants can be found on the North Carolina DEQ at http://deq.nc.gov/about/divisions/air-quality/air-quality-planning/state-implementation-plans.

[118] Conformity: Compliance with the State Implementation Plan.

11.1.12.3. Specific Regulatory Considerations Buncombe County (Regulated by the Western North Carolina Regional Air Quality Agency)

National and State Ambient Air Quality Standards

The Western North Carolina Regional Air Quality Agency (WNCRAQA) monitors and regulates Buncombe County's air quality. In conjunction with the federal NAAQS, WNCRAQA maintains its own air quality standards as defined by the WNCRAQA Code Chapter 4.0400 (Ambient Air Quality Standards), which are the same as the NCAAQS (see Table 11.1.12-1), with the exception of annual $PM_{2.5}$ which is 15 μg/m^3 instead of 12 μg/m^3.

Title V Operating Permits/State Operating Permits

WNCRAQA has authorization to issue CAA Title V operating permits on behalf of the USEPA, as outlined in 40 CFR 70. The Title V program refers to Title V of the CAA that governs permitting requirements for major industrial air pollution sources and consolidates all CAA requirements for the facility into one permit (USEPA, 2016). The overall goal of the Title V program is to "reduce violations of air pollution laws and improve enforcement of those laws" (Fedcenter.gov, 2016). WNCRAQ A Code Chapter 17, Section 17.0500 (Title V Procedures) describes the applicability of Title V operating permits. WNCRAQA requires Title V operating permits for any major source if it emits or has the potential to emit pollutants in excess of the major source thresholds (see Table 11.1.12-1). The permit issued to a facility contains both state and federal portions and incorporates a reporting schedule (USEPA, 2016).

Exempt Activities

WNCRAQA exempts specific types of activities, unless a facility is required to have a permit under the WNCRAQA Code Chapter 17.0500 (Construction and Operation Permits). WNCRAQA Code Chapter 17.0802 (Exclusionary Rules) exempts "any facility whose emergency generators[119] and emergency use internal combustion engines[120] consume less than:

- 322,000 gallons per year of diesel fuel for diesel-powered generators,
- 62,500,000 cubic feet per year of natural gas for natural gas-powered generators,
- 1,440,000 gallons per year of liquefied petroleum gas for liquefied petroleum gas-powered generators, and
- 50,800 gallons per year of gasoline for gasoline-powered generators shall be exempted from the requirements of Section .0500 of this Chapter." (WNCRAQA, 2006)

[119] Emergency generator means "a stationary internal combustion engine used to generate electricity only during the loss of primary power at the facility that is beyond the control of the owner or operator of the facility or during maintenance when necessary to protect the environment. An emergency generator may be operated periodically to ensure that it will operate." (WNCRAQA, 2006)

[120] Emergency use internal combustion engines "means stationary internal combustion engines used to drive pumps, aerators, and other equipment only during the loss of primary power at the facility that is beyond the control of the owner or operator of the facility or during maintenance when necessary to protect the environment. An emergency use internal combustion engine may be operated periodically to ensure that it will operate." (WNCRAQA, 2006)

WNCRAQA exempts the specific types of activities, unless a facility is required to have a permit under the WNCRAQA Code Chapter 17.0300 (Construction and Operation Permits). WNCRAQA Code Chapter 17.0102 (Activities Exempted from Permit Requirements) exempts:

- Non-self-propelled non-road engines, except generators, regulated by rules adopted under Title II of the federal CAA (Generators are required to be permitted under Chapter 17.0300 [Construction and Operation Permits] unless they qualify for another exemption under this Paragraph. [WNCRAQA Code Chapter 17.0102(L) Activities Exempted from Permit Requirements]);
- Portable generators regulated by rules adopted under Title II of the Federal CAA…;
- A source whose emissions are regulated only under Section 112(r) or Title VI [Stratospheric Ozone Protection] of the Federal CAA…;
- Emergency use generators and other internal combustion engines not regulated by rules adopted under Title II of the Federal CAA that have a rated capacity of no more than:
  a. 680 kilowatts (electric) or 1000 horsepower for natural gas-fired engines;48,000,000 cubic feet per calendar year of natural gas;
  b. 1800 kilowatts (electric) or 2510 horsepower for liquefied petroleum gas-fired engines;
  c. 590 kilowatts (electric) or 900 horsepower for diesel-fired engines or kerosene-fired engines; or
  d. 21 kilowatts (electric) or 31 horsepower for gasoline-fired engines;

Portable generators and other portable equipment with internal combustion engines not regulated by rules adopted under Title II of the Federal CAA that operate at the facility no more than a combined 350 hours for any 365-day period, provided the generators or engines have a rated capacity of no more than 750 kilowatts (electric) or 1100 horsepower each and provided records are maintained to verify the hours of operation;

- Peak-shaving generators that produce no more than 325,000 kilowatt-hours of electric energy for any 12-month period provided records are maintained to verify the energy production on a monthly basis and on a 12-month basis;
- Case-by-case exemption: activities that the applicant demonstrates to the satisfaction of Buncombe County:
  a. To be negligible in their air quality impacts;
  b. Not to have any air pollution control device; and
  c. Not to violate any applicable emission control standard when operating at maximum design capacity or maximum operating rate, whichever is greater;

Any source whose emissions would not violate any applicable emissions standard and whose potential emissions of particulate, SO_2, NO2, VOCs, and CO before air pollution control devices, i.e., potential uncontrolled emissions, are each no more than five tons per year." (WNCRAQA, 2011)

Temporary Emissions Sources Permits

WNCRAQA Code Chapter 17.0311 (Permitting of Facilities at Multiple Temporary Sites) allows Buncombe County to issue permits for facilities or sources that will reside at multiple temporary sites. (WNCRAQA, 2014)

Preconstruction Permits

WNCRAQA Code Chapter 17.0301 (Applicability) requires new, modified, or existing facility or source to obtain a construction and operation permit before beginning construction or operation. (WNCRAQA, 2014)

General Conformity

The WNCRAQA follows the federal General Conformity regulations and do not maintain their own. See Section 11.1.12.2 for a general discussion of the Federal General Conformity regulations.

SIP Requirements

The WNCRAQA does not have an SIP.

11.1.12.4. Specific Regulatory Considerations Forsyth County Office of Environmental Assistance and Protection (EAP)

National and State Ambient Air Quality Standards

In conjunction with the federal NAAQS, Forsyth County maintains its own air quality standards. Forsyth County standards as defined by Forsyth County Air Quality Technical Code (FCAQTC) Section 3D-0400, which are the same as the NCAAQS (see Table 11.1.12-1).

Title V Operating Permits/State Operating Permits

Forsyth County has authorization to issue CAA Title V operating permits on behalf of the USEPA, as outlined in 40 CFR 70. The Title V program refers to Title V of the CAA that governs permitting requirements for major industrial air pollution sources and consolidates all CAA requirements for the facility into one permit (USEPA, 2015i). The overall goal of the Title V program is to "reduce violations of air pollution laws and improve enforcement of those laws" (USEPA, 2015i). FCAQTC Section 3Q-0502 describes the applicability of Title V operating permits. Forsyth requires Title V operating permits for any major source if it emits or has the potential to emit pollutants in excess of the major source thresholds (see Table 11.1.12-2). The permit issued to a facility contains both state and federal portions and incorporates a reporting schedule (USEPA, 2016).

Exempt Activities

FCAQTC Section 3Q-0800. (Exclusionary Rules) lists exemptions for activities that require a construction and operating permit under Section 3Q-0500.(Title V Procedures):

Facilities that do not meet the Major Air Pollutant Source Thresholds (see Table 11.1.12-2).

"Any facility whose emergency generators and emergency use internal combustion engines consume less than:

- 322,000 gallons per year of diesel fuel for diesel-powered generators;
- 62,500,000 cubic feet per year of natural gas for natural gas-powered generators;
- 1,440,000 gallons per year of liquefied petroleum gas for liquefied petroleum gas-powered generators; and
- 50,800 gallons per year of gasoline for gasoline-powered generators shall be exempted from the requirements of Section .0500 of this Chapter." (Forsyth County EAP, 2012)

Temporary Emissions Sources Permits

FCAQTC Section 3Q-0311 (Permitting of Facilities at Multiple Temporary Sites) allows the Forsyth County OEAP to issues permits for facilities or sources that will reside at multiple temporary sites. (Forsyth County EAP, 2012)

Preconstruction Permits

FCAQTC Section 3Q-0301 (Applicability) requires new, modified, or existing facility or source to obtain a construction and operation permit before beginning construction or operation. (Forsyth County EAP, 2012)

General Conformity

The Forsyth County EAP follows the federal General Conformity regulations and do not maintain their own. See Section 11.2.12.2 for a general discussion of the Federal General Conformity regulations.

SIP Requirements

The Forsyth County EAP's SIP is composed of many related actions to ensure ambient air concentrations for CO comply with the NAAQS. Forsyth County EAP's SIP is a conglomeration of separate actions taken for each of the pollutants. Forsyth County EAP's SIP actions are codified under 40 CFR Part 52 Subpart II. The SIP actions for CO can be found on USEPA's website at https://www3.epa.gov/region4/air/sips/.

11.1.12.5. Specific Regulatory Considerations Mecklenburg County Air Pollution Control Office (APC)

National and State Ambient Air Quality Standards

In conjunction with the federal NAAQS, MCAQC maintains its own air quality standards as defined by Mecklenburg County Air Pollution Control Ordinance (MCAPCO) Article 2.0400 (Air Pollution Control Regulations and Procedures – Ambient Air Quality Standards) which are the same as the NCAAQS (see Table 11.1.12-1), with the exception of annual $PM_{2.5}$ which is 15 $\mu g/m^3$ instead of 12 $\mu g/m^3$. (MCAQ, 2010)

Title V Operating Permits/State Operating Permits

MCAQC has authorization to issue CAA Title V operating permits on behalf of the USEPA, as outlined in 40 CFR 70. The Title V program refers to Title V of the CAA that governs permitting requirements for major industrial air pollution sources and consolidates all CAA requirements for the facility into one permit (USEPA, 2015h). The overall goal of the Title V program is to "reduce violations of air pollution laws and improve enforcement of those laws" (USEPA, 2015h). MCAPCO Section 1.5500 (Title V Procedures) describes the applicability of Title V operating permits. MCAPCO requires Title V operating permits for any major source if it emits or has the potential to emit pollutants in excess of the major source thresholds (see Table 11.1.12-2). The permit issued to a facility contains both state and federal portions and incorporates a reporting schedule (USEPA, 2014b).

Exempt Activities

MCAQC exempts specific types of activities, unless a facility is required to have a permit under MCAPCO Section 1.5500 (Title V Procedures). MCAPCO Section 1.5211 (f) (Applicability) states "A facility does not need a permit or permit modification under this Article if the facility's uncontrolled potential emissions of particulate, SO_2, NO_2, VOCs, or CO are each no more than five tons…" MCAPCO Section 1.521 (g) (Applicability) exempts:

- "Motor vehicles;
- Non-self-propelled non-road engines, except generators, regulated by rules adopted under Title II of the CAA (Generators are required to be permitted under MCAPCO Section 1.5200 [Air Quality Permits] unless they qualify for another exemption under MCAPCO Section 1.5211 (g).); and
- Portable generators regulated by rules adopted under Title II of the CAA."

Emergency use generators and other internal combustion engines not regulated by rules adopted under Title II of the CAA that have a rated capacity of no more than:

- 680 kilowatts (electric) or 1000 horsepower for natural gas-fired engines;48,000,000 cubic feet per calendar year of natural gas;
- 1800 kilowatts (electric) or 2510 horsepower for liquefied petroleum gas-fired engines;
- 590 kilowatts (electric) or 900 horsepower for diesel-fired engines or kerosene-fired engines; or
- 21 kilowatts (electric) or 31 horsepower for gasoline-fired engines.

Portable generators and other portable equipment with internal combustion engines not regulated by rules adopted under Title II of the CAA that operate at the facility no more than a combined 350 hours for any 365-day period, provided the generators or engines have a rated capacity of no more than 750 kilowatts (electric) or 1100 horsepower each and provided records are maintained to verify the hours of operation.

Case-by-case exemption: activities that the applicant demonstrates to the satisfaction of Mecklenburg County:

- To be negligible in their air quality impacts;
- Not to have any air pollution control device; and
- Not to violate any applicable emission control standard when operating at maximum design capacity or maximum operating rate, whichever is greater." (MCAQ, 2014)

Temporary Emissions Sources Permits

MCAPCO Section 1.5222 (Permitting of Facilities at Multiple Temporary Sites) allows Mecklenburg County to issue permits for facilities or sources that will reside at multiple temporary sites. (MCAQ, 2014)

Preconstruction Permits

MCAQC under MCAPCO Section 1.5211(c)(1) requires any new, modified, or existing facility or source to first obtain a construction and operation permit before beginning construction or operation.

General Conformity

The MCAQ follows the federal General Conformity regulations and do not maintain their own. See Section 11.1.12.2 for a general discussion of the Federal General Conformity regulations.

SIP Requirements

The MCAQ's SIP is composed of many related actions to ensure ambient air concentrations for CO and O_3 comply with the NAAQS. MCAQ's SIP is a conglomeration of separate actions taken for each of the pollutants. MCAQ's SIP actions are codified under 40 CFR Part 52 Subpart II. The SIP actions for CO and O_3 can be found on USEPA's https://www3.epa.gov/region4/air/sips/.

11.1.12.6. Environmental Setting: Ambient Air Quality

Nonattainment Areas

The USEPA classifies areas as attainment, nonattainment, maintenance, or unclassifiable for six criteria pollutants. When evaluating an area's air quality against regulatory thresholds (i.e., permitting and general conformity), maintenance areas are often combined with nonattainment, while unclassifiable areas are combined with attainment areas. Figure 11.1.12-1 and Table 11.1.12-4 present the nonattainment areas in North Carolina as of January 30, 2015. The years listed in the table for each pollutant indicate the date(s) when USEPA promulgated an ambient air quality standard for that pollutant. Note certain pollutants have more than one standard in effect (e.g., $PM_{2.5}$ and O_3). Unlike Table 11.1.12-4, Figure 11.1.12-1 does not differentiate between standards for the same pollutant. Additionally, given that particulate matter is the criteria pollutant of concern, PM_{10} and $PM_{2.5}$ are merged in the figure and presented as a single pollutant.

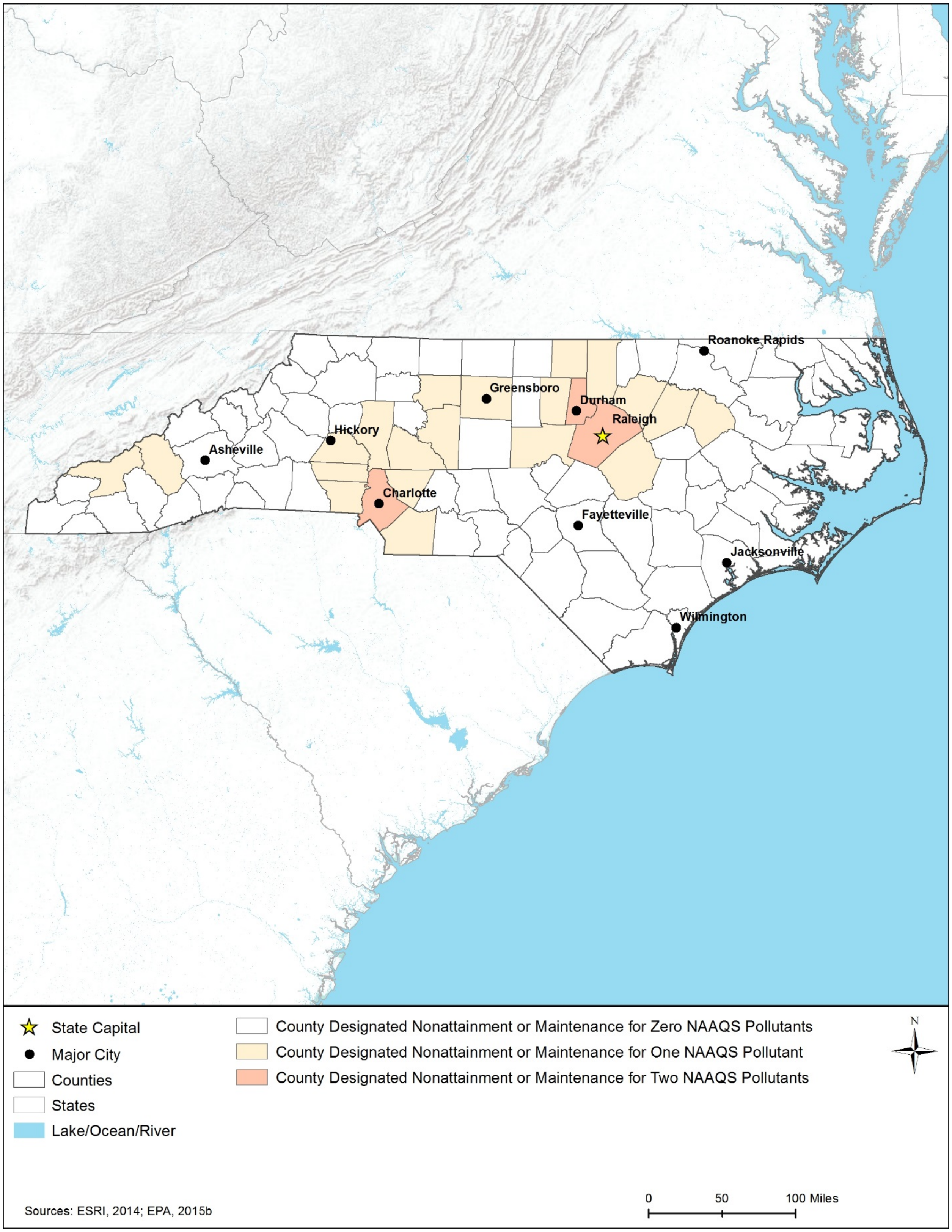

Figure 11.1.12-1: Nonattainment and Maintenance Counties in North Carolina

Table 11.1.12-4: North Carolina Nonattainment and Maintenance Areas by Pollutant Standard and County

County	Pollutant and Year USEPA Implemented Standard										
	CO	Lead		NO_2	PM_{10}	$PM_{2.5}$		O_3		SO_2	
	1971	1978	2008	1971	1987	1997	2006	1997	2008	1971	2010
Cabarrus								M			
Cabarrus (Charlotte-Rock Hill, NC-SC (NC portion))									M		
Catawba						M					
Chatham								M			
Davidson						M					
Durham	M							M			
Edgecombe								M			
Forsyth	M										
Franklin								M			
Gaston								M			
Gaston (Charlotte-Rock Hill, NC-SC (NC portion))									M		
Granville								M			
Guilford						M					
Haywood								M			
Iredell								M			
Iredell (Charlotte-Rock Hill, NC-SC (NC portion))									M		
Johnston								M			
Lincoln								M			
Lincoln (Charlotte-Rock Hill, NC-SC (NC portion))									M		
Mecklenburg (Charlotte-Gastonia-Rock Hill, NC-SC)								M			
Mecklenburg (Charlotte-Rock Hill, NC-SC (NC portion))									M		
Mecklenburg (Charlotte, NC)	M										
Nash								M			
Orange								M			
Person								M			
Rowan								M			

County	Pollutant and Year USEPA Implemented Standard										
	CO	Lead		NO_2	PM_{10}	$PM_{2.5}$		O_3		SO_2	
	1971	1978	2008	1971	1987	1997	2006	1997	2008	1971	2010
Rowan (Charlotte-Rock Hill, NC-SC (NC portion))									M		
Swain								M			
Union								M			
Union (Charlotte-Rock Hill, NC-SC (NC portion))									M		
Wake	M							M			

Source: (USEPA, 2015j)
X-1 = Nonattainment Area (Extreme)
X-2 = Nonattainment Area (Severe)
X-3 = Nonattainment Area (Serious)
X-4 = Nonattainment Area (Moderate)
X-5 = Nonattainment Area (Marginal)
X-6 = Nonattainment Area (Unclassified)
M = Maintenance Area

Air Quality Monitoring and Reporting

The North Carolina DEQ measures air pollutants at 65 sites across the state as part of the National Air Monitoring Stations Network and the State and Local Air Monitoring Stations Network. Annual North Carolina State Ambient Air Quality Reports are prepared, containing pollutant data summarized by region. The North Carolina DEQ reports real-time pollution levels of O_3 and $PM_{2.5}$ on the AirNOW[121] website (https://airnow.gov) to inform the public as O_3 and $PM_{2.5}$ are the main pollutants of concern in North Carolina.

- Throughout 2011, O_3 measurements exceeded the federal standard of 0.075 ppm 100 times, 26 sites had at least one exceedance while both Enochville (Rowan County) and Charlotte in (Mecklenburg County) exceeded nine times.
- In 2011 SO_2 measurements exceeded the 2011 standards one time at Highway 421 North, Wilmington (New Hanover County).
- There were no exceedances for NO_2, PM_{10}, and CO measurements. (NCDEQ, 2013)

WNCAQA measures air pollutants at four sites across Buncombe County as part of the National Air Monitoring Stations Network and the County Air Monitoring Stations Network. Annual ambient air quality information is prepared and submitted with the North Carolina DEQ and submitted in with their report. The WNCAQA reports real-time pollution levels of O3 and PM2.5 on their website (https://www.buncombecounty.org/Governing/Depts/wncair/airquality/air-quality-forecast.aspx) to inform the public, as O_3 and $PM_{2.5}$ is the main pollutant of concern in Buncombe County.

[121] AirNOW is a government website that posts daily Air Quality Index for more than 400 cities.

Throughout 2014, there were no AAQS exceedances for Buncombe County, North Carolina. (WNC Air Quality, 2015)

Forsyth County OEPA measures air pollutants at six sites across Forsyth County as part of the National Air Monitoring Stations Network and the County Air Monitoring Stations Network. Forsyth County OEAP reports real-time pollution levels of O_3 and $PM_{2.5}$ on the AirNOW website (https://airnow.gov) to inform the public, as O_3 and $PM_{2.5}$ are the main pollutants of concern in Forsyth County. (Forsyth County Office of Environmental Assistance and Protection, 2015)

MCAQC measures air pollutants at six sites across Mecklenburg County as part of the National Air Monitoring Stations Network and the County Air Monitoring Stations Network. MCAQC reports real-time pollution levels of O3 and PM2.5 on their website to inform the public, as O3 and PM2.5 are the main pollutant of concern in Mecklenburg County.

- As per conversations with the regulator throughout 2014, there were no AAQS exceedances for Mecklenburg County.

Air Quality Control Regions

USEPA classified all land in the United States as a Class I, Class II, or Class III Federal Air Quality Control Region (AQCR) (42 U.S.C. § 7470). These are different from the air quality classification levels defined in Table 11.1.12-1 as part of the NCAAQS. Class I areas include international parks, national wilderness areas which exceed 5,000 acres in size, national memorial parks which exceed 5,000 acres in size, and national parks which exceed 6,000 acres in size. Class I areas cannot be re-designated as Class II or Class III and are intended to maintain pristine air quality. Although USEPA developed the standards for a Class III AQCR, to date they have not actually classified any area as Class III. Therefore, any area that is not classified as a Class I area is, by default, automatically designated as a Class II AQCR (42 U.S.C. § 7472).

In a 1979 USEPA memorandum, the Assistant Administrator for Air, Noise, and Radiation (USEPA, 1979) advised USEPA Regional Offices to provide notice to the Federal Land Manager (FLM) of any facility subject to the Prevention of Significant Deterioration (PSD) permit requirements and within 100 kilometers[122] of a Class I area. "The USEPA's policy is that FLMs should be notified by the Regional Office about any project that is within 100 kilometers of a Class I area. For sources having the capability to affect air quality at greater distances, notification should also be considered for Class I areas beyond 100 kilometers" (Page, 2012). The 2005 USEPA guidelines for air quality modeling do not provide a precise modeling range for Class I areas.

PSD applies to new major sources or major modifications at existing sources for pollutants where the source is in an attainment or unclassifiable area. An air quality analysis is required for sources subject to PSD requirements and generally consists of using a dispersion model to evaluate emission impacts to the area. "Historically, the USEPA guidance for modeling air quality impacts under the PSD program has tended to focus more on the requirements for a Class

[122] The memorandum and associated guidance use kilometers. 100 kilometers is equal to about 62 miles.

II modeling analysis. Such guidance has if applicants need not model beyond the point of significant impact or the source or 50 kilometers[123] (the normal useful range of USEPA-approved Gaussian plume models" (USEPA, 1992).

North Carolina contains five federal Class I areas; all other land within the state is classified as Class II (USEPA, 2012c). If an action is considered major source and consequently subject to PSD requirements, the air quality impact analysis need only to analyze the impacts to air quality within 100 kilometers from the source (USEPA 1992). Tennessee has three Class I areas where the 100-kilometer buffer intersects a few North Carolina counties. North Carolina has one Class I area where the 100-kilometer buffer enters Virginia, two that enter Georgia, and two that enter small portions of South Carolina. Any PSD-applicable action within these counties would require FLMs notification from the appropriate Regional Office.

Figure 11.1.12-2 provides a map of North Carolina highlighting all relevant Class I areas and all areas within the 100-kilometer radiuses. The numbers next to each of the highlighted Class I areas in Figure 11.1.12-2 correspond to the numbers and Class I areas listed in Table 11.1.12-5.

Table 11.1.12-5: Relevant Federal Class I Areas

<table>
<tr><th>#[a]</th><th>Area</th><th>Acreage</th><th>State</th></tr>
<tr><td>1</td><td>Shining Rock Wilderness</td><td>13,350</td><td>NC-SC</td></tr>
<tr><td>2</td><td>Linville Gorge Wilderness</td><td>7,575</td><td>NC-VA-SC</td></tr>
<tr><td rowspan="6">3</td><td>Swanquarter Wilderness</td><td rowspan="6">9,000</td><td rowspan="6">NC</td></tr>
<tr><td>Swanquarter Wilderness</td></tr>
<tr><td>Swanquarter Wilderness</td></tr>
<tr><td>Swanquarter Wilderness</td></tr>
<tr><td>Swanquarter Wilderness</td></tr>
<tr><td>Swanquarter Wilderness</td></tr>
<tr><td>4</td><td>Joyce Kilmer-Slickrock Wilderness</td><td>10,201</td><td>TN-NC-GA</td></tr>
<tr><td>5</td><td>Great Smoky Mountains NP [b]</td><td>514,758</td><td>TN-NC</td></tr>
<tr><td>6</td><td>Cohutta Wilderness</td><td>36,980</td><td>TN-GA</td></tr>
</table>

[a] The numbers correspond to the shaded regions in
[b] Great Smoky Mountains National Park, 514,758 acres overall, of which 273,551 acres are in North Carolina, and 241,207 acres are in Tennessee.
Source: (USEPA, 2012c)

[123] The memorandum and associated guidance use kilometers. 50 kilometers is equal to about 31 miles.

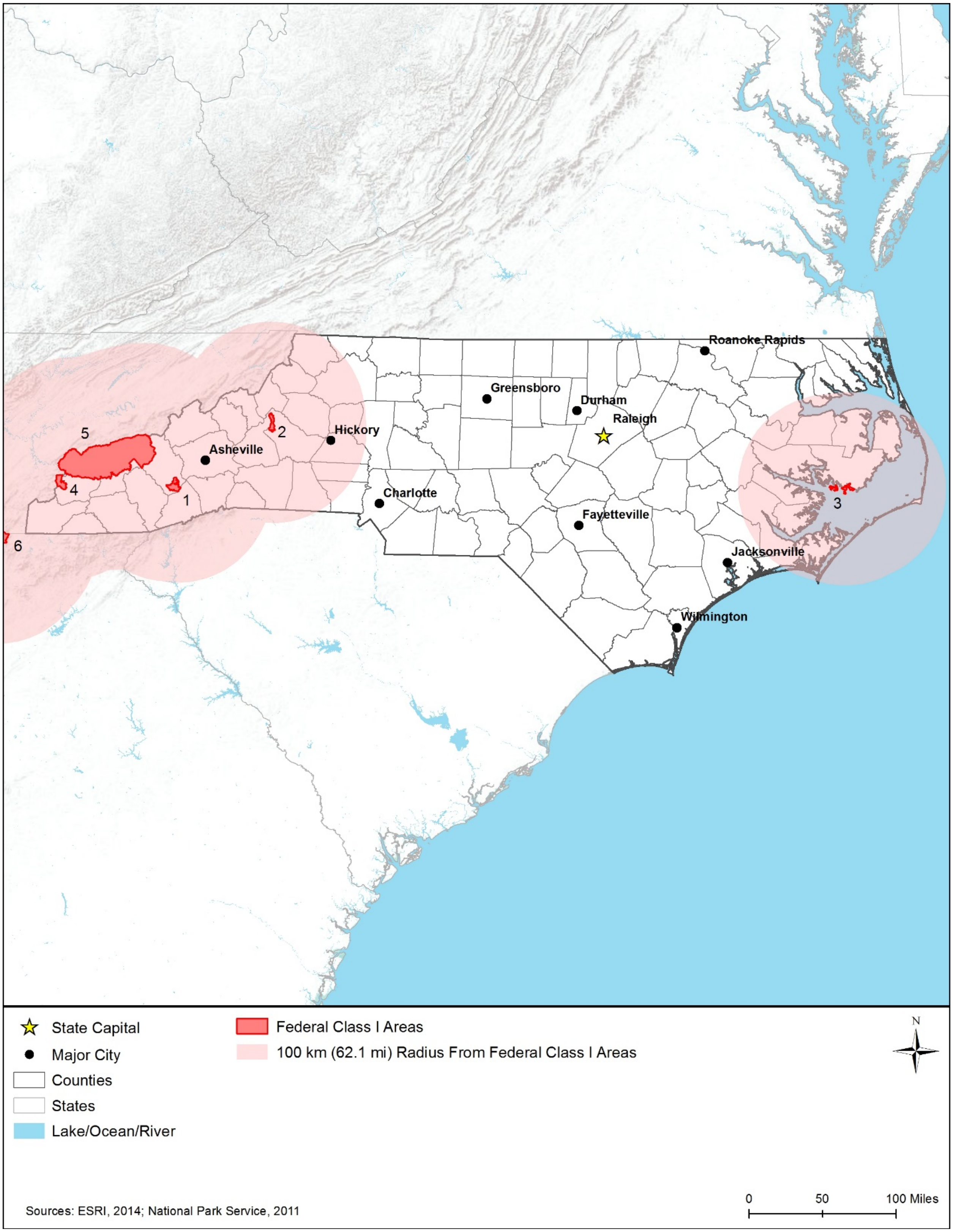

Figure 11.1.12-2: Federal Class I Areas with Implications for North Carolina

11.1.13. Noise

This section presents a discussion of a basic understanding of environmental noise, background/ambient noise levels, noise standards, and guidelines.

11.1.13.1. Definition of the Resource

Noise is a form of sound caused by pressure variations that the human ear can detect and is often defined as unwanted sound (USEPA, 2012d). Noise is one of the most common environmental issues that interferes with normal human activities and otherwise diminishes the quality of the human environment. Typical sources of noise that result in this type of interference in urban and suburban surroundings includes interstate and local roadway traffic, rail traffic, industrial activities, aircraft, and neighborhood sources like lawn mowers, leaf blowers, etc.

The effects of noise can be classified into three categories:

- Noise events that result in annoyance and nuisance;
- Interference with speech, sleep, and learning; and,
- Physiological effects such as hearing loss and anxiety.

Fundamentals of Noise

For environmental noise analyses, a noise metric refers to the unit that quantitatively measures the effect of noise on the environment. The unit used to describe the intensity of sound is the decibel (dB). Audible sounds range from 0 dB (“threshold of hearing”) to about 140 dB (“threshold of pain”) (OSHA, 2016). The vibration frequency characteristics of the sound, measured as sound wave cycles per second [Hertz (Hz)], determines the pitch of the sound (FTA, 2006). The normal audible frequency range is approximately 20 Hz to 20 kHz (FAA, 2015g). The A-weighted scale, denoted as dBA, approximates the range of human hearing by filtering out lower frequency noises, which are not as damaging as the higher frequencies. The dBA scale is used in most noise ordinances and standards (OSHA, 2016).

Measurements and descriptions of noise (i.e., sounds) are based on various combinations of the following factors (FTA, 2006):

- The total sound energy radiated by a source, usually reported as a sound power level;
- The actual air pressure changes experienced at a particular location, usually measured as a sound pressure level (SPL) (the frequency characteristics and SPL combine to determine the loudness of a sound at a particular location);
- The duration of a sound; and
- The changes in frequency characteristics or pressure levels through time.

Figure 11.1.13-1 presents the sound levels of typical events that occur on a daily basis in the environment. For example, conversational speech is measured at about 55 to 60 dBA, whereas a band playing loud music may be as high as 120 dBA.

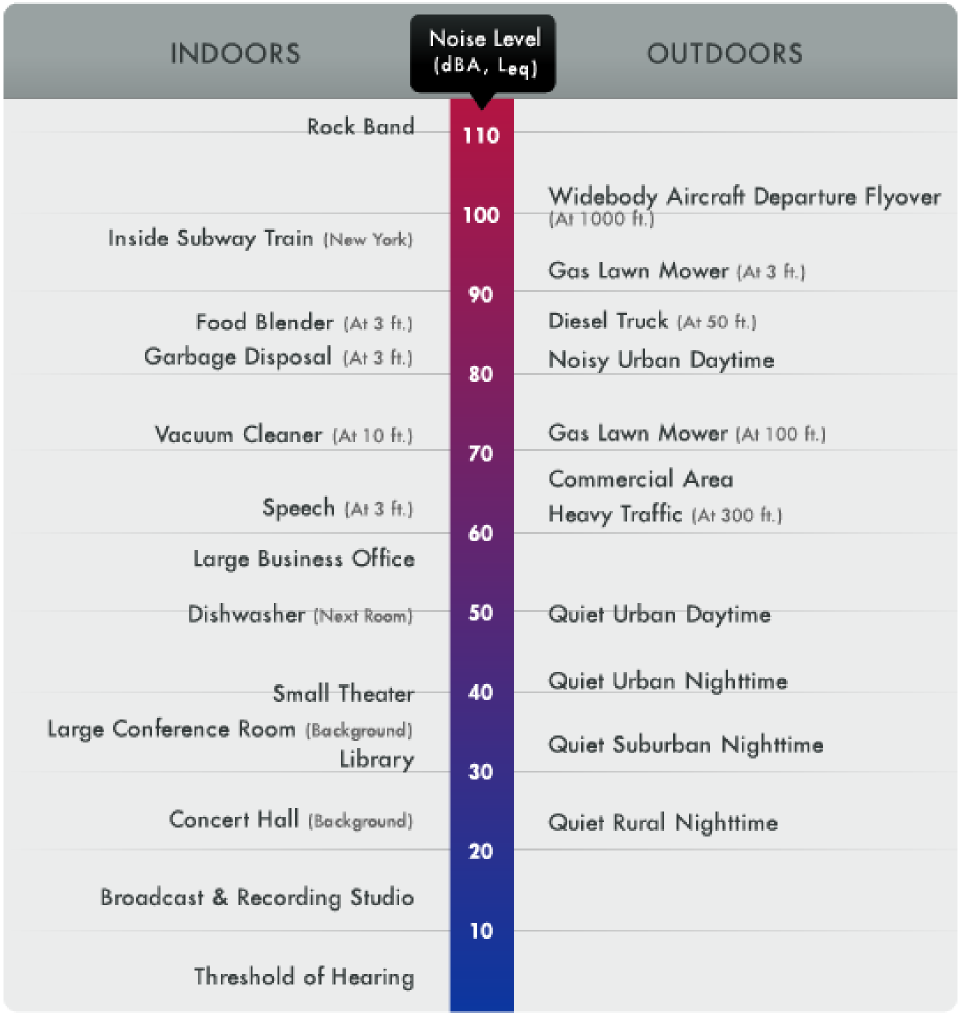

Figure 11.1.13-1: Sound Levels of Typical Sounds

Leq: Equivalent Continuous Sound Level
Source: (Sacramento County Airport System, 2015)
Prepared by: Booz Allen Hamilton

Because of the logarithmic unit of measurement, sound levels cannot be added or subtracted linearly. However, several methods of estimating sound levels can be useful in determining approximate sound levels. First, if two sounds of the same level are added, the sound level increases by approximately three dB (for example: 60 dB + 60 dB = 63 dB). Secondly, the sum of two sounds of a different level is slightly higher than the louder level (for example: 60 dB + 70 dB = 70.4 dB).

The changes in human response to changes in dB levels is categorized as follows (FTA, 2006):

- A 3-dB change in sound level is considered a barely noticeable difference;
- A 5-dB change in sound level will typically result in a noticeable community response; and
- A 10-dB change, which is generally considered a doubling of the sound level, almost certainly causes an adverse community response.

In general, ambient noise levels are higher during the day than at night and typically this difference is about 10 dB (USEPA, 1973). Ambient noise levels can differ considerably depending on whether the environment is urban, suburban, or rural.

11.1.13.2. Specific Regulatory Considerations

As identified in Appendix C, Environmental Laws and Regulations, the Noise Control Act of 1972, along with its subsequent amendments (e.g., Quiet Communities Act of 1978 [42 U.S.C. Parts 4901−4918]), delegates authority to the states to regulate environmental noise and directs government agencies to comply with local community noise statutes and regulations. Although no federal noise regulations exist, the USEPA has promulgated noise guidelines (USEPA, 1974). Similarly, most states have no quantitative noise-limit regulations.

North Carolina has several statewide noise regulations written into its general and permanent law, which are compiled under the North Carolina General Statutes. They mainly apply to motor vehicle functions such as mufflers. Table 11.1.13-1 provides a brief summary of North Carolina state laws and regulations relating to noise.

Table 11.1.13-1: Relevant North Carolina Noise Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
20-128	The North Carolina General Assembly	Requires motor vehicles operating on highways to be equipped with a muffler that prevents excessive noise.
153A-133	The North Carolina General Assembly	Allows counties to regulate noise levels.
160A-184	The North Carolina General Assembly	Allows cities to regulate noise levels.

Many cities and towns may have additional, local noise ordinances (as allowed by NC Statute 160A-184) to further manage community noise levels. The noise limits specified in such ordinances are typically applied to define noise sources and specify a maximum permissible noise level. Large cities and towns, such as Charlotte, Raleigh, and Greensboro are likely to have different regulations than rural or suburban communities largely due to the population density and difference in ambient noise levels (FHWA, 2011).

11.1.13.3. Environmental Setting: Ambient Noise

The range and level of ambient noise in North Carolina varies widely based on the area and environment of the area. The population of North Carolina can choose to live and interact in areas that are large cities, rural or suburban communities, small towns, and national and state parks. Figure 11.1.13-1 illustrates noise values for typical community settings and events that are representative of what the population of North Carolina may experience on a day-to-day basis. These noise levels represent a wide range and are not specific to North Carolina. As such, this section describes the areas where the population of North Carolina can potentially be exposed to higher than average noise levels.

Urban Environments: Urban areas are likely to have higher noise levels on a daily basis due to highway traffic (70 to 90 dBA), construction noise (90 to 120 dBA), and outdoor conversations (e.g., small/large groups of people) (60 to 90 dBA) (USDOI, 2008). The urban areas that are likely to have the highest ambient noise levels in the state are Charlotte, Raleigh, and Greensboro.

Airports: Areas surrounding airports tend to have higher noise levels due to aircraft operations that occur throughout the day. A jet engine aircraft can produce between 130 to 160 dBA in its direct proximity (FAA, 2007). However, commercial aircraft are most likely to emit noise levels between 70 to 100 dBA depending of the type of aircraft and associated engine (FAA, 2012a). This noise will be perceived differently based on the altitude of the aircraft and its distance to the point of measurement. Airport operations are primarily arrivals and departures of commercial aircraft, but based on the type of airport, can include touch-and-go operations that are typical of general aviation airports and military airfields. The location of most commercial airports is in proximity to urban communities resulting in noise exposures from aircraft operations (arrivals/departures) to surrounding areas at higher levels and with the potential for increased noise levels during peak operation times (early morning and evenings), when there is an increase in air traffic. The noise levels in areas surrounding commercial airports can have significantly higher ambient noise levels than in other areas. In North Carolina, Charlotte/Douglas International Airport (CLT), Raleigh-Durham International Airport (RDU), and Piedmont Triad International Airport (GSO) have combined annual operations of more than 806,000 flights (FAA, 2015g). These operations result in increased ambient noise levels in the surrounding communities. See Section 11.1.6.7, Land Use, Recreation, and Airspace, and Table 11.1.7-8 for more information about airports in the state.

Highways: Communities near major highways also experience higher than average noise levels when compared to areas that are not in close proximity to a highway (FHWA, 2015f). There are a number of major highways within the state that may contribute to higher ambient noise levels for residents living near those traffic corridors. The major highways in the state tend to have higher than average ambient noise levels on nearby receptors, ranging from 52 to 75 dBA (FHWA, 2015f). See Section 11.1.1, Infrastructure, and Figure 11.1.1-1 for more information about the major highways in the state.

Railways: Like highways, railways tend to have higher than average ambient noise levels for residents living in close proximity (FTA, 2006). Railroad operations can produce noise ranging from 70 dBA for an idling locomotive to 115 dBA when the locomotive engineer rings the horn while approaching a crossing (DOT, 2015). North Carolina has multiple rail corridors with high levels of commercial and commuter rail traffic (NCDOT, 2015c). The Piedmont service extends from Raleigh to Durham, Greensboro, and Charlotte. The Carolinian service extends from Charlotte to Greensboro, Durham, Raleigh, Rocky Mount, and eventually terminates in New York. The Crescent Service extends from Greensboro to Gastonia. The Silver Star service extends from Rocky Mount to Southern Pines and Hamlet. Finally, the Silver Meteor and Palmetto services extend from Rocky Mount to Fayetteville. See Section 11.1.1, Infrastructure, and Figure 11.1.1-1 for more information about rail corridors in the state.

National and State Parks: The majority of national and state parks are likely to have lower than average ambient noise levels given their size and location in wilderness areas. National and state parks, historic areas, and monuments are protected areas to preserve these areas in their natural environment. These areas typically have lower noise levels, as low as 30 to 40 dBA (NPS, 2014d). North Carolina has 10 national park units and 13 National Natural Landmarks (NPS, 2014b). Visitors to these areas expect lower ambient noise conditions than the surrounding urban areas. See Section 11.1.8, Visual Resources, and Figure 11.1.8-1 for more information about national and state parks for North Carolina.

11.1.13.4. Sensitive Noise Receptors

Noise-sensitive receptors include residences, schools, medical facilities, places of worship, libraries, churches, nursing homes, concert halls, playgrounds, and parks. Sensitive noise receptors are typically areas where the intrusion of noise can disrupt the use of the environment. A quiet urban area usually has a typical noise level in the daytime of 50 dBA, and 40 dBA during the evening. Noise levels in remote wilderness and rural nighttime areas are usually 30 dBA (BLM, 2014). Most cities and towns in North Carolina have at least one school, church, or park, in addition to likely having other noise-sensitive receptors. There are most likely thousands of sensitive receptors throughout North Carolina.

11.1.14. Climate Change

11.1.14.1. Definition of the Resource

Climate change, according to the Intergovernmental Panel on Climate Change (IPCC), is defined as "…a change in the state of the climate that can be identified (e.g., using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or human activity." (IPCC, 2007)

Accelerated rates of climate change are linked to an increase in atmospheric concentrations of greenhouse gas (GHG) caused by emissions from human activities such as burning fossil fuels to generate electricity (USEPA, 2012e). The IPCC is now 95 percent certain that humans are the main cause of current global warming (IPCC, 2013). Human activities result in emissions of four main GHGs: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and halocarbons (a group of gases containing fluorine, chlorine, or bromine) (IPCC, 2007). The common unit of measurement for GHGs is metric tons of CO_2-equivalent (MT CO_2e[124]), which equalizes for the different global warming potential of each type of GHG. Where this document references emissions of CO_2 only, the units are in million metric tons (MMT) CO_2. Where the document references emissions of multiple GHGs, the units are in MMT CO_2e.

"Global concentrations of these four GHGs have increased significantly since 1750" (IPCC, 2007). "Atmospheric concentrations of CO_2 increased from 280 parts per million (ppm) of carbon in 1750 to 379 ppm of carbon in 2005" (IPCC, 2007). The atmospheric concentration of

[124] CO_2e refers to Carbon Dioxide Equivalent, "A metric measure used to compare the emissions from various greenhouse gases based upon their global warming potential (GWP). Carbon dioxide equivalents are commonly expressed as million metric tons of carbon dioxide equivalents (MMTCO_2e). The carbon dioxide equivalent for a gas is derived by multiplying the tons of the gas by the associated GWP. $MMTCO_{2e}$ = (million metric tons of a gas) * (GWP of the gas)" (USEPA, 2016c).

CH_4 has increased from a pre-industrial value of about 715 parts per billion (ppb) to 1774 ppb in 2005. (IPCC, 2007) "Atmospheric concentrations of N_2O increased from a pre-industrial value of about 270 ppb to 319 ppb in 2005" (IPCC, 2007). "Many halocarbons have increased from a near-zero pre-industrial concentrations, primarily due to human activities" (IPCC, 2007).

Both the GHG emissions effects of the Proposed Action and Alternatives, and the relationships of climate change effects to the Proposed Action and Alternatives, will be considered in this PEIS (see Chapter 4, Environmental Consequences). Therefore, to form the baseline against which to assess possible impacts from the Proposed Action, the existing climate conditions in the project area will be described first by state and sub-region, where appropriate, and then future projected climate scenarios will be described by state and sub-region. The discussion will focus on the following climate change impacts: 1) temperature; 2) precipitation; 3) sea level; and 4) severe weather events (including tropical storms, tropical cyclones, and hurricanes).

11.1.14.2. Specific Regulatory Considerations

The pertinent federal laws relevant to the protection and management of climate change are summarized in Appendix C. North Carolina has not established goals and regulations to reduce GHG emissions to combat climate change.

11.1.14.3. North Carolina Greenhouse Gas Emissions

Estimates of North Carolina's total GHG emissions vary. The Department of Energy's (DOE) Energy Information Agency (EIA) collects and disseminates national-level emissions data on other GHGs such as CH_4 and nitrous oxide (NO_2), but not at the state level (EIA, 2011). The USEPA also collects and disseminates national-level GHG emissions data, but by economic sector, not by state (USEPA, 2015k). Individual states have developed their own GHG inventories, which are updated with different frequencies and trace GHG in a variety of ways. For the purposes of this PEIS, the EIA data on CO_2 emissions are used as the baseline metric to ensure consistency and comparability across the 50 states. However, if additional data sources on GHG emissions are available for a given state, including other GHGs such as CH_4, they are described and cited.

According to the EIA, North Carolina emitted a total of 122.4 MMT of CO_2 in 2013. The Electric power sector was the largest emitter, producing 45 percent of total CO_2, and accounting for almost all of the coal-related emissions. The transportation sector is the next highest emitter, with all but a tiny fraction of emission coming from petroleum products (Table 11.1.14-1) (EIA, 2015d). Annual emissions between 1980 and 2013 are presented in Figure 11.1.14-1. Emissions overall increased between 1980 and 2005 when they peaked at 153.3 MMTs before declining 20 percent to their current level, with a slight increase in 2013. The gains between 1980 and 2005 took place across all sectors and fuel types. Recent declines have been led by reductions in petroleum-related emissions from the transportation sector, and reductions in coal-related emissions from the electric power sector. North Carolina was ranked 14th among the 50 states and the District of Columbia for total emissions in 2013, and 36th for per capita emissions (EIA, 2015d).

Table 11.1.14-1: North Carolina CO_2 Emissions from Fossil Fuels by Fuel Type and Source, 2013

Fuel Type (MMT)		Source (MMT)	
Coal	46.6	Residential	5.2
Petroleum Products	52.1	Commercial	4.3
Natural Gas	23.6	Industrial	10.7
		Transportation	46.7
		Electric Power	55.5
TOTAL	**122.4**	**TOTAL**	**122.4**

Source: (EIA, 2015d)

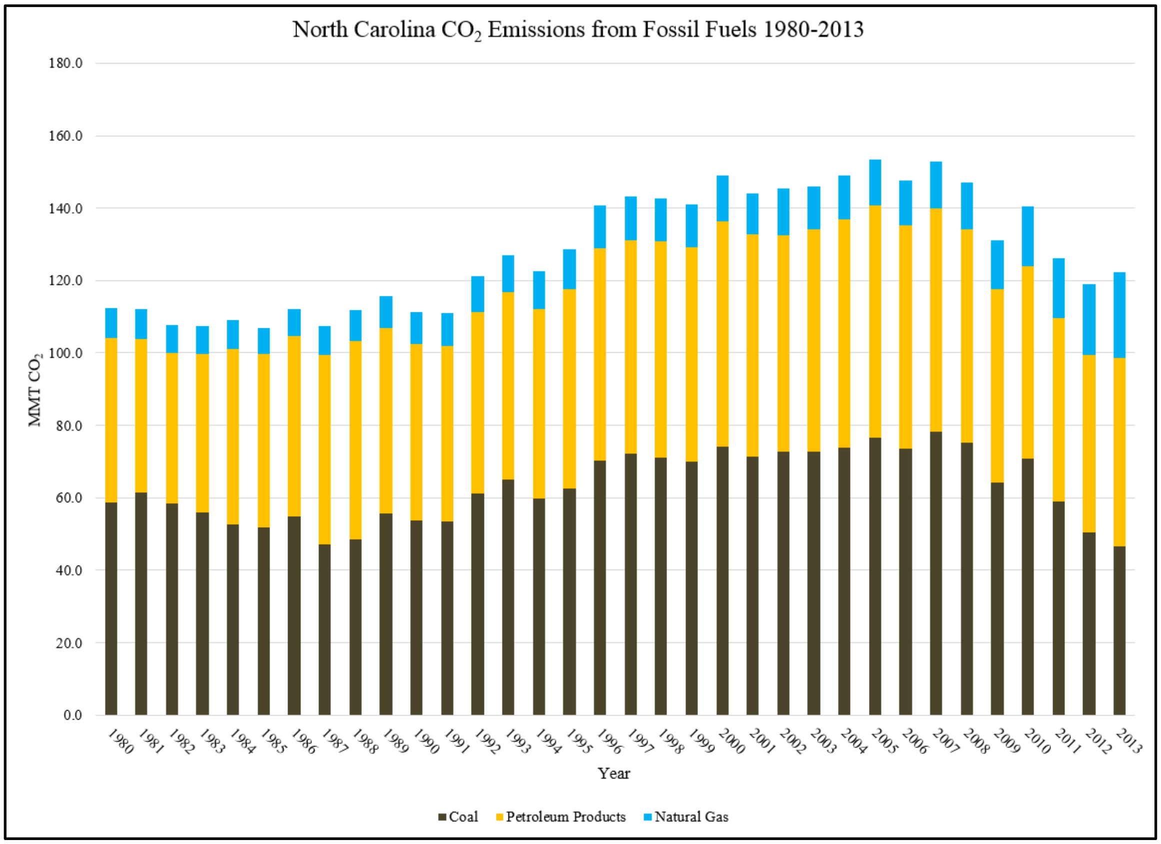

Figure 11.1.14-1: North Carolina CO_2 Emissions from Fossil Fuels by Fuel Type 1980-2013

Source: (EIA, 2015d)

North Carolina commissioned the Center for Climate Studies (CCS) to prepare an inventory of North Carolina's GHG emissions in September 2007. The inventory includes estimates for GHG emissions from 1990, 2000, 2005, and projections for 2010 and 2020. Total GHG emissions in 1990 were approximately 136 MMT CO_2e, in 2000 were 180 MMT CO_2e, and in 2005 were 192 MMT CO_2e. For comparison, total U.S. GHG emissions in 1990 are estimated to have been 6,397 MMT CO_2e, in 2000 7,259 MMT CO_2e, and in 2005 7,379 MMT CO_2e (USEPA 2014).

Future projections of emissions for 2010 and 2020 were 214 MMT CO_2e and 258 MMT CO_2e, respectively.

According to the GHG Inventory, the majority (87 percent) of North Carolina's GHG emissions in 2005 was CO_2 emitted from the energy sector. Other significant GHGs emitted in North Carolina are CH_4 and N_2O, with small quantities of hydrofluorocarbons (HFCs), sulfur hexafluoride (SF_6), and perfluorocarbons (PFCs). Future emissions growth was projected to come from additional electricity generation, and then HFCs and PFCs, which are being used to substitute for ozone-depleting substances (NCDEQ, 2007).

North Carolina does not produce natural gas or petroleum and only produces a small amount of coal. There are three pipelines that go through the state, one that supplies North Carolina with natural gas and propane from southern and western states. As of 2014, coal was still the main source of electricity generation with nuclear power supplying the remaining one-third. A small amount of electricity is also powered by 70 hydroelectric dams, biomass, and solar energy. (NCDEQ, 2007) (EIA, 2015e)

A majority of petroleum in North Carolina is consumed within the transportation sector. In 2000, vehicles powered by gasoline and diesel contributed 72 percent and 21 percent respectfully. The remaining emissions are attributed to air travel, vehicles from natural gas and liquefied petroleum gas (LPG). Because of the growing tourist industry, vehicle emissions will likely continue to increase. However, the state is taking steps to help lower emissions by requiring, "the use of motor gasoline formulated to reduce emissions that contribute to ozone formation in several of its more densely populated counties." (EIA, 2015e). This policy, along with enhanced vehicle per mile technology and new energy efficiency standards, will help reduce GHG emissions within this sector (NCDEQ, 2007), (EIA, 2015e).

11.1.14.4. Environmental Setting: Existing Climate

The National Weather Service defines climate as the "reoccurring average weather found in any particular place" (NWS, 2011a). The widely accepted division of the world into major climate categories is referred to as the Köppen-Geiger climate classification system. Climates within this system are classified based "upon general temperature profiles related to latitude" (NWS, 2011a). The first letter in each climate classification details the climate group. The Köppen-Geiger system further divides climates into smaller sub-categories based on precipitation and temperature patterns. The secondary level of classification details the seasonal precipitation, degree of aridity, and presence or absence of ice. The tertiary levels distinguish different monthly temperature characteristics. (NWS, 2011b)

The Köppen-Geiger climate classification system classifies the entirety of North Carolina as climate group (C) (see Figure 11.1.14-2). Climates classified as (C) are warm, with humid summers and mild winters. During winter months, "the main weather feature is the mid-latitude cyclone" (NWS, 2011a). During summer months, thunderstorms are frequent. (NWS, 2011b).

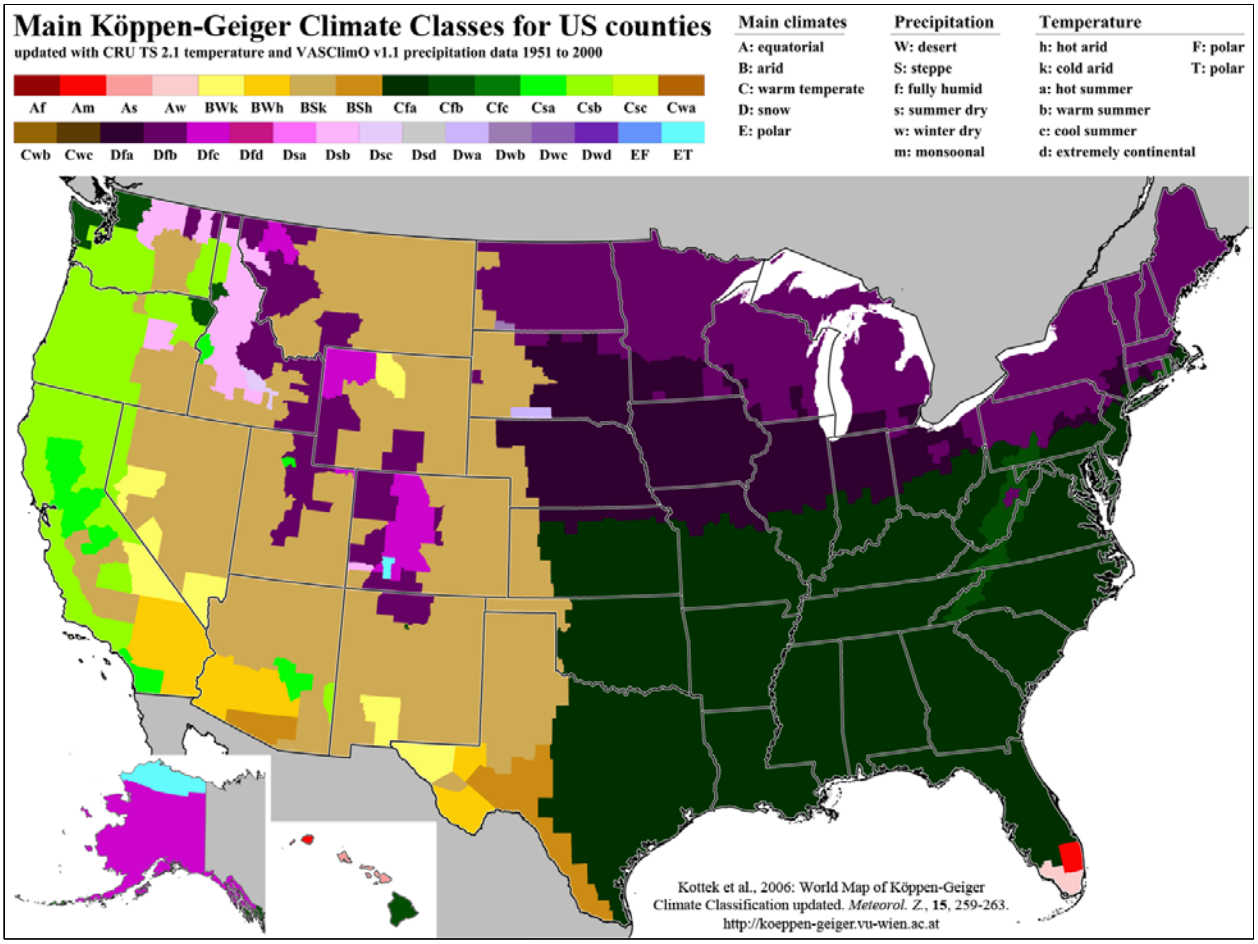

Figure 11.1.14-2: Köppen-Geiger Climate Classes for U.S. Counties

Source: (Kottek, 2006)

Cfa – The Köppen-Geiger climate classification system classifies the entirety of North Carolina as Cfa. These climates are generally warm, with humid summers and mild winters. In this climate classification zone, the secondary classification indicates year-round rainfall, but it is highly variable; thunderstorms are dominant during summer months. In this climate classification zone, the tertiary classification indicates mild, hot summers with average temperature of warm months over 72 °F. Average temperatures of the coldest months are under 64 °F. (NWS, 2011a) (NWS, 2011b)

This section discusses the current state of North Carolina’s climate with regard to air temperature, precipitation, sea level, stream flow, and extreme weather events (e.g., tropical storms, tropical cyclones, hurricanes, flooding, and thunderstorms) in the state’s Cfa climate zone.

Air Temperature

North Carolina’s altitude is the single most important influencer to the state’s climate. Statewide, average temperatures between coastal and mountainous areas can vary by as much as

20 °F. During winter months, North Carolina's mountain range protects it from "the frequent outbreaks of cold air, which move southeastward and across the central States" (State Climate Office of North Carolina, 2015). In North Carolina's interior, temperatures are approximately 10 °F cooler than along the state's coast, particularly during winter months. Temperatures that drop to as low as 0 °F are rare outside of the interior, mountainous regions of the state. The lowest temperature to occur in North Carolina was on January 21, 1985 with a record low of negative 34 °F in Mount Mitchell. In eastern, coastal areas of the state, winter temperatures are "modified by the Atlantic Ocean" (State Climate Office of North Carolina, 2015). As a result, average winter temperatures along the coastline are generally warmer. (State Climate Office of North Carolina, 2015)

During spring months, storm systems that "bring cold weather southward reach North Carolina less often and less forcefully" (State Climate Office of North Carolina, 2015). During summer months, temperatures occasionally reach 100 °F in interior regions of the state, but the majority of summers pass without reaching a high of 100 °F. Statewide, the average daily maximum temperature is approximately 90 °F. In more central and coastal regions of the state, such as Goldsboro, average daily temperature maximums can exceed 92 °F during summer months. Southwest of Goldsboro, is Fayetteville, which only reaches an average daily maximum of 89 °F. During autumn months, temperatures change most rapidly, with "the daily downward trend being greater than the corresponding rise in spring" (State Climate Office of North Carolina, 2015). Temperature drop-off is greatest during the month of October, "and continues at a rapid pace in November, so that average daily temperatures by the end of that month are within about five degrees of the lowest point of the year" (State Climate Office of North Carolina, 2015).

The following paragraph describes annual temperatures as they occur in North Carolina's single climate classification zone:

Cfa – Raleigh, the capital of North Carolina, is in central North Carolina and within the climate classification zone Cfa. The average annual temperature in Raleigh is 60.8 °F; 42.9 °F during winter months; 78.4 °F during summer months; 60.0 °F during spring months; and 61.8 °F during autumn months (NOAA, 2015b). Asheville, located in western North Carolina, is also within the climate classification zone Cfa. The average annual temperature in Asheville is 55.9 °F; 38.9 °F during winter months; 72.4 °F during summer months; 55.1 °F during spring months; and 56.7 °F during autumn months (NOAA, 2015b). Wilmington, located along the southern coast of North Carolina, is also within the climate classification zone Cfa. The average annual temperature in Wilmington is 64.0 °F; 47.8 °F during winter months; 79.6 °F during summer months; 62.8 °F during spring months; and 65.5 °F during autumn months (NOAA, 2015b).

Precipitation

Although North Carolina does not experience a distinct wet or dry season, precipitation does vary year round. Precipitation during summer months is typically the greatest, with July being the wettest month of the year. Precipitation during summer months is also highly variable as compared to other seasons, with the majority of showers occurring due to heavy showers and thunderstorms. Autumn is typically the driest season, with November being the driest month of the year. (State Climate Office of North Carolina, 2015)

Southwestern North Carolina is the rainiest region in the U.S., receiving an average of 90 inches per year. In the French Broad River valley, average annual precipitation is significantly less, with approximately 37 inches. The French Broad River valley is considered the "driest point south of Virginia and east of the Mississippi River" (State Climate Office of North Carolina, 2015). East of the mountains, approximately 40 to 55 inches falls on average each year. (State Climate Office of North Carolina, 2015)

Snow and sleet occur an average of once or twice a year. The majority of winter precipitation events occur near the coast of North Carolina, with very few events occurring over southeastern areas of the state. In mountainous areas of the state, frozen precipitation occasionally occurs in association with low-pressure storms (State Climate Office of North Carolina, 2015). Snowfall in North Carolina ranges from approximately one inch along the coast, to approximately 10 inches in the northern Piedmont area and 16 inches in the southern Mountains. In higher elevations, along mountain peaks and upper slopes, average snowfall can reach nearly 50 inches per year. (State Climate Office of North Carolina, 2015).

The following paragraph describes annual precipitation in North Carolina's single climate classification zone:

Cfa – Raleigh, the state capital, is in central North Carolina and within the climate classification zone Cfa. The average annual precipitation accumulation in Raleigh is 43.34 inches; 9.80 inches during winter months; 12.51 inches during summer months; 10.30 inches during spring months; and 10.73 inches during autumn months (NOAA, 2015b). Asheville, in western North Carolina, is also within the climate classification zone Cfa. The average annual precipitation accumulation in Asheville is 45.57 inches; 11.02 inches during winter months; 13.36 inches during summer months; 10.82 inches during spring months; and 10.37 inches during autumn months (NOAA, 2015b). Wilmington, located along the southern coast of North Carolina, is also within the climate classification zone Cfa. The average annual precipitation accumulation in Wilmington is 57.61 inches; 11.00 inches during winter months; 20.07 inches during summer months; 11.52 inches during spring months; and 15.02 inches during autumn months (NOAA, 2015b).

Sea Level

North Carolina has approximately 300 miles of coastline, with 3,375 miles of tidal shoreline (North Carolina Division of Coastal Management, 2015). Much of this shoreline is at risk for damage from strong winds, heavy rainfall, flooding, and hurricanes. Since 1900, sea level rise in North Carolina (at Sandy Point) has risen approximately 2.8 millimeters per year (Kopp, Horton, Kemp, & Tebaldi, 2015). Between 1940 and 1980 and between 1980 and 2010, sea level rise at certain gages in North Carolina (Wilmington and Southport) "decelerated relative to the global mean," and accelerated north of Cape Hatteras (Kopp, Horton, Kemp, & Tebaldi, 2015). As sea level continues to rise, it threatens "coastal populations, economic activity, static infrastructure, and ecosystems by increasing the frequency and magnitude in low-lying areas" (Kopp, Horton, Kemp, & Tebaldi, 2015). For example, in Wilmington, severe flooding occurred approximately

2.5 days per year on average between 1938 and 1970, “compared to 28 days per year between 1991 and 2013” (Kopp, Horton, Kemp, & Tebaldi, 2015).

Severe Weather Events

Hurricanes and tropical storms are relatively frequent in North Carolina. Although North Carolina’s hurricane season generally peaks in early to mid-September, its proximity to the Gulf Stream and its protruding coastline increases the probability of a hurricane strike during an early season (June and July) spike in tropical activity (North Carolina State Climate Office, 2014). Between 1851 and 2014, 48 tropical storms or hurricanes made direct landfall in North Carolina, and an additional 53 passed within 150 miles of the state (sufficiently close to have an effect) (North Carolina State Climate Office, 2014).

Tropical cyclones affecting North Carolina usually take one of three tracks. One is a coastal track where the storm moves from southwest to northeast, tracking roughly parallel to the East Coast and continuing up the coast after passing along North Carolina. The largest threats from this storm track are high winds and coastal flooding from storm surge. The second is an inland track, where the storm moves from further offshore directly towards the North Carolina coast, making landfall and continuing inshore before dissipating. These storms usually cause nearly statewide damage from flooding and high winds. The third is a Gulf track, when a storm crosses Alabama and the Florida panhandle before dissipating in the mountains of Georgia, South Carolina, and North Carolina, where it is mostly likely to cause flooding. (North Carolina State Climate Office, 2014)

Hurricane activity in North Carolina runs in cycles with periods of high activity tapering to periods of low activity and back up again. In the 1850s, hurricane activity in the 1850s was relatively tame, with 13 storms affecting North Carolina. Activity increased to a high of 26 storms affecting North Carolina in the 1880s before declining again to 13 storms in the 1920s. Since then, hurricane activity increased to 28 storms in the 1970s, down to the 22 and 21 in the 1980s and 1990s respectively, before peaking the 2000s at 29 storms. However, some of the increase in recent may be attributable to better detection and tracking technologies, augmenting the underlying increasing trend. (North Carolina State Climate Office, 2014)

Thunderstorms, tornadoes, and high winds occur in North Carolina during all seasons. North Carolina experiences thunderstorms on average 40-50 times per year. Tornadoes can occur at any time of year although they are most frequent and strong in the months of March, April, and May. Most of the tornados in North Carolina are F0-F2 in strength, with only 1 percent as strong as F4. No F5 tornados have occurred in recorded history in North Carolina. (North Carolina State Climate Office, 2015)

Flooding in North Carolina can occur as a result of heavy rain due to tropical storms, non-tropical storm-related downpours, coastal storm surge (both tropical and winter storm related), snow and ice melt, and dam or levee breakage (weather and non-weather related). North Carolina’s top five worst flooding events were all hurricane-related: The 1928 Okeechobee Hurricane, the Great Catawba River Flood of 1916, the 1940 Flood, the Homestead Hurricane of 1945, and Hurricane Floyd in 1999. The damage from Hurricane Floyd was unprecedented;

eastern North Carolina was hardest hit with 15-20 inches of rain, a 10-15 foot storm surge along the coast, and more than 15 tornadoes. (NOAA, 2015h)

11.1.15. Human Health and Safety

11.1.15.1. Definition of the Resource

The existing environment for health and safety is defined by occupational and environmental hazards likely to be encountered during the construction, operation, and maintenance of towers, antennas, cables, utilities, and other equipment and infrastructure at existing and potential FirstNet telecommunication sites. There are two human populations of interest within the existing environment of health and safety, (1) telecommunication occupational workers and (2) the general public near telecommunication sites. Each of these populations could experience different degrees of exposure to hazards as a result of their relative access to FirstNet telecommunication sites and their function throughout the implementation of the FirstNet telecommunication network infrastructure.

The health and safety issues reviewed in this section include occupational safety for telecommunications workers, contaminated sites, and manmade or natural disaster sites. This section does not evaluate the health and safety risks associated with radio frequency (RF) radiation, vehicular traffic, or the transportation of hazardous materials and wastes. Vehicle traffic and the transportation of hazardous materials and wastes are evaluated in Section 11.1.1, Infrastructure.

11.1.15.2. Specific Regulatory Considerations

Federal organizations, such as the Occupational Safety and Health Administration (OSHA), USEPA, the U.S. Department of Health and Human Services, and others protect human health and the environment. In North Carolina, this resource area is regulated by the North Carolina Department of Labor (NCDOL), Occupational Safety and Health (NCOSH) Division, and the NCDEQ. Federal OSH regulations apply to workers through either OSHA, or stricter state-specific plans that must be approved by OSHA. North Carolina has an OSHA-approved “State Plan,” which has jurisdiction over all private and public sector employees, except federal employees (OSHA, 2015a). Occupational safety regulations are enforced at the state level by the NCDOL Compliance Bureau and at the federal level by OSHA. Occupational and public health are regulated by the North Carolina Department of Health and Human Services (NCDHHS).

Federal laws relevant to protecting occupational and public health and safety are summarized in Appendix C, and Section 1.8, Overview of Relevant Federal Laws and Executive Orders. Table 11.1.15-1 below summarizes the major North Carolina laws relevant to the state’s occupational health and safety, hazardous materials, and hazardous waste management programs.

Table 11.1.15-1: Relevant North Carolina Human Health and Safety Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
North Carolina General Statutes: 74, Article 7	NCDOL	Describes regulations relating to the reclamation of mined land to prevent undesirable land and water conditions that would be detrimental to the health and safety of the citizens of the state.
North Carolina General Statutes: Chapter 74, Article 2A	NCDOL, Mine and Quarry Bureau	Regulates worker protection in mines through prevention, research, education, and enforcement.
North Carolina General Statutes: Chapter 74, Article 16	NCDOL, Occupational Safety and Health Division	Requires safe working conditions by encouraging employers, providing training, developing standards, and providing enforcement.
North Carolina General Statutes: Chapter 95, Article 19A	NCDOL, Occupational Safety and Health Division	Promotes the safety and protection of workers near high-voltage overhead lines, defines the conditions under which work may be carried out safely, and identifies precautionary safety measures.

11.1.15.3. Environmental Setting: Existing Telecommunication Sites

There are many inherent health and safety hazards at telecommunication sites. Telecommunication site work is performed indoors, below ground level, on building roofs, over water bodies, and on communication towers. Tasks may also be performed at dangerous heights or confined spaces, while operating heavy equipment, on energized equipment near underground and overhead utilities, and while using hazardous materials, such as flammable gases and liquids. Because telecommunication workers are often required to perform work outside, heat and cold exposure, precipitation, and lightning strikes also present hazard and risks depending on the task, occupational competency, and work-site monitoring (OSHA, 2016a). A summary description of the health and safety hazards present in the telecommunication occupational work environment is listed below.

Working from height, overhead work, and slips, trips, or falls – At tower and building-mount sites, workers regularly climb structures using fixed ladders or step bolts to heights up to 2,000 feet above the ground's surface (OSHA, 2015b). In addition to tower climbing hazards, telecommunication workers have restricted workspace on rooftops or work from bucket trucks parked on uneven ground. Cumulatively, these conditions present fall and injury hazards to telecommunication workers, and the general public who may be observing the work or transiting the area (IFC, 2007).

Trenches and confined spaces – Installation of underground utilities, building foundations, and work in utility manholes[125] are examples of when confined space work is necessary. Installation of telecommunication activities involves laying conduit and in small trenches (generally 6 to 12 inches in width). Confined space work can involve poor atmospheric conditions, requiring ventilation and rescue equipment. Additionally, when inside a confined space, worker

[125] Manholes may be used for telecommunications activities, especially in cities and urban areas, depending on the location of other utilities. In cities, power, water, and telecommunication lines are often co-located; if access is through a manhole in the street, that access will be used.

movement is restricted and may prevent a rapid escape or interfere with proper work posture and ergonomics. (OSHA, 2016b)

Heavy equipment and machinery – New and replacement facility deployment and maintenance can involve the use of heavy equipment and machinery. During the lifecycle of a telecommunication site, heavy equipment such as bulldozers, backhoes, dump trucks, cement trucks, and cranes are used to prepare the ground, transport materials and soil, and raise large sections of towers and antennas. Telecommunication workers may be exposed to the additional site traffic and often work near heavy equipment to direct the equipment drivers and to accomplish work objectives. Accessory machinery such as motorized pulley systems, hydraulic metal shears, and air driven tools present additional health and safety risks as telecommunication work sites. These pieces of machinery can potentially sever skin and bone, or cause other significant musculoskeletal injuries to the operator. (OSHA, 2016b)

Energized equipment and existing utilities – Electrical shock from energized equipment and utilities is an elevated risk at telecommunication sites due to the amount of electrical energy required for powering communication equipment and broadcasting towers. Telecommunication cables are often co-located with underground and overhead utilities, which can further increase occupational risk during earth-breaking and aerial work. (IFC, 2007)

Optical fiber safety – Optical fiber cable installation and repair presents additional risks to telecommunications workers, including potential eye or tissue damage, through ingestion, inhalation, or other contact with glass fiber shards. The shards are generated during termination and splicing activities, and can penetrate exposed skin (IFC, 2007). Additionally, fusion splicing (to join optical fibers) in confined spaces or other environments with the potential for flammable gas accumulation presents risk of fire or explosion (Fiber Optic Association, 2010).

Noise – Sources of excess noise at telecommunication sites include heavy equipment operation, electrical power generators and other small engine equipment, air compressors, electrical and pneumatic power tools, and road vehicles, such a diesel engine work trucks. The cumulative noise environment has the potential to exceed the OSHA acceptable level of 85 decibels (dB) per 8-hour time weighted average (TWA) (see Section 11.1.13, Noise) (U.S. Census Bureau, 2015a). Fugitive noise may emanate beyond the telecommunication work site and impact the public living in the vicinity, observing the work, or transiting through the area. (OSHA, 2016b)

Hazardous materials and hazardous waste – Work at telecommunication sites may require the storage and use of hazardous materials such as fuel sources for backup power generators and compressed gases used for welding and metal cutting (new towers only). In some cases, telecommunication sites require use of potentially hazardous products (e.g., herbicides). Secondary hazardous materials (e.g., exhaust fumes) may be a greater health risk than the primary hazardous material (e.g., diesel fuel). Furthermore, the use of hazardous materials creates down-stream potential to generate hazardous waste. While it is unlikely that any FirstNet activities would involve the generation or storage of hazardous waste, older existing telecommunication structures and sites could have hazardous materials present, such as lead-based (exterior and interior) paint at outdoor structures or asbestos tiles and insulation in equipment sheds. The public, unless a telecommunication work site allows unrestricted access, are typically shielded from hazardous materials and hazardous wastes that are components of telecommunication site work. (OSHA, 2016b)

Aquatic environments – Installation of telecommunication lines may include laying, burying, or boring lines under wetlands and waterways, including lakes, rivers, ponds, and streams. Workers responsible for these activities operate heavy equipment from soft shorelines, boats, barges, and other unstable surfaces. There is potential for equipment and personnel falls, as well as drowning in waterbodies. Wet work conditions also increase risks of electric shock and hypothermia. (OSHA, 2016b)

Outdoor elements – Weather conditions have the potential to quickly and drastically reduce safety, and increase hazards at telecommunication work sites. Excessive heat and cold conditions impact judgement, motor skills, hydration, and in extreme cases may lead to hyper or hypothermia. Precipitation, such as rain, ice, and snow, create slippery climbing conditions and wet or muddy ground conditions. Lightning strikes are risks to telecommunication workers climbing towers or working on top of buildings.

Telecommunication Worker Occupational Health and Safety

The BLS uses established industry and occupational codes to classify telecommunications workers. For industry classifications, BLS uses the North American Industry Classification System (NAICS) codes, which identify the telecommunications industry (NAICS code 517XX) as being within the information industry (NAICS code 51). For occupational classifications, BLS uses the Standard Occupational Classification (SOC) system to identify workers as belonging to one of 840 occupations. Telecommunications occupations are identified as either telecommunication equipment installers and repairers, except line installers (SOC code 49-2022); or telecommunication line installers and repairers (SOC code 49-9052). Both occupations are reported under the installation, maintenance and repair occupations (SOC code 49-0000).

As of May 2014, there were 5,510 telecommunication equipment installers and repairers, and 2,210 telecommunication line installers and repairers working in North Carolina (BLS, 2015c) (Figure 11.1.15-1). In 2013, the most recent year data are available, North Carolina had 1.2 cases of nonfatal occupational injuries or illnesses in the telecommunications industry per 100 full-time workers (BLS, 2013a). By comparison, there were 1.9 nonfatal occupational injury cases nationwide in both 2012 and 2013 per 100 full-time workers in the telecommunications industry (BLS, 2013b).

Nationwide in 2013, there were 18 fatalities reported across the telecommunications industry (5 due to violence and other injuries by persons or animals; 3 due to transportation incidents; and 7 due to slips, trips, or falls), with an hours-based fatal injury rate of 7.9 per 100,000 full-time equivalent workers (BLS, 2013c). This represents 45 percent of the broader information industry fatalities (40 total), and less than 1 percent of occupational fatalities (4,585 total). Since 2003, when data are first available, North Carolina had four fatalities in the telecommunications line installers and repairers occupation (SOC code 49-9052) in 2004. By comparison, within the broader installation, maintenance, and repair occupations (SOC code 49-0000), there were 129 fatalities in North Carolina between 2003 and 2014, with the highest being 21 fatalities in 2006. (BLS, 2015d)

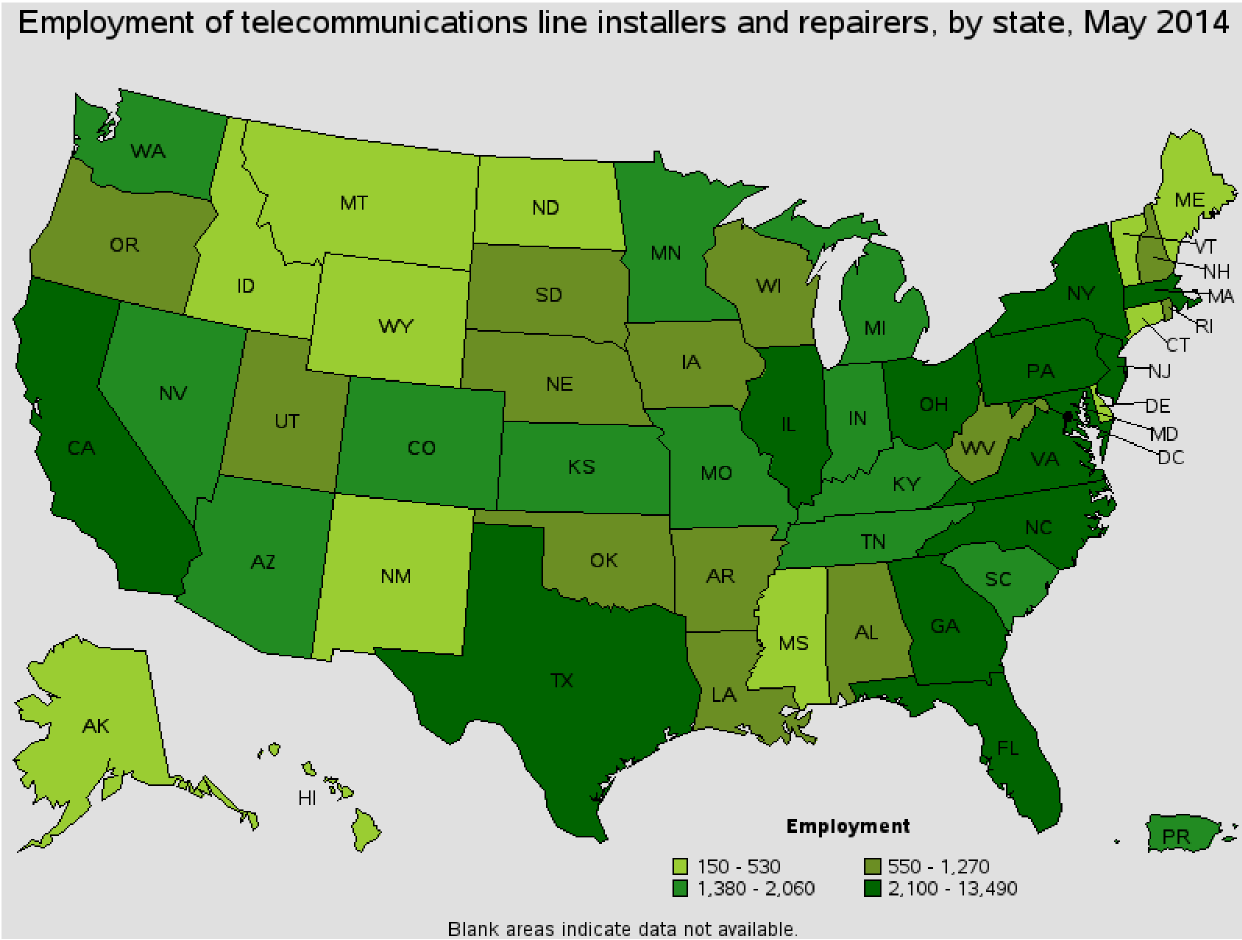

Figure 11.1.15-1: Number of Telecommunication Line Installers and Repairers Employed per State, May 2014

Source: (BLS, 2015g)

Public Health and Safety

The general public is unlikely to encounter occupational hazards at telecommunication sites due to limited access. NCDHHS, State Center for Health Statistics collects injury surveillance and fatality data among the general public through the Health Data Query System. While the system cannot be searched for cases specific to telecommunication sites, many available injury categories are consistent with risks present at telecommunication sites. For example, in 2014, there were 25 fatalities due to a fall from, out of, or through a building or structure; 5 fatalities due to exposure to electric transmission lines; and 1 fatality due to being caught, crushed, jammed or pinched in or between objects (NCDHHS State Center for Health Statistics, 2015). Among the general public, trespassers entering telecommunication sites would be at the greatest risk for exposure to health and safety hazards.

11.1.15.4. Environmental Setting: Contaminated Properties at or near Telecommunication Sites

Existing and surrounding land uses, including landfills or redeveloped brownfields, near telecommunication sites have the potential to impact human health and safety. Furthermore, undocumented environmental practices of telecommunication site occupants, including practices before current environmental laws, could result in environmental contamination, affecting the quality of soil, sediments, groundwater, surface water, and air.

Contaminated property is typically classified by the federal environmental remediation or cleanup programs that govern them, such as sites administered through the Superfund Program[126] or listed on the National Priorities List (NPL), as well as the Resource Conservation and Recovery Act (RCRA) Corrective Action sites and Brownfields. These regulated cleanup sites are known to contain environmental contaminants at concentrations exceeding acceptable human health exposure thresholds. Contact with high concentrations of contaminated media can result in adverse health effects, such as dermatitis, pulmonary and cardiovascular events, organ disease, central nervous system disruption, birth defects, and cancer. It generally requires extended periods of exposure over a lifetime for the most severe health effects to occur.

The Inactive Hazardous Sites Branch of the NCDEQ, Division of Waste Management, addresses contamination at over 2,000 hazardous sites and landfills under the North Carolina Inactive Hazardous Sites Response Act. The Federal Remediation Branch of the Division of Waste Management assists the USEPA during the investigation and remediation of federal Superfund sites in North Carolina (NCDEQ, 2015t). As of October 2015, North Carolina had 87 RCRA Corrective Action sites,[127] 626 brownfield sites, and 39 proposed or final Superfund/NPL sites (USEPA, 2015l). Based on a October 2015 search of USEPA Cleanups in My Community (CIMC) database, there are two Superfund sites (CTS of Asheville, Inc. in Asheville, NC and Ward Transformer Company in Raleigh, NC) in North Carolina where contamination has been detected at an unsafe level, or a reasonable human exposure risk still exists (USEPA, 2015m).

Brownfield sites in North Carolina may enroll in the state Brownfields Program, which assists property owners or prospective buyers with voluntarily cleaning up contaminated sites, which they are not responsible for (NCDEQ, 2015u). One example of a brownfield site is Conover Station in Conover, NC. Broyhill Furniture closed the 26-acre downtown Conover manufacturing plant in 2005, leaving the property contaminated with petroleum products from underground and aboveground storage tanks at the facility. The City of Conover redeveloped the vacant and abandoned property, transforming the preexisting buildings and surrounding site into a park, library, coffee shop, and a small area for a technology business startup. (NCDEQ, 2015v)

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[126] The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) enacted in 1980, commonly referred to as the Superfund Program, governs abandoned hazardous waste sites, and collects a tax on chemical and petroleum industries. CERCLA was amended by the Superfund Amendments and Reauthorization Act (SARA) in 1986; see Appendix C (USEPA, 2011b).

[127] Data gathered using USEPA's CIMC search on October 19, 2015, for all sites in North Carolina, where cleanup type equals 'RCRA Hazardous Waste – Corrective Action,' and excludes sites where cleanup phase equals 'Construction Complete' (i.e., no longer active). (USEPA, 2013c)

In addition to contaminated properties, certain industrial facilities are permitted to release toxic chemicals into the air, water, or land. One such program is the Toxics Release Inventory (TRI), administered by the USEPA under the Emergency Planning and Community Right to Know Act (EPCRA) of 1986. The Toxic Release Inventory database is a measure of the industrial nature of an area and the over-all chemical use, and can be used to track trends in releases over time. The "releases" do not necessarily equate to chemical exposure by humans or necessarily constitute to quantifiable health risks because the releases include all wastes generated by a facility – the majority of which are disposed of via managed, regulated processes that minimize human exposure and related health risks (e.g., in properly permitted landfills or through recycling facilities). As of October 2015, North Carolina had 748 TRI reporting facilities. The identification of a TRI facility does not necessarily indicate that the facility is actively releasing to the environment; the majority of TRI reports involve permitted disposal facilities. According to the USEPA, in 2013, the most recent data available, North Carolina released 54 million pounds of toxic chemicals through onsite and offsite disposal, transfer, or other releases, largely from the chemicals and paper industries. This accounted for 1.32 percent of releases nationwide, ranking North Carolina 22 of 56 states and territories based on total releases per square mile. (USEPA, 2015n)

Another USEPA program is the NPDES, which regulates the quality of storm water and sewer discharge from industrial and manufacturing facilities. Permitted discharge facilities are potential sources of toxic constituents that are harmful to human health or the environment. As of November 12, 2015, North Carolina had 221 major NPDES permitted facilities registered with the USEPA Integrated Compliance Information System (USEPA, 2015o).

The National Institutes of Health (NIH), U.S. National Library of Medicine, provides an online mapping tool called TOXMAP, which allows users to "visually explore data from the USEPA's TRI and Superfund Program" (NIH, 2015a). Figure 11.1.15-2 provides an overview of potentially hazardous sites in North Carolina.

Telecommunication Worker Occupational Health and Safety

Telecommunications sites may be on or near contaminated land, industrial discharge facilities, or sites presenting additional hazards. Occupational exposure to contaminated environmental media can occur during activities like soil excavating, trenching, other earthwork, and working over water bodies. Indoor air quality may also be impacted from vapor intrusion infiltrating indoors from contaminated soil or groundwater that are present beneath a building's foundation. As of October 2015, there are 19 USEPA-regulated telecommunications sites in North Carolina (USEPA, 2015p). These sites are regulated under one or more environmental programs including NPDES compliance, Superfund/NPL status, and TRI releases.

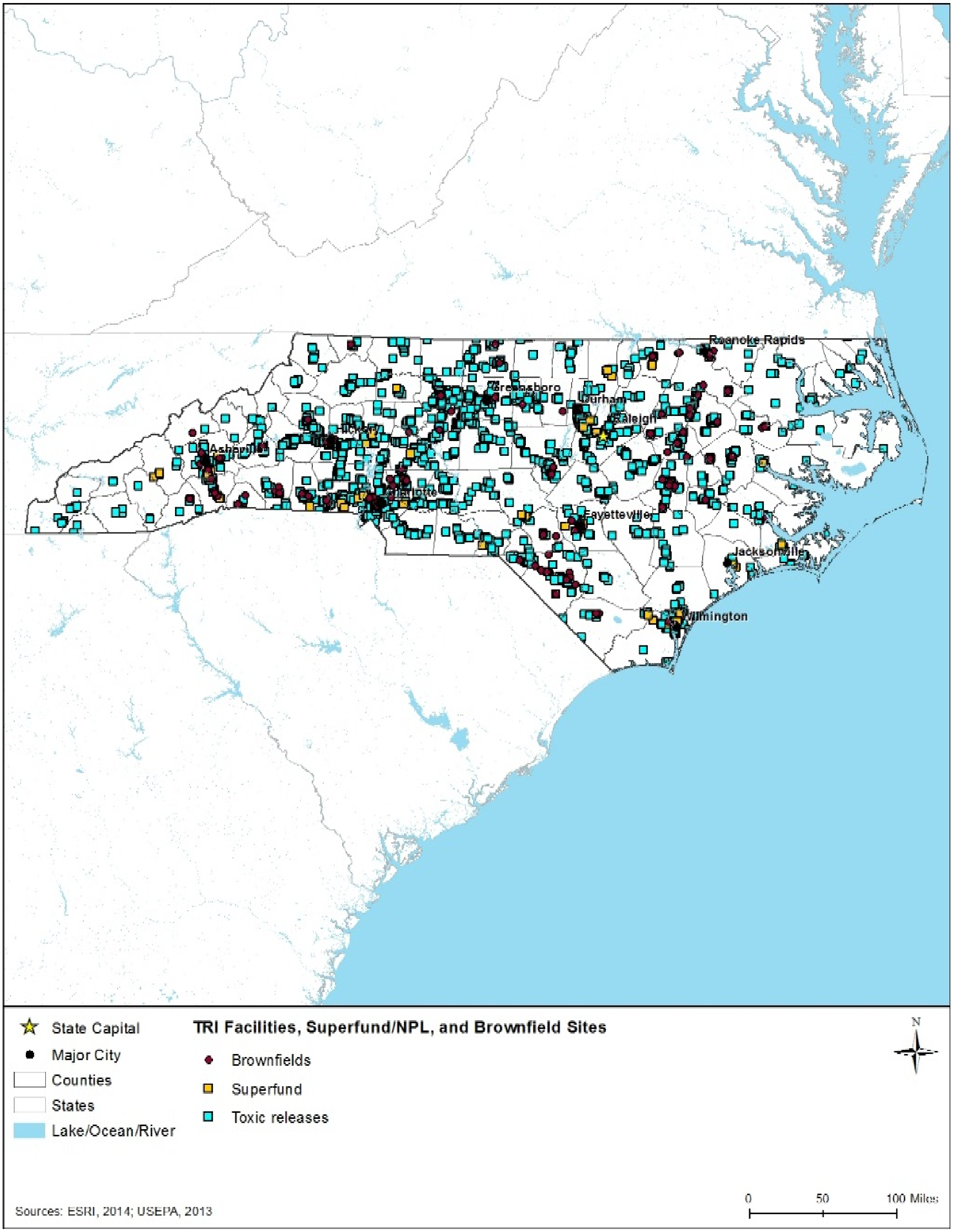

Figure 11.1.15-2: TOXMAP TRI Facilities, Superfund/NPL and Brownfield Sites in North Carolina (2013)

According to BLS data, North Carolina had three occupational fatalities in 2014 and one fatality[128] in 2014 within the telecommunications line installers and repairers occupation (SOC code 49-9052) from exposure to "harmful substances or environments" (BLS, 2015d). By comparison, the BLS reported four fatalities in 2014 nationwide within the telecommunications line installers and repairers occupation (SOC code 49-9052), and no fatalities within the telecommunications equipment installers and repairers occupation (SOC code 49-2022) due to exposure to harmful substances or environments (BLS, 2014). In 2014, BLS also reported three fatalities in 2011 and three fatalities nationwide within the telecommunications industry (NAICS code 517), due to exposure to harmful substances or environments (BLS, 2015e).

Public Health and Safety

As described earlier, access to telecommunications sites is nearly always restricted to occupational workers. Although site access control is one of the major reasons telecommunications sites present an inherent low risk to non-occupational workers, the general public could be potentially exposed to contaminants and other hazards in a variety of ways. One example would be if occupational workers disturb contaminated soil while digging, causing hazardous chemicals to mix with an underlying groundwater drinking water sources. If a

Spotlight on North Carolina Superfund Sites: Ward Transformer Site

The 11-acre Ward Transformer facility, located near Raleigh, NC, operated from 1964 until 2006, manufacturing and rebuilding transformers and other electrical equipment (USEPA, 2015t). Prior to 1977, the use of PCB transformer oil led to the contamination of onsite soils and downstream sediments and surface water. The Agency for Toxic Substances and Disease Registry (ATSDR) found that fish downstream of the site had elevated PCB levels high enough to increase the risk of cancer, and that site workers exposed to PCB-contaminated soils have an increased risk of cancer. As a result, ATSDR classified the Ward Transformer site as a public health hazard, and the State issued a fish consumption advisory for nearby rivers and lakes. (ATSDR, 2005)

The USEPA listed the site on the NPL in 2003, and began short-term cleanup activities to address immediate health and safety risks. The Potentially Responsible Parties have since removed over 420,000 tons of PCB-impacted material from the site, conducted ecological restoration to offsite areas, and continue to fund cleanup activities. (USEPA, 2015t)

contaminant enters a drinking water source, the surrounding community could inadvertently ingest or absorb the contaminant when using that source of water for drinking, cooking, bathing, and swimming. By trespassing on a restricted property, a trespasser may come in contact with contaminated soil or surface water, or by inhaling harmful vapors.

The NCDHHS, Environmental Health Section promotes human health and protects the environment through several programs, such as asbestos, hurricane health and safety, lead poisoning, and public water system testing (NCDHHS, 2015). At the federal level, the Centers

[128] BLS Census of Fatal Occupational Injuries data for 2014 is for preliminary reporting only. Final data are expected to be released in spring 2016. (BLS, 2015f)

for Disease Control and Prevention (CDC), National Environmental Public Health Tracking Network, provides health, exposure, and hazard information, including known chemical contaminants, chronic diseases, and conditions based on geography. In 2011, the most recent year data are available, North Carolina reported a rate of 1 injury and fatality due to reported acute toxic substance release incidents per 100,000 population, and 251 total reported release incidents (CDC, 2015).

11.1.15.5. Environmental Setting: Abandoned Mine Lands at or near Telecommunications Sites

Another health and safety hazard in North Carolina includes surface and subterranean mines. In 2015, the North Carolina mining industry ranked 20th for non-fuel minerals (primarily crushed stone, phosphate rock, construction sand and gravel, industrial sand and gravel, and common clays), generating a value of $1.29B (USGS, 2016a). Health and safety hazards know at active mines and abandoned mine lands (AML) include falling into open shafts, cave-ins from unstable rock and decayed support, deadly gases and lack of oxygen inside the mine, unused explosives and toxic chemicals, horizontal and vertical openings, high walls, and open pits (Federal Mining Dialogue, 2015).

In North Carolina, the NCDOL, Mine and Quarry Bureau, is responsible for managing AML health and safety hazards resulting from pre-1977 mining operations (NCDOL, 2015). Figure 11.1.15-3 shows the distribution of High Priority (Priority 1, 2 and adjacent Priority 3) AMLs in North Carolina, where Priority 1 and 2 sites pose a significant risk to human health and safety, and Priority 3 sites pose a risk to the environment. As of December 2015, North Carolina had 4 Priority 1 and 2 AMLs (USDOI, 2015a).

Figure 11.1.15-3: High Priority Abandoned Mine Land in North Carolina (2015)

Source: (USDOI, 2015b)

Telecommunication Worker Occupational Health and Safety

Telecommunications sites may be on or near AMLs, presenting occupational exposure risks from fire, toxic gases, and subsidence during FirstNet deployment, operation, and maintenance activities. Because the locations of many abandoned mines are unknown or hidden, these mines pose a risk to telecommunications workers because they may be encountered during deployment and maintenance operations.

Public Health and Safety

Subterranean mines present additional health and safety risks to the general public, by generating toxic combustible gases, which can penetrate the surface through ground fractures, potentially seeping into residential structures. Additionally, mine fires can consume enough sub-surface material, that risk of subsidence increases. As a result, AMLs and mine fires in particular, can result in evacuations of entire communities (USDOI, 2015c).

11.1.15.6. Environmental Setting: Natural and Manmade Disaster Sites

Natural and manmade disaster events can create health and safety risks, as well as present unique hazards, to telecommunication workers and the public. Telecommunications, including public safety communications, can be unavailable (temporarily or permanently) during disaster events. Examples of manmade disasters are train derailments, refinery fires, or other incident involving the release of hazardous constituents. A common example of a natural disaster is flooding. Floodwaters damage transportation infrastructure (roads, railways, etc.) and utility lines (sewer, water, electric power, broadband, natural gas lines, etc.). Hazardous chemicals and sanitary wastes often contaminate floodwaters, which can cause headaches, skin rashes, dizziness, nausea, excitability, weakness, fatigue, and disease to exposed workers (OSHA, 2003). Another natural hazard common to North Carolina is lightning strikes. Between 1959 and 2014, North Carolina ranked 3rd in the United States for the most lightning fatalities (194 total), amounting to a fatality rate of 0.54 per one million people (NOAA, 2015i).

Telecommunication Worker Occupational Health and Safety

Telecommunication workers are often called upon to provide support to natural and manmade disaster response efforts because of the critical need to restore and maintain telecommunication capabilities. During natural and manmade disasters, access to the telecommunication sites can be obstructed by debris. The need to enter disaster areas as part of the recovery effort exposes telecommunication workers to elevated risks because chemical, biological, and physical hazards might not have not been fully identified or assessed. Transportation infrastructure and utilities in the affected areas are often compromised and present unknown chemical and biologic hazards. Correspondingly, if telecommunication workers are injured during response and repair operations, their rescue and treatment might over-extend first responder staff and medical facilities that are delivering care to victims of the initial incident.

Currently, NCDOL and BLS do not report data specific to injuries or fatalities among telecommunication workers responding to natural or manmade disasters. However, the National Response Center (NRC), managed by the U.S. Coast Guard, compiles reports for oil spills, chemical releases, or other maritime security incidents and contains incident reports related to occupational health and safety. Of the 349 NRC-reported incidents for North Carolina in 2015 with known causes, only 14 were attributed to natural disaster (e.g., earthquake, flood, hurricane, tornado, or other natural phenomenon), while 335 incidents were attributed to manmade disasters (e.g., derailment, dumping, equipment failure, operator error, over pressuring, suicide, transport accident, or trespasser) or other indeterminate causes (USCG, 2015). For example, during Hurricane Irene, five vessels were sunk in the Hancock Marina near Cherry Point, NC, spilling fuel into a local waterway (USCG, 2011). Such incidents present unique, hazardous challenges to telecommunication workers responding during natural and manmade disasters.

Public Health and Safety

Hazards present during natural and manmade disasters are often far-reaching, affecting large geographic areas and affecting all populations living within the area. Similar to telecommunication workers, the general public faces risks during these types of disasters, such as compromised transportation infrastructure and utilities, potential for exposure to unknown chemical and biologic hazards, and inadequate medical support. In 2014, North Carolina reported 9 weather-related fatalities (4 due to wind, 3 due to winter weather, 1 due to tornado, and 1 due to unknown causes) and 43 injuries. By comparison, 384 weather-related fatalities and 2,203 injuries were reported nationwide the same year. (NWS, 2015a).

Spotlight on North Carolina Natural Disaster Sites: Hurricane Irene

On August 27, 2011, Hurricane Irene made landfall near Cape Lookout, NC, as a Category 1 hurricane. Precipitation of 15 inches was recorded in Beaufort County, NC, and winds up to 115 miles per hour occurred as the eye of the storm made landfall (NWS, 2015b). The result was numerous downed trees, utility outages, and damaged or destroyed roads and infrastructure. Hurricane Irene damaged farms and crops in North Carolina, and closed 270 roads and 21 bridges due to flooding or other damage. Flooding and high winds caused the evacuation of residents and some area hospitals in eastern North Carolina. Extensive damage caused by the storm hindered initial relief efforts, particularly in the Outer Banks where access was limited due to washout conditions (NWS, 2012)**.**

Figure 11.1.15-4: Gas Station Damaged by Hurricane Irene

Source: (NWS, 2015b)

11.2. Environmental Consequences

This section describes the potential environmental impacts, beneficial, or adverse, resulting from the Proposed Action and Alternatives. As this is a programmatic evaluation, site- and project-specific issues are not assessed. The specific deployment activity and where the deployment will take place will be determined based on location-specific conditions and the results of site-specific environmental reviews.

At the programmatic level, the categories of impacts have been defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Each resource area identifies the range of possible impacts on resources for the Proposed Action and Alternatives, including the No Action Alternative. The No Action Alternative provides a comparison to describe the effects of environmental resources of the existing conditions to the Proposed Alternatives.

NEPA requires agencies to assess the potential direct and indirect impacts each alternative could have on the existing environment (as characterized earlier in this section). Direct impacts are those impacts that are caused by the Proposed Action and occur at the same time and place, such as soil disturbance. Indirect impacts are those impacts related to the Proposed Action but result from an intermediate step or process, such as changes in surface water quality because of soil erosion.

For each resource, the potential impact is assessed in terms of context of the action and the intensity of the potential impact, per CEQ regulations (40 CFR §1508.27). *Context* refers to the timing, duration, and where the impact could potentially occur (i.e., local vs. national; pristine vs. disturbed; common species vs. protected species). In terms of duration of potential impact, context is described as short or long term. *Intensity* refers to the magnitude or severity of the effect as either beneficial or adverse. Resource-specific significance rating criteria are provided at the beginning of each resource area section.

11.2.1. Infrastructure

11.2.1.1. Introduction

This section describes potential impacts to infrastructure in North Carolina associated with construction, deployment, and operation of the Proposed Action and Alternatives. Chapter 16, Best Management Practices (BMPs) and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

11.2.1.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on infrastructure were evaluated using the significance criteria presented in Table 11.2.1-1. The categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to infrastructure addressed in this section are presented as a range of possible impacts.

Table 11.2.1-1: Impact Significance Rating Criteria for Infrastructure

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Transportation system capacity and safety	Magnitude or Intensity	Creation of substantial traffic congestion/delay and/or a substantial increase in transportation incidents (e.g., crashes, derailments).	Effect that is potentially significant, but with mitigation is less than significant.	Minimal change in traffic congestion/delay and/or transportation incidents (e.g., crashes, derailments).	No effect on traffic congestion or delay, or transportation incidents.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Permanent: Persisting indefinitely.		Short-term effects will be noticeable for up to the entire construction phase or a portion of the operational phase.	NA
Capacity of local health, public safety, and emergency response services	Magnitude or Intensity	Impacted individuals or communities cannot access health care and/or emergency services, or access is delayed, due to the project activities.	Effect is potentially significant, but with mitigation is less than significant.	Minor delays to access to care and emergency services that do not impact health outcomes.	No impacts on access to care or emergency services.
	Geographic Extent	Regional impacts observed (“regional” assumed to be at least a county or county-equivalent geographical extent, could extend to state).		Impacts only at a local/neighborhood level.	NA
	Duration or Frequency	Duration is constant during construction and deployment phase.		Rare event during construction and deployment phase.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Modifies existing public safety response, physical infrastructure, telecommunication practices, or level of service in a manner that directly affects public safety communication capabilities and response times	Magnitude or Intensity	Substantial adverse changes in public safety response times and the ability to communicate effectively with and between public safety entities.	Effect that is potentially significant, but with mitigation is less than significant.	Minimal change in the ability to communicate with and between public safety entities.	No perceptible change in existing response times or the ability to communicate with and between public safety entities.
	Geographic Extent	Local/City, County/Region, or State/Territory.		Local/City, County/Region, or State/Territory.	Local/City, County/Region, or State/Territory.
	Duration or Frequency	Permanent or perpetual change in emergency response times and level of service.		Change in communication and/or the level of service is perceptible but reasonable to maintaining effectiveness and quality of service.	NA
Effects to commercial telecommunication systems, communications, or level of service	Magnitude or Intensity	Substantial adverse changes in level service and communications capabilities.	Effect that is potentially significant, but with mitigation is less than significant.	Minor changes in level of service and communications while transitioning to the new system.	No perceptible effect to level of service or communications while transitioning to the new system.
	Geographic Extent	Local/City, County/Region, or State/Territory.		Local/City, County/Region, or State/Territory.	Local/City, County/Region, or State/Territory.
	Duration or Frequency	Persistent, long-term, or permanent effects to communications and level of service.		Minimal effects to level of service or communications lasting no more than a short period (minutes to hours) during the construction and deployment phase.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Effects to utilities, including electric power transmission facilities and water and sewer facilities	Magnitude or Intensity	Substantial disruptions in the delivery of electric power or to physical infrastructure that results in disruptions, including frequent power outages or drops in voltage in the electrical power supply system ("brownouts"). Disruption in water delivery or sewer capacity, or damage to or interference with physical plant facilities that impact delivery of water or sewer systems.	Effect that is potentially significant, but with mitigation is less than significant.	Minor disruptions to the delivery of electric power, water, and sewer services, or minor modifications to physical infrastructure that result in minor disruptions to delivery of power, water, and sewer services.	There would be no perceptible impacts to delivery of other utilities and no service disruptions.
	Geographic Extent	Local/City, County/Region, or State/Territory.		Local/City, County/Region, or State/Territory.	Local/City, County/Region, or State/Territory.
	Duration or Frequency	Effects to other utilities would be seen throughout the entire construction phase.		Effects to other utilities would be of short duration (minutes to hours) and would occur sporadically during the entire construction phase.	NA

NA = Not Applicable

11.2.1.3. Description of Environmental Concerns

Transportation System Capacity and Safety

The primary concerns for transportation system capacity and safety related to FirstNet activities would primarily occur during the construction phases of deployment. Depending on the exact site locations and placement of new assets in the field, temporary impacts on traffic congestion, railway use, airport or harbor operations, or use of other transportation corridors could occur if site locations were near or adjacent to roadways and other transportation corridors, requiring temporary closures (lane closures on roadways, for example). Coordination would be necessary with the relevant transportation authority (i.e., North Carolina Departments of Transportation, airport authorities, railway companies, and harbormasters) to ensure proper coordination during deployment. Based on the impact significance criteria presented in Table 11.2.1-1, such impacts would be less than significant due to the temporary nature of the deployment activities, even if impacts would be realized at one or more isolated locations. These impacts would be noticeable during the deployment phase, but would be short-term, with no anticipated impacts continuing into the operational phase, unless any large-scale maintenance would become necessary during operations.

Capacity of Local Health, Public Safety, and Emergency Response Services

With close to 313,000 first responder or related personnel, over 300 fire stations, over 300 registered fire departments, and more than 100 law enforcement agencies in North Carolina, the capacity to impact first responder services must be taken into consideration (Table 11.1.1-5 and Table 11.1.1-6) (National Fire Department Census, 2015) (U.S. Bureau of Justice Statistics , 2011) (U.S. Bureau of Justice Statistics , 2011). The capacity of local health, public safety, and emergency response services would experience less than significant impacts during construction or operation phases. During deployment and system optimization, existing services would likely remain operational in a redundant manner ensuring continued operations and availability of services to the public. The only potential impact would be extremely rare, if emergency response services were using transportation infrastructure to respond to an emergency at the exact time that deployment activities were taking place. This type of impact would be isolated at the local or neighborhood level, and the likelihood of such an impact would be extremely low. Once operational, the new network would provide beneficial impacts to the capacity of local health, public safety, and emergency response services through enhanced communications infrastructure, thereby increasing capacity for and enhancing the ability of first responders to communicate during emergency response situations. Based on the impact significance criteria presented in Table 11.2.1-1, potential negative impacts would be less than significant. Substantial beneficial impacts are likely to result from implementation.

Modifies Existing Public Safety Response Telecommunication Practices, Physical Infrastructure, or Level of Service in a manner that directly affects Public Safety Communication Capabilities and Response Times

The Proposed Action and Alternatives contemplated by FirstNet would not cause negative impacts to existing public safety response telecommunication practices, physical infrastructure, or level of service in a manner that directly affects public safety communication capabilities and response times. Based on the impact significance criteria presented in Table 11.2.1-1, any potential impacts would be less than significant during deployment. As described above, during deployment and system optimization, existing services would likely remain operational in a redundant manner ensuring continued operations and availability of services to the public. Once operational, state, and local public safety organizations would need to evaluate telecommunication practices and standard operating procedures (SOPs). FirstNet's mission is to complement such practices and SOPs in a positive manner; therefore, only beneficial or complementary impacts would be anticipated. Public safety communication capabilities and response times would be expected to also experience beneficial impacts through enhanced communications abilities. It is possible that FirstNet would be upgrading physical telecommunications infrastructure, thus the infrastructure would also experience a positive and beneficial impact. Disposal or reuse of old public safety communications infrastructure would also likely need to be considered once the specifics are known. Any negative impacts would be expected to be less than significant given the short-term nature of the deployment activities.' Any negative impacts would be expected to be less than significant given the short-term nature of deployment activities.

Effects to Commercial Telecommunication Systems, Communications, or Level of Service

North Carolina's VIPER Statewide P25 Network, a 700 MHz/800 MHz LMR system, provides statewide coverage for public safety and emergency communications agencies in the state. It also interoperates with South Carolina's statewide public safety network (RadioReference.com, 2015a). Also, there are over 3,200 commercial towers in North Carolina (FCC 2015b). Commercial telecommunication systems, communications, or level of service would experience no impacts, as such commercial assets would likely be using a different spectrum for communications. FirstNet has exclusive rights to use of the assigned spectrum, and only designated public safety organizations would be authorized to connect to FirstNet's network. Depending on the use patterns of FirstNet's spectrum, such spectrum use may be over-built or under-utilized.[129] Anticipated impacts would be less than significant due to the limited extent and temporary nature of the deployment. Such leases would then have less than significant positive impacts on commercial telecommunication systems, communications, or level of service, per the impact significance criteria presented in Table 11.2.1-1.

[129] Telecommunications equipment for specific spectrum use can be built where other equipment for other spectrum use already exists. If the new equipment and spectrum is not fully utilized, the geographic region may experience "over-build," where an abundance of under-utilized equipment may exist in that geographic location. This situation can be caused by a variety of factors including changes in current and future use patterns, changes in spectrum allocation, changes in laws and regulations, and other factors.

Effects to Utilities, including Electric Power Transmission Facilities, and Water and Sewer Facilities

The North Carolina Utilities Commission (NCUS) regulates electric utilities; the DEQ Division of Water Resources (DWR) manages water and wastewater utilities; and the DWM manages the state's solid waste. The activities proposed by FirstNet would have less than significant impacts on utilities, including electric power transmission facilities, and water and sewer facilities. Also, depending on the specific project contemplated, installation of new equipment could require connection with local electric sources, and use of site-specific local generators, on a temporary or permanent basis. Additionally, depending on the specific project contemplated, the draw or use of power from the transmission facilities may need to be examined; however, it is not anticipated that such use of power would have negative impacts, due to the local nature of the proposed activities and the widespread availability and use of the power grid in the United States.

11.2.1.4. Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operation activities.

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to infrastructure and others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have no impacts to infrastructure under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be no impacts to infrastructure resources since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes or disruption of transportation, telecommunications, or utility services.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber would have no impacts to infrastructure resources because there would be no ground disturbance and no interference with existing utility, transportation, or communication systems.

- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the use of portable devices that use satellite technology would not impact infrastructure resources because there would be no change to the built or natural environment from the use of portable equipment. Installation of satellite-enabled equipment would not be expected to have any impacts to infrastructure resources, given that construction activities would occur on existing structures, would not be expected to interfere with existing equipment, and transportation capacity and safety, and access to emergency services would not be impacted.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN, however it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact infrastructure resources, it is anticipated that this activity would have no impact on infrastructure resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to infrastructure as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur as a result of direct interface with existing infrastructure, most notably existing telecommunication infrastructure. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to infrastructure include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of points of presence (POP) huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to infrastructure resources, depending on the specific assets connected on either end of the buried fiber. If a fiber optic plant is being used to tie into existing telecommunications assets, then localized impacts to telecommunications sites could occur during the deployment phase, however, it is anticipated that this tie-in would cause less than significant impacts as the activity would be temporary and minor.
  - New Build – Aerial Fiber Optic Plant: Installation of a new aerial fiber optic plant could impact new telecommunications infrastructure through the installation of new, or replacement of existing telecommunications poles.
  - Collocation on Existing Aerial Fiber Optic Plant: Similar to new build activities (above), collocation on existing aerial fiber optic plant could include installation of new or replacement towers requiring ground disturbance.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water would not impact infrastructure resources because there would be no local infrastructure to impact, other than harbor operations. However, impacts to infrastructure resources could potentially occur as result of the construction of landings and/or facilities

on shore to accept submarine cable, depending on the exact site location and proximity to existing infrastructure.

- Installation of Optical Transmission or Centralized Transmission Equipment: Installation of transmission equipment such as small boxes or huts, or access roads could potentially impact infrastructure. Impacts could include disruption of service in transportation corridors, disruption of service to telecommunications infrastructure, or other temporary impacts.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads might result in temporary or unintended impacts to current utility services during installation or interconnection activities. Generally, however, these deployment activities would be independent and would not be expected to interfere with other existing towers and structures. In addition, installation activities would have beneficial impacts due to expansion of infrastructure at a local level. Such activities could enhance public safety infrastructure, and other telecommunications as the site could potentially be available for subsequent collocation.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would result in localized impacts to that tower and tower site such as minor disruptions in services. As a result of collocation of equipment, the potential addition of power units, structural hardening, and physical security measures could potentially have beneficial impacts on existing infrastructure assets, depending on the site-specific plans.
  - Deployable Technologies: Deployable technologies such as Cells on Wheels (COWs), Cells on Light Trucks (COLTs), and Systems on Wheels (SOWs) are comprised of cellular base stations, sometimes with expandable antenna masts, and generators that connect to utility power cables. Connecting the generators to utility power cables has the potential to disrupt electric power utility systems or cause power outages; however, this is expected to be temporary and minor. Some staging or landing areas (depending on the type of technology) could require minor construction and maintenance within public road ROWs and utility corridors, heavy equipment movement, and minor excavation and paving near public roads, which have the potential to impact transportation capacity and safety as these activities could increase transportation congestion and delays. Implementation of deployable technologies could result in potential impacts to infrastructure resources in terms of infrastructure expansion, if deployment requires paving of previously unpaved surfaces or other new infrastructure build to accommodate the deployable technology. Also, beneficial impacts could be realized, as deployable technologies are used when other infrastructure is impaired in some way; so deployable technologies could provide continuity of service during emergency events. Where

deployable technologies would be implemented on existing paved surfaces and the acceptable load on those paved surfaces is not exceeded, or where aerial deployable technologies may be utilized but launched from existing paved surfaces, it is anticipated that there would be no impacts to infrastructure resources because there would be no disturbance of the natural or built environment.

In general, the abovementioned activities could potentially impact infrastructure resources in different ways, resulting in both potentially negative and potentially positive impacts. Potential negative impacts to infrastructure associated with deployment could include temporary disruption of various types of transportation corridors, temporary impacts on existing or new telecommunications sites, and more permanent impacts on utilities, if new infrastructure required tie-in to the electric grid. These impacts are expected to be less than significant at the programmatic level as the deployment activities will likely be of short duration (generally a few hours to a few months depending on the activity), would be regionally based around the on-going phase of deployment, and minor. Chapter 16, BMPs and Mitigation Measures provides Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Positive impacts to infrastructure resources may result from the expansion of public safety and commercial telecommunications capacity and an improvement in public safety telecommunications coverage, system resiliency, response times, and system redundancy.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in potential impacts similar to the abovementioned deployment impacts. It is anticipated that there would be no impacts to infrastructure associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors, or if further construction related activities are required along public road and utility ROWs, increased traffic congestion, current telecommunication system interruption, and utility interruptions could occur. These potential impacts would be expected to be minor and temporary as explained above.

Numerous beneficial impacts would be associated with operation of the NPSBN. The new system is intended to result in substantial improvements in public safety response times and the ability to communicate effectively with and between public safety entities, and would likely result in substantial improvements in level of service and communications capabilities. Operation of the NPSBN is intended to involve high-speed data capabilities, location information, images, and eventually streaming video, which would likely significantly improve communications and the ability of the public safety community to effectively engage and respond. The NPSBN is also intended to have a higher level of redundancy and resiliency than current commercial networks to support the public safety community effectively, even in events of extreme demand. This improvement in the level of resiliency and redundancy is intended to increase the reliability of systems, communications, and level of service, and minimize disruptions and misinformation resulting from limited or disrupted service. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

11.2.1.5. Alternatives Impact Assessment

The following section assesses potential impacts to infrastructure associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to infrastructure as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts at the programmatic level to infrastructure even if deployment requires expansion of infrastructure, such as paving of previously unpaved surfaces or other new infrastructure built to support deployment. This is primarily due to the small amount of paving or new infrastructure that might have to be constructed to accommodate the deployables. The site-specific location of deployment would need to be considered, and any local infrastructure assets (transportation, telecommunications, or utilities) would need to be considered, planned for, and managed accordingly to try and avoid any negative impacts to such resources. Beneficial impacts could be realized, as deployable technologies are used when other infrastructure is impaired in some way; so deployable technologies could provide continuity of service during emergency events. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred

Alternative, it is anticipated that there would be no impacts to infrastructure resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment, as part of routine maintenance or inspection occurs off an established access road or utility ROW, or if additional maintenance-related construction activities occur within public road and utility ROWs, less than significant impacts would likely still occur at the programmatic level to transportation systems or utility services due to the limited amount of new infrastructure needed to accommodate the deployables. Chapter 16, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated deployment or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to infrastructure as a result of deployment and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 11.1.1, Infrastructure. The state also would not realize positive beneficial impacts to infrastructure resources described above.

11.2.2. Soils

11.2.2.1. Introduction

This section describes potential impacts to soil resources in North Carolina associated with deployment and operation of the Proposed Action and Alternatives. Chapter 16, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

11.2.2.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on soil resources were evaluated using the significance criteria presented in Table 11.2.2-1. The categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to soil resources addressed in this section are presented as a range of possible impacts. Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to soil resources addressed in this section are presented as a range of possible impacts.

Table 11.2.2-1: Impact Significance Rating Criteria for Soils

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Soil erosion	Magnitude or Intensity	Severe, widespread, and observable erosion in comparison to baseline, high likelihood of encountering erosion-prone soils.	Effect that is potentially significant, but with mitigation is less than significant.	Perceptible erosion in comparison to baseline conditions; low likelihood of encountering erosion-prone soil types.	No perceptible change in baseline conditions.
	Geographic Extent	State or territory.		Region or county.	NA
	Duration or Frequency	Chronic or long-term erosion not likely to be reversed over several years.		Isolated, temporary, or short-term erosion that that is reversed over few months or less.	NA
Topsoil mixing	Magnitude or Intensity	Clear and widespread mixing of the topsoil and subsoil layers.	Effect that is potentially significant, but with mitigation is less than significant.	Minimal mixing of the topsoil and subsoil layers has occurred.	No perceptible evidence that the topsoil and subsoil layers have been mixed.
	Geographic Extent	State or territory.		Region or county.	NA
	Duration or Frequency	NA		NA	NA
Soil compaction and rutting	Magnitude or Intensity	Severe and widespread, observable compaction and rutting in comparison to baseline.	Effect that is potentially significant, but with mitigation is less than significant.	Perceptible compaction and rutting in comparison to baseline conditions.	No perceptible change in baseline conditions.
	Geographic Extent	State or territory.		Region or county.	NA
	Duration or Frequency	Chronic or long-term compaction and rutting not likely to be reversed over several years.		Isolated, temporary, or short term compaction and rutting that is reversed over a few months or less.	No perceptible change in baseline conditions.

NA = Not Applicable

11.2.2.3. Description of Environmental Concerns

Soil Erosion

Soil erosion is an environmental concern for nearly every construction activity that involves ground disturbance. Construction erosion typically only occurs in a small area of land with the actual removal of vegetative cover from construction equipment or by wind and water erosion. Of concern in North Carolina and other states with similar geography and weather patterns is the erosion of construction site soils to natural waterways, where the sediment could impair water and habitat quality, and potentially affect aquatic plants and animals (USDA NRCS, 2000). Approximately 23.3 percent[130] of North Carolina contains soil types that occur on steep slopes and, therefore, have a medium to high potential for erosion. Those soil types include Aqualfs, Aquepts, Aquods, Aquults, and Saprists (see Section 11.1.2.4, Soil Suborders and Figure 11.1.2-2).

Based on the impact significance criteria presented in Table 11.2.2-1, building of some of FirstNet's network deployment sites could cause potentially significant erosion at locations with highly erodible soil and steep grades. For the majority of projects, impacts to soils would be expected to be less than significant at the programmatic level given the short-term and temporary duration of the activities.

To the extent practicable, FirstNet would attempt to minimize ground-disturbing construction in areas with high erosion potential due to steep slopes or soil type. Where construction is required in areas with a high erosion potential, FirstNet could implement BMPs and mitigation measures, where practicable and feasible, to avoid or minimize impacts, and minimize the periods when exposed soil is open to precipitation and wind (see Chapter 16).

Topsoil Mixing

The loss of topsoil (i.e., organic and mineral topsoil layers) by mixing is a potential impact at all ground disturbing construction sites, including actions requiring clearing, excavation, grading, trenching, backfilling, or site restoration/remediation work.

Based on impact significance criteria presented in Table 11.2.2-1, and due to the relatively small scale (less than 1 acre) of most FirstNet Proposed Action sites minimal topsoil mixing is anticipated. Additionally, implementation of BMPs and mitigation measures (Chapter 16) could further reduce potential impacts.

Soil Compaction and Rutting

Soil compaction and rutting at construction sites could involve heavy land clearing equipment such as bulldozers and backhoes, trenchers and directional drill rigs to install buried fiber, and cranes to install towers and aerial infrastructure. Soils with the highest potential for compaction or rutting were identified by using the STATSGO2 database (see Section 11.1.2.4, Soil

[130] This percentage was calculated by dividing the acres of soils that fall within the suborders listed above by the total soil land cover for the state.

Suborders). The most compaction susceptible soils in North Carolina are hydric soils with poor drainage conditions, which include Aqualfs, Aquepts, Aquods, Aquults, and Saprists. These suborders constitute approximately 23.33 percent of North Carolina's land area[131] (see Figure 11.1.2-2). The potential for compaction or rutting impact would be generally low at FirstNet network deployment sites where other soil types predominate.

Based on impact significance criteria presented in Table 11.2.2-1, the risk of soil compaction and rutting resulting from FirstNet deployment activities would be less than significant at the programmatic level due to the extent of susceptible soils in the state.

11.2.2.4. Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operation activities.

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could deploy various types of facilities or infrastructure. Depending on the physical nature and location of FirstNet facilities or infrastructure and the specific action, some activities would result in potential impacts to soil resources and others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have no impacts to soil resources under the conditions described below:

- Wired Projects
  - Use of Existing Conduit: New Buried Fiber Optic Plant: Installation of fiber optic cable in existing conduit would be through existing hand holes, pulling vaults, junction boxes, huts, and POP structures, and would not impact soil resources because it would not produce perceptible changes to soil resources.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber would be conducted electronically through existing infrastructure, with no impacts to soil resources. If physical access were required to light dark fiber, it would be through existing hand holes, pulling vaults, junction boxes, huts, and similar existing structures.

[131] This percentage was calculated by dividing the acres of soils that fall within the suborders listed above by the total soil land cover for the state.

- Satellites and Other Technologies
    - Satellite-Enabled Devices and Equipment: Deployment of temporary or portable equipment that use satellite technology, including COWs, COLTs, SOWs, satellite phones, and video cameras, would not impact soil resources because those activities would not require ground disturbance.

Activities with the Potential to Have Impacts

Implementation of the Preferred Alternatives could include potential deployment-related impacts to soil resources resulting from ground disturbance activities, including soil erosion, topsoil mixing, and soil compaction and rutting. The types of deployment activities that could be part of the Preferred Alternative and result in potential impacts to soil resources include the following:

- Wired Projects
    - New Build – Buried Fiber Optic Plant: New fiber optic cable installation usually requires trenching, plowing (including vibratory plowing), or directional boring, as well as construction of hand holes, pulling vaults, junction boxes, huts, and POP structures that require ground disturbance. Impacts from fiber optic plant installation and structure construction, as well as associated grading and restoration of the disturbed ground when construction is completed, could result in soil erosion, topsoil mixing, or soil compaction and rutting.
    - New Build – Aerial Fiber Optic Plant: Installation of new utility poles, and replacement/upgrading of existing poles and structures could potentially impact soil resources resulting from ground disturbance for pole/structure installation (soil erosion and topsoil mixing), and heavy equipment use from bucket trucks operating on existing paved, gravel, or dirt roads (soil compaction and rutting). Potential impacts to soils are anticipated to be small-scale and short-term.
    - Collocation on Existing Aerial Fiber Optic Plant: Topsoil removal, soil excavation, and excavated material placement during the replacement of poles and structural hardening could result in soil erosion and topsoil mixing. Heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in soil compaction and rutting.
    - New Build – Submarine Fiber Optic Plant: Installation of fiber optic plants in or near bodies of water could potentially impact soil resources at and near the landings or facilities on shore or the banks of waterbodies that accept the submarine cable. Soil erosion and topsoil mixing could potentially occur as result of grading, foundation excavation, or other ground disturbance activities. Perceptible soil compaction and rutting could potentially occur due to heavy equipment use during these activities depending on the duration of the construction activity.
    - Installation of Optical Transmission or Centralized Transmission Equipment: Installation of optical transmission equipment or centralized transmission equipment, including associated new utility poles, hand holes, pulling vault, junction box, hut, and POP

structure installation, would require ground disturbance that could potentially impact soil resources. Potential impacts to soils resulting from soil erosion, topsoil mixing, soil compaction, and rutting are anticipated to be small-scale and short-term.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures, such as generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads, or access roads could result in impacts to soil resources. Land/vegetation clearing, excavation activities, landscape grading, and other ground disturbance activities during the installation of new wireless towers and associated structures or access roads could result in soil erosion or topsoil mixing, and heavy equipment use during these activities could result in soil compaction and rutting.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to soils. However, if additional power units, structural hardening, and physical security measures required ground disturbance, such as grading, or excavation activities, impacts to soil resources could occur, including soil erosion and topsoil mixing, as well as soil compaction and rutting associated with heavy equipment use.
  - Deployable Technologies: Implementation of deployable technologies could result in potential impacts to soil resources depending on the technology and location for deployment. Potential impacts may result if deployment of vehicles (i.e., SOWs, COWs, COLTs) occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in soil erosion and topsoil mixing. Heavy equipment use associated with these activities may result in soil compaction and rutting. In addition, implementation of deployable technologies themselves could result in soil compaction and rutting if deployed in unpaved areas. Where technologies such as COWs, COLTs, and SOWs are deployed on existing paved surfaces, there would be no impacts to soil resources because there would be no ground disturbance.

In general, the abovementioned activities could potentially involve land/vegetation clearing, topsoil removal, excavation, excavated material placement, trenching or directional boring, construction of access roads and other impervious surfaces, landscape grading, and heavy equipment movement. Potential impacts to soil resources associated with deployment of this infrastructure could include soil erosion, topsoil mixing, or soil compaction and rutting. These impacts are expected to be less than significant at the programmatic level as the activity would likely be short term, localized to the deployment locations, and would return to normal conditions as soon as revegetation occurs, often by the next growing season. It is expected that heavy equipment would utilize existing roadways and utility rights-of-way for deployment activities. Chapter 16, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described earlier, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that there would be no impacts to soil resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections because there would be no ground disturbance. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors, or if the acceptable load of the surface is exceeded, soil compaction and rutting impacts could result as explained above. The impacts are expected to be less than significant at the programmatic level due to the temporary nature and small scale of operations activities with the potential to create impacts. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

11.2.2.5. Alternatives Impact Assessment

The following section assesses potential impacts to soils associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to soil resources as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts to soil resources at the programmatic level, regardless of whether the deployment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Although impacts to soils could occur on paved surfaces if the acceptable load of the surface is exceeded. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in soil erosion and topsoil mixing. Heavy equipment use associated with these activities may result in soil compaction and rutting. In addition, implementation of deployable technologies themselves could also result in soil compaction and rutting if deployed in unpaved areas. However, these potential impacts are expected to be less than significant due to the small scale and short-term nature of the deployment. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be no impacts to soil resources associated with routine inspections of deployable assets, assuming that the same access roads used for deployment are also used for inspections because there would be no ground disturbance. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors, or if the acceptable load of the surface is exceeded, less than significant soil compaction and rutting impacts could result as previously explained above. Finally, if deployable technologies are parked and operated with air conditioning for extended periods, the condensation water from the air conditioner could result in minimal soil erosion. However, it is anticipated that the potential soil erosion would result in less than significant impacts at the programmatic level as described above. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed. Therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to soil resources as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 11.1.2, Soils.

11.2.3. Geology

11.2.3.1. Introduction

This section describes potential impacts to North Carolina geology resources associated with deployment and operation of the Proposed Action and Alternatives. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

11.2.3.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on geology resources were evaluated using the significance criteria presented in Table 11.2.3-1. The categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to geology addressed in this section are presented as a range of possible impacts.

Table 11.2.3-1: Impact Significance Rating Criteria for Geology

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMP and Mitigation Measures Incorporated	Less than Significant	No Impact
Seismic Hazard	Magnitude or Intensity	High likelihood that a project activity could be located within a high-risk earthquake hazard zone or active fault.	Effect that is potentially significant, but with mitigation is less than significant.	Low likelihood that a project activity could be located within an earthquake hazard zone or active fault.	No likelihood of a project activity being located in an earthquake hazard zone or active fault.
	Geographic Extent	Hazard zones or active faults are highly prevalent within the state/territory.		Earthquake hazard zones or active faults occur within the state/territory, but may be avoidable.	Earthquake hazard zones or active faults do not occur within the state/territory.
	Duration or Frequency	NA		NA	NA
Volcanic Activity	Magnitude or Intensity	High likelihood that a project activity could be located near a volcano lava or mud flow area of influence.	Effect that is potentially significant, but with mitigation is less than significant.	Low likelihood that a project activity could be located near a volcanic ash area of influence.	No likelihood of a project activity located within a volcano hazard zone.
	Geographic Extent	Volcano lava flow areas of influence are highly prevalent within the state/territory.		Volcano ash areas of influence occur within the state/territory, but may be avoidable.	Volcano hazard zones do not occur within the state/territory.
	Duration or Frequency	NA		NA	NA
Landslide	Magnitude or Intensity	High likelihood that a project activity could be located within a landslide area.	Effect that is potentially significant, but with mitigation is less than significant.	Low likelihood that a project activity could be located within a landslide area.	No likelihood of a project activity located within a landslide hazard area.
	Geographic Extent	Landslide areas are highly prevalent within the state/territory.		Landslide areas occur within the state/territory, but may be avoidable.	Landslide hazard areas do not occur within the state/territory.

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMP and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
	Duration or Frequency	NA		NA	NA
Land Subsidence	Magnitude or Intensity	High likelihood that a project activity could be located within an area with a hazard for subsidence (e.g., karst terrain).	Effect that is potentially significant, but with mitigation is less than significant.	Low likelihood that a project activity could be located within an area with a hazard for subsidence.	Project activity located outside an area with a hazard for subsidence.
	Geographic Extent	Areas with a high hazard for subsidence (e.g., karst terrain) are highly prevalent within the state/territory.		Areas with a high hazard for subsidence occur within the state/territory, but may be avoidable.	Areas with a high hazard for subsidence do not occur within the state/territory.
	Duration or Frequency	NA		NA	NA
Potential Mineral and Fossil Fuel Resource Impacts	Magnitude or Intensity	Severe, widespread, observable impacts to mineral and/or fossil fuel resources.	Effect that is potentially significant, but with mitigation is less than significant.	Limited impacts to mineral and/or fossil resources.	No perceptible change in mineral and/or fossil fuel resources.
	Geographic Extent	Regions of mineral or fossil fuel extraction areas are highly prevalent within the state/territory.		Mineral or fossil fuel extraction areas occur within the state/territory, but may be avoidable.	Mineral or fossil fuel extraction areas do not occur within the state/territory.
	Duration or Frequency	Long-term or permanent degradation or depletion of mineral and fossil fuel resources.		Temporary degradation or depletion of mineral and fossil fuel resources.	NA
Potential Paleontological	Magnitude or Intensity	Severe, widespread, observable impacts to paleontological resources.	Effect that is potentially significant, but with mitigation is less than significant.	Limited impacts to paleontological and/or fossil resources.	No perceptible change in paleontological resources.

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMP and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Resources Impacts	Geographic Extent	Areas with known paleontological resources are highly prevalent within the state/territory.		Areas with known paleontological resources occur within the state/territory, but may be avoidable.	Areas with known paleontological resources do not occur within the state/territory.
	Duration or Frequency	NA		NA	NA
Surface Geology, Bedrock, Topography, Physiography, and Geomorphology	Magnitude or Intensity	Substantial and measurable degradation or alteration of surface geology, bedrock, topography, physiographic characteristics, or geomorphological processes.	Effect that is potentially significant, but with mitigation is less than significant.	Minor degradation or alteration of surface geology, bedrock, topography that do not result in measurable changes in physiographic characteristics or geomorphological processes.	No degradation or alteration of surface geology, bedrock, topography, physiographic characteristics, or geomorphologic processes.
	Geographic Extent	State/territory.		State/territory.	NA
	Duration or Frequency	Permanent or long-term changes to characteristics and processes.		Temporary degradation or alteration of resources that is limited to the construction and deployment phase.	NA

NA = Not Applicable

11.2.3.3. Description of Environmental Concerns

Environmental concerns regarding geology can be viewed as two distinct types, those that would potentially provide impacts to the project, such as seismic hazards, landslides, and volcanic activity, and those that would be impacts from the project, such as land subsidence and effects on mineral and fossil fuel resources, paleontological resources, surface geology, bedrock, topography, physiography, and geomorphology. These concerns and their impacts on geology are discussed below.

Seismic Hazard

A concern related to deployment is placement of equipment in highly active seismic zones. Equipment that is exposed to earthquake activity is subject to misalignment, alteration, or, in extreme cases, destruction; all of these activities could result in connectivity loss.

As discussed in Section 11.1.3, the majority of North Carolina is not at risk to significant earthquake events. Based on the impact significance criteria presented Table 11.2.3-1, seismic impacts from deployment or operation of the Proposed Action would have no impact on seismic activity; however, seismic impacts to the Proposed Action could be potentially significant if FirstNet's deployment locations were within high-risk earthquake hazard zones. As shown in Figure 11.1.3-4, northeastern North Carolina and areas near the shore are at the lowest risk to earthquakes throughout the state, while more moderate areas are in the western part of the state (more in-land). Given the potential for minor to moderate earthquakes in parts of North Carolina, some amount of infrastructure could be subject to earthquake hazards. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Volcanic Activity

Volcanoes were considered but not analyzed for North Carolina, as they do not occur in North Carolina; therefore, volcanoes do not present a hazard to the state.

Landslides

Similar to seismic hazards, another concern would be placement of equipment in areas that are highly susceptible to landslides. Equipment that is exposed to landslides is subject to misalignment, alteration, or, in extreme cases, destruction; all of these activities could result in connectivity loss.

Based on the impact significance criteria presented in Table 11.2.3-1, potential impacts to landslides from deployment or operation of the Proposed Action would have less than significant impacts as it is likely that the project would attempt to avoid areas that are prone to landslides; however, landslide impacts to the Proposed Action could be potentially significant if FirstNet's deployment locations were within areas in which landslides are highly prevalent.

As discussed in Section 11.1.3, the majority of North Carolina is at low to moderate risk of experiencing landslide events. The highest potential for landslides in North Carolina is found in the western part of the state, in the Blue Ridge Province in areas with steep slopes. Landslides in North Carolina are typically related to significant precipitation events (e.g., hurricanes). To the extent practicable, FirstNet would avoid deployment in areas that are susceptible to landslide events. However, given that several of North Carolina's major cities, including Charlotte and Asheville, are in areas that experience landslides with moderate to high frequency, some amount of infrastructure could be subject to landslide hazards, Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Land Subsidence

Equipment that is exposed to land subsidence, such as sinkholes created by karst topography or mine collapse, is subject to misalignment, alteration, or, in extreme cases, destruction. Significant long-term land subsidence, due to factors such as aquifer compaction, in coastal areas could lead to relative sea level rise[132] and inundation of equipment. All of these activities could result in connectivity loss.

Based on the impact significance criteria presented in Table 11.2.3-1, potential impacts to soil subsidence from deployment or operation of the Proposed Action would have less than significant impacts; however, subsidence impacts to the Proposed Action could be potentially significant if FirstNet's deployment locations were within areas at high risk to karst topography, mine collapse, or inundation due to long-term land subsidence. As discussed in Section 11.1.3.8 and shown in Figure 11.1.3-6, portions of North Carolina are vulnerable to land subsidence due to aquifer compaction and overuse of groundwater. To the extent practicable, FirstNet would avoid deployment in known areas of aquifer compaction. However, where infrastructure is subject to landslide hazards, BMPs and mitigation measures could help avoid or minimize the potential impacts. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Potential Mineral and Fossil Fuel Resource Impacts

Equipment deployment near mineral and fossil fuel resources is not likely to affect these resources. Rather the new construction is only likely to limit access to extraction of these resources. Based on the impact significance criteria presented in Table 11.2.3-1, impacts to mineral and fossil fuel resources is unlikely as the Proposed Action could be potentially significant if FirstNet's deployment locations were to cause severe, widespread, observable impacts to mineral and/or fossil fuel resources. To the extent practicable and feasible, FirstNet would likely avoid construction in areas where these resources exist. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

[132] Relative Sea Level Rise: "[Sea level rise that] includes the combined movement of both water and land. Even if sea level was constant, there could be changes in relative sea level. For example, a rising land surface would produce a relative fall in sea level, whereas a sinking land surface would produce a relative rise in sea level" (U.S. Geological Survey, 2015).

Potential Paleontological Resource Impacts

Equipment installation and construction activities that require ground disturbance could damage existing paleontological resources, which are both fragile and irreplaceable. Based on the impact significance criteria presented in Table 11.2.3-1, impacts to paleontological resources could be potentially significant if FirstNet's buildout/deployment locations uncovered paleontological resources during construction activities. As discussed in Section 11.1.3.6, fossils are abundant throughout parts of North Carolina. It is anticipated that potential impacts to specific areas known to contain paleontological resources would be avoided, minimized, or mitigated, and any potential impacts would be limited and localized. Potential impacts to paleontological resources should be considered on a site-by-site basis, BMPs and mitigation measures may help avoid or minimize potential impacts. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Surface Geology, Bedrock, Topography, Physiography, and Geomorphology

Equipment installation and construction activities that degrade or alter surface geology, bedrock, or topography could cause measurable changes in physiographic characteristics of an area's geology, topography, physiography, or geomorphology. Based on the impact significance criteria presented in Table 11.2.3-1, impacts could be potentially significant if FirstNet's deployment were to cause substantial and measurable degradation or alteration of surface geology, bedrock, topography, physiographic characteristics, or geomorphological processes. Construction activities related to the Proposed Action and Alternatives are likely to be minor and less than significant as the proposed activities are not likely to require removal of significant volumes of terrain and any rock ripping would likely occur in discrete locations and would be unlikely to result in large-scale changes to the geologic, topographic, or physiographic characteristics. When ground disturbance is required, BMPs and mitigation measures could be implemented to help avoid or minimize the potential impacts. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

11.2.3.4. Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operation activities.

Deployment Impacts

Implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities have the potential to be impacted by geologic hazards, some activities could result in potential impacts to geology, and other activities would have no impacts. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have no impacts to geology under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. In most cases, there would be no impacts to geologic resources since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to geologic resources because there would be no ground disturbance.
- Satellites and Other Technologies
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN, however it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact geologic resources, it is anticipated that this activity would have no impact on geologic resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to geologic resources, or resulting from geologic hazards due to implementation of the Preferred Alternative, would encompass a range of impacts that could occur as a result of ground disturbance activities, including loss of mineral and fuel resources and paleontological resources. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to geologic resources, or impacts from geologic hazards, include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POP huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to geologic resources due to associated ground disturbance, such as impacts to fuel and mineral resources or paleontological resources. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
  - New Build – Aerial Fiber Optic Plant: Installation of new utility poles, and associated use of heavy equipment during construction, could result in potential impacts to geologic resources due to associated ground disturbance. Where equipment is installed in

locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.

- Collocation on Existing Aerial Fiber Optic Plant: Replacement of utility poles and structural hardening, and associated use of heavy equipment during construction, could result in potential impacts to geologic resources due to associated ground disturbance. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
- New Build – Submarine Fiber Optic Plant: The installation of cables in in or near bodies of water is not expected to impact geologic resources including marine paleontological resources. However, where landings and/or facilities for submarine cable are installed at locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts and require ground disturbance in locations that are susceptible to specific geologic hazards (e.g., land subsidence, landslides, or earthquakes), it is possible that they could be affected by that hazard.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to geologic resources. Land/vegetation clearing, excavation activities, landscape grading, and other ground disturbance activities during the installation of new wireless towers and associated structures or access roads could result in erosion or disturbance of geologic resources. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in ground disturbance. However, if additional power units, structural hardening, and physical security measures required ground disturbance, such as grading, or excavation activities, impacts to geologic resources could occur due to ground disturbance. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
  - Deployable Technologies: Implementation of deployable technologies could result in potential impacts to geologic resources depending on the technology and location proposed for deployment. Potential impacts may result if deployment of vehicles (i.e., SOWs, COWs, COLTs) occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the

type of technology) may require land/vegetation clearing, excavation, and paving. Where deployable technologies would be implemented on existing paved surfaces, there would be no impacts to/from geologic resources because there would be no ground disturbance and mobile technologies could be moved to avoid geologic hazards.

- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: In most cases, the installation of permanent equipment on existing structures, adding equipment to satellites launched for other purposes, or the use of portable devices that use satellite technology would not impact geologic resources because those activities would not require ground disturbance. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that they could be affected by that hazard. The use of portable satellite-enabled devices would not impact geologic resources nor would it be affected by geologic hazards because there would be no ground disturbance nor any impact to the built or natural environment.

In general, the abovementioned activities could potentially involve ground disturbance resulting from land/vegetation clearing, topsoil removal, excavation, excavated material placement, trenching or directional boring, construction of access roads and other impervious surfaces, landscape grading, and heavy equipment movement. Potential impacts to geological resources associated with deployment could result in incidental removal of bedrock or mineral resources, or adverse impacts to installed equipment resulting from geologic hazards (e.g., seismic hazards and land subsidence). Specific FirstNet Proposed Actions are likely to be small-scale; correspondingly, disturbance to geologic resources for those types of projects with the potential to impact geologic resources is also expected to be small-scale as a result, these potential impacts are expected to be less than significant at the programmatic level. For the same reason, impacts to deployment from geologic hazards are likely to be less than significant as well. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. It is anticipated that there would be no impacts to geology associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections because there would be no ground disturbance.

The operation of the Preferred Alternative could be affected by to geologic hazards including seismic activity, landslides, and land subsidence. However, potential impacts would be anticipated to be less than significant as it is anticipated that deployment locations would avoid, as practicable and feasible, locations that are more likely to be affected by potential seismic activity, landslides, or land subsidence. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

11.2.3.5. Alternatives Impact Assessment

The following section assesses potential impacts to geology associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to geology as a result of implementation of this alternative could be as described below.

Deployment Impacts

Implementation of deployable technologies on existing paved surfaces would not result in impacts to geologic resources (or from geologic hazards) as there would be no ground disturbance and mobile technologies could be moved to avoid geologic hazards. Potential impacts may result if deployment of vehicles (i.e., SOWs, COWs, COLTs, or UAVs) occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These impacts are expected to be less than significant at the programmatic level due to the minor amount of paving or new infrastructure needed to accommodate the deployables. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be no impacts to geologic resources (or from geologic hazards) associated with routine inspections of the Preferred Preferred Alternative because there would be no ground disturbance.

The operation of the Deployable Technologies Alternative could be affected by to geologic hazards including seismic activity, volcanic activity, landslides, and land subsidence. However, potential impacts would be anticipated to be less than significant at the programmatic level as the deployment would be temporary and likely would attempt to avoid locations that was subject to increased seismic activity, landslides, and land subsidence. Chapter 16, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure, or satellites and other technologies. As a result, there would be no impacts to geologic resources (or from geologic hazards) from construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 11.1.3, Geology.

11.2.4. Water Resources

11.2.4.1. Introduction

This section describes potential impacts to water resources in North Carolina associated with deployment and operation of the Proposed Action and Alternatives. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

11.2.4.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on water resources were evaluated using the significance criteria presented in Table 11.2.4-1. The categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to water resources addressed in this section are presented as a range of possible impacts.

Table 11.2.4-1: Impact Significance Rating Criteria for Water Resources

Type of Effect	Effect Characteristics	Impact Level: Potentially Significant	Impact Level: Less than Significant with BMPs and Mitigation Measures Incorporated	Impact Level: Less than Significant	Impact Level: No Impact
Water Quality (groundwater and surface water) - sedimentation, pollutants, nutrients, water temperature	Magnitude or Intensity	Groundwater contamination creating a drinking quality violation, or otherwise substantially degrade groundwater quality or aquifer; local construction sediment water quality violation, or otherwise substantially degrade water quality; water degradation poses a threat to the human environment, biodiversity, or ecological integrity. Violation of various regulations including: CWA, SDWA.	Effect that is potentially significant, but with mitigation is less than significant.	Potential impacts to water quality, but potential effects to water quality would be below regulatory limits and would naturally balance back to baseline conditions.	No changes to water quality; no change in sedimentation or water temperature, or the presence of water pollutants or nutrients.
	Geographic Extent/Context	Watershed level, and/or within multiple watersheds.		Watershed or sub-watershed level.	NA
	Duration or Frequency	Chronic and long term changes not likely to be reversed over several years or seasons.		Impact is temporary, lasting no more than six months.	NA
Floodplain degradation [a]	Magnitude or Intensity	The use of floodplain fill, substantial increases in impervious surfaces, or placement of structures within a 500-year flood area that will impede or redirect flood flows or impact floodplain hydrology. High likelihood of encountering a 500-year floodplain within a state or territory.	Effect that is potentially significant, but with mitigation is less than significant.	Activities occur inside the 500-year floodplain, but do not use fill, do not substantially increase impervious surfaces, or place structures that will impede or redirect flood flows or impact floodplain hydrology, and do not occur during flood events. Low likelihood of encountering a 500-year floodplain within a state or territory.	Activities occur outside of floodplains and therefore do not increase fill or impervious surfaces, nor do they impact flood flows or hydrology within a floodplain.

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or sub-watershed level.	NA
	Duration or Frequency	Chronic and long term changes not likely to be reversed over several years or seasons.		Impact is temporary, lasting no more than one season or water year, or occurring only during an emergency.	NA
Drainage pattern alteration	Magnitude or Intensity	Alteration of the course of a stream of a river, including stream geomorphological conditions, or a substantial and measurable increase in the rate or amount of surface water or changes to the hydrologic regime.	Effect that is potentially significant, but with mitigation is less than significant.	Any alterations to the drainage pattern are minor and mimic natural processes or variations.	Activities do not impact drainage patterns.
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or sub-watershed level.	NA
	Duration or Frequency	Impact occurs in perennial streams, and is ongoing and permanent.		Impact is temporary, lasting no more than six months.	NA
Flow alteration	Magnitude or Intensity	Consumptive use of surface water flows or diversion of surface water flows such that there is a measurable reduction in discharge.	Effect that is potentially significant, but with mitigation is less than significant.	Minor or no consumptive use with negligible impact on discharge.	Activities do not impact discharge or stage of waterbody (stream height).
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or sub-watershed level.	NA
	Duration or Frequency	Impact occurs in perennial streams, and is ongoing and permanent.		Impact is temporary, not lasting more than six months.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Changes in groundwater or aquifer characteristics	Magnitude or Intensity	Substantial and measurable changes in groundwater or aquifer characteristics, including volume, timing, duration, and frequency of groundwater flow, and other changes to the groundwater hydrologic regime.	Effect that is potentially significant, but with mitigation is less than significant.	Any potential impacts to groundwater or aquifers are temporary, lasting no more than a few days, with no residual impacts.	Activities do not impact groundwater or aquifers.
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or sub-watershed level.	NA
	Duration or Frequency	Impact is ongoing and permanent.		Impact is temporary, not lasting more than six months.	NA

[a] Since public safety infrastructure is considered a critical facility, project activities should avoid the 500-year floodplain wherever practicable, per the Executive Orders on Floodplain Management (EO 11988 and EO 13690). (See http://www.archives.gov/federal-register/codification/executive-order/11988.html and https://www.federalregister.gov/articles/2015/02/04/2015-02379/establishing-a-federal-flood-risk-management-standard-and-a-process-for-further-soliciting-and).
NA = Not Applicable

11.2.4.3. Description of Environmental Concerns

Potential Water Quality Impacts

Water quality impaired waterbodies are those waters that have been identified as not supporting their appropriate uses. Projects in watersheds of impaired waters may be subject to heightened permitting requirements. For example, the CWA requires states to assess and report on the quality of waters in their state. Section 1103(d) of the CWA requires states to identify impaired waters. For these impaired waters, states must consider the development of a Total Maximum Daily Load (TMDL) or other strategy to reduce the input of the specific pollutant(s) restricting waterbody uses, in order to restore and protect such uses.

Most of North Carolina's rivers, streams, lakes, reservoirs, ponds, estuaries, bays, and coastal shoreline are impaired (see, Figure 11.1.4-3). Groundwater quality within the state is generally good. (USEPA, 2015q)

Deployment activities could contribute pollutants in a number of ways but the primary likely manner is increased sediment in surface waters. Vegetation removal onsite exposes soils to rain and wind that could increase erosion. Impacts to water quality may occur from post construction vegetation management, such as herbicides, that may leach into groundwater or move to surface waters through soil erosion or runoff, spray drift, or inadvertent direct overspray. Fuel, oil, and other lubricants from equipment could contaminate groundwater and surface waters if carried in runoff. Other water quality impacts could include changes in temperature, pH, or dissolved oxygen levels, water odor, color, or taste, or addition of suspended solids.

Soil erosion or the introduction of suspended solids into waterways from implementation of the Preferred Alternative could contribute to degradation of water quality. If the Proposed Action and Alternatives would disturb more than 1 acre of soil, a state or USEPA NPDES Construction General Permit (CGP) would be required. As part of the permit application for the CGP, a storm water pollution prevention plan (SWPPP) would need to be prepared containing BMPs that would be implemented to prevent, or minimize the potential for, sedimentation and erosion. Adherence to the CGP and the BMPs would help prevent sediment and suspended solids from entering the waterways and ensure that effects on water quality during construction would not be adverse.

Deployment activities associated with the Proposed Action have the potential to increase erosion and sedimentation around construction and staging areas. Grading activities associated with construction would potentially result in a temporary increase in the amount of suspended solids running off construction sites. If a storm event were to occur, construction site runoff could result in sheet erosion of exposed soil. If not adequately controlled, water runoff from these areas would have the potential to degrade surface water quality. Implementing BMPs and mitigation measures could help reduce potential impacts to surface water quality.

Expected deployment activities would not violate applicable state, federal (e.g., CWA, SDWA), or local regulations, cause a threat to the human environment, biodiversity, or ecological integrity through water degradation, or cause a sediment water quality violation from local construction, or otherwise substantially degrade water quality. Therefore, based on the impact significance criteria presented in Table 11.2.4-1, water quality impacts would likely be less than significant and could be further reduced if BMPs and mitigation measures were to be incorporated where practicable and feasible.

During implementation of the Proposed Action and Alternatives, there is the potential to encounter shallow groundwater due to clearing and grading activities, shallow excavation, or relocation of utility lines. This is unlikely, as trenching is not expected to exceed a 48-inch depth. However, groundwater contamination may exist in areas directly within or near the project area. If trenching[133] or tower construction were to occur near or below the existing water table (depth to water), then dewatering would be anticipated at the location. Residual contaminated groundwater could be encountered during dewatering activities. Construction activities would need to comply with North Carolina dewatering requirements. Any groundwater extracted during dewatering activities, or subject to the terms of a dewatering permit, may be required to be treated prior to discharge or disposed of at a wastewater treatment facility.

Based on the impact significance criteria presented in Table 11.2.4-1, groundwater quality impacts could be potentially significant if the majority of FirstNet's deployment locations resulted in a drinking quality violation, or otherwise substantially degrade groundwater quality or aquifer. Due to the high water table and type of rock affecting North Carolina's aquifers, there is potential for groundwater contamination within a watershed or multiple watersheds. However, site-specific analysis, BMPs, and mitigation measures could be implemented to further reduce potential impacts.

Floodplain Degradation

Floodplains are low-lying lands next to rivers and streams. When left in a natural state, floodplain systems store and dissipate floods without adverse impacts on human beings, buildings, roads and other infrastructure. The 500-year floodplain is the area of minimal flood hazard, where there is a 0.2-percent-annual-chance of flooding. Some projects may be outside of a floodplain, but still be in an area with known flooding history.

Based on the impact significance criteria presented in Table 11.2.4-1, floodplain degradation impacts would be potentially less than significant since the majority of FirstNet's likely deployment activities, on the watershed or sub-watershed level, would occur inside the 500-year floodplain, would use minimal fill, would not substantially increase impervious surfaces, structures would not impede or redirect flood flows or impact floodplain hydrology, and would not occur during flood events with the exception of deployable technologies which may be deployed in response to an emergency. Additionally, any effects would likely be temporary, lasting no more than one season or water year,[134] or occur only during an emergency.

[133] Telecommunications activities involve laying conduit, with minimal trenching. Trenching activities would likely be at a minimal depth (less than 36 inches) and width (6 to 12 inches).
[134] A water year is defined as "the 12-month period October 1, for any given year through September 30, of the following year. The water year is designated by the calendar year in which it ends and which includes 9 of the 12 months." (USGS, 2016c)

Examples of activities that would have less than significant impacts include:

- Construction of any structure in the 500-year floodplain but is built above base flood elevation pursuant to floodplain management regulations;
- Land uses that include pervious surfaces such as gravel parking lots;
- Land uses that do not change the flow of water or drainage patterns; and
- Limited clearing or grading activities.

Implementation of BMPs and mitigation measures could help reduce the risk of additional impacts to floodplain degradation (see Chapter 16).

Drainage Pattern Alteration

Flooding and erosion from land disturbance could changes drainage patterns. Storm water runoff causes erosion while construction activities and land clearing could change drainage patterns. Clearing or grading activities, or the creation of walls or berms, could alter water flow in an area or cause changes to drainage patterns. Drainage could be directed to storm water drains, storage, and retention areas designed to slow water and allow sediments to settle out. Improperly handled drainage could cause increased erosion, changes in storm water runoff, flooding, and damage to water quality. Existing drainage patterns could be modified by channeling (straightening or restructuring natural watercourses); creation of impoundments (detention basins, retention basins, and dams); storm water increases; or altered flow patterns.

According to the significance criteria in Table 11.2.4-1, any temporary (lasting less than six months) alterations to drainage patterns that are minor and mimic natural processes or variations within the watershed or sub-watershed level would be considered less than significant.

Example of projects that could have minor changes to the drainage patterns include:

- Land uses with pervious surfaces that create limited storm water runoff;
- Where storm water is contained onsite and does not flow to or impact surface waterbodies offsite on other properties;
- Activities designed so that the amount of storm water generated before construction is the same as afterwards; and
- Activities designed using low impact development techniques for storm water.

Since the proposed activities would not substantially alter drainage patterns in ways that alter the course of a stream or river, create a substantial and measurable increase in the rate and amount of surface water, or change the hydrologic regime, and any effects would be short-term, impacts to drainage patterns would be less than significant. BMPs and mitigation measures could be implemented to further reduce any potentially significant impacts.

Flow Alteration

Flow alteration refers to the modification of flow characteristics, relative to natural conditions. Human activities may change the amount of water reaching a stream, divert flow through artificial channels, or alter the shape and location of streams. Surface water and groundwater withdrawals could alter flow by reducing water volumes in streams. Withdrawals may return to the surface/groundwater system at a point further downstream, be removed from the watershed through transpiration by crops, lawns or pastures, or be transferred to another watershed altogether (e.g., water transferred to a different watershed for drinking supply). Altered flow could increase flooding and introduce more erosion and potential for pollution. Alternatively, if water is diverted from its normal flow, the opposite may occur; wetlands and streams may not receive as much water as necessary to maintain the ecology and previous functions.

Activities that do not impact discharge or stage of waterbody (stream height) are not anticipated to have an impact on flow, according to Table 11.2.4-1. Projects that include minor consumptive use of surface water with less than significant impacts on discharge (do not direct large volumes of water into different locations) on a temporary (no more than six months) are likely to have less than significant impacts on flow alteration, on a watershed or sub-watershed level. Examples of projects likely to have less than significant impacts include:

- Construction of any structure in a 100-year or 500-year floodplain that is built above base flood elevation pursuant to floodplain management regulations;
- Land uses that are maintaining or increasing pervious surfaces;
- Land uses that do not change the flow of water or drainage patterns offsite or into surface water bodies that have not received that volume of storm water previously;
- Minor clearing or grading activities; and
- Flow alteration in sensitive or protected waterbodies could be considered potentially significant.

Since the proposed activities would not likely alter flow characteristics or change the hydrologic regime, impacts would be less than significant impacts to flow alteration. BMPs and mitigation measures could be implemented to further reduce any impacts.

Changes in Groundwater or Aquifer Characteristics

As described in Section 11.1.4.7, approximately 50 percent (4.95 million) of North Carolina residents rely on groundwater as a source of potable water. Groundwater is an important natural resource used by industrial, commercial, agricultural, and residential uses for manufacturing, irrigation, and drinking water purposes. Generally, the water quality of North Carolina's aquifers is suitable for drinking and daily water needs. Once a groundwater supply is exhausted or contaminated, it is very expensive, and sometimes impossible, to replace. Water supply demand from the deployment activities is unlikely to exceed safe and sustainable withdrawal capacity rate of the local supply or aquifer.

Storage of generator fuel over groundwater or an aquifer would be unlikely to cause significant impacts to water quality due to the expected small volume of these materials. Activities that may cause changes is groundwater or aquifer characteristics include:

- Excavation, mining, or dredging during or after construction;
- Any liquid waste, including but not limited to wastewater, generation; and
- Storage of petroleum or chemical products.

Private and public water supplies often use groundwater as a water source. To maintain a sustainable system, the amount of water withdrawn from these groundwater sources must be balanced with the amount of water returned to the groundwater source (groundwater recharge).

Deployment activities will likely have less than significant impacts since they would not substantially deplete supplies of potable groundwater, as any construction dewatering would be short-term. The siting of deployment activities should be considered to avoid areas that would extract groundwater from potable groundwater sources in the area. According to Table 11.2.4-1, potentially significant impacts to groundwater or aquifer characteristics would only occur if actions resulted in substantial and measurable changes in groundwater or aquifer characteristics, including volume, timing, duration, and frequency of groundwater flow, and other changes to the groundwater hydrologic regime on a watershed or within multiple watersheds that is ongoing and permanent. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

11.2.4.4. Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operation activities.

Deployment Impacts

As described in Section 2.1.2 Proposed Action, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to water resources and others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of no impacts to potentially significant impacts depending on the deployment scenario or site-specific conditions. The impact on the water resources that could be affected would depend on the watershed, duration (chronic or short-term) and frequency (many years or a few months) the resource would be used and the water resource's current use (sole source for drinking water, considered exceptional value for recreation, or provides critical habitat for a species).

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have no impacts to water resources under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be no impacts to water resources since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to water resources because there would be no ground disturbance.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact water resources because those activities would not require ground disturbance.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact water resources, it is anticipated that this activity would have no impact on water resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to water resources because of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including impaired water quality. The types of deployment activities that could be part of the Preferred Alternative and result in potential impacts to water resources include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to water resources. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites. The amount of impact depends on the land area affected, installation technique, and location. Trenching would not be expected to occur near or below the existing water table (depth to water). Implementing BMPs and mitigation measures could reduce impact intensity.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water would impact water resources from a short-term increase in suspended solids in the water. Site-specific impact assessment could be required to marine and shoreline

environments prior to installation to fully assess potential impacts to lake or river coastal environments.

- New Build – Aerial Fiber Optic Plant: Potential impacts would be similar to Buried Fiber Optic Plant. Ground disturbance activities could cause impacts to water quality from increased suspended solids; groundwater impacts from trenching activities are not expected. If a new roadway were built, additional impervious surface would not be expected to impact water resources or the overall amount of runoff and nonpoint pollution.
- Collocation on Existing Aerial Fiber Optic Plant: Replacement of poles or structural hardening could result in ground disturbance that could cause impacts to water quality from increased suspended solids.
- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required grading or other ground disturbance to install small boxes or huts, or access roads, there could potentially be direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites. The amount of impact depends on the land area affected, installation technique, and location. Trenching would not be expected to occur near or below the existing water table (depth to water). If installation of transmission equipment would occur in existing boxes or huts and require no ground disturbance, there would be no impacts to water resources.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security lighting, electrical feeds, and concrete foundations and pads) or access roads could result in potential direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites. The amount of impact depends on the land area affected, installation technique, and location. Trenching would not be expected to occur near or below the existing water table (depth to water). Implementing BMPs could reduce impact intensity. If a new roadway were built, additional impervious surface would not be expected to impact water resources or the overall amount of runoff and nonpoint pollution.
  - Deployable Technologies: Implementation of land-based deployable technologies could result in potential impacts to water resources if deployment involves movement of equipment through streams, occurs in riparian or floodplain areas, occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites or deployment in unpaved areas. The amount of impact depends on the land area affected, installation technique, and location.

Implementing BMPs and mitigation measures could reduce impact intensity. The activities could also result in indirect impacts on water quality if fuels leak into surface or groundwater. Where deployable technologies would be implemented on existing paved surfaces, or where aerial and vehicular deployable technologies may be used on existing paved surfaces, it is anticipated that there would be no impacts to water resources because there would be no ground disturbance.

- Deployment of drones, balloons, blimps, or piloted aircraft could have indirect impacts on water quality if fuels spill or other chemicals seep into ground or surface waters. In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to water resources associated with deployment of this infrastructure could include water quality impacts, but are expected to be less than significant due to the small scale of individual activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers or poles; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to water resources associated with deployment of this infrastructure would likely be less than significant at the programmatic level due to the limited geographic scale of individual activities and would likely return to baseline conditions once revegetation of disturbed areas is complete. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities, and are expected to have no impacts as there would be no ground disturbing activity and it is likely routine maintenance activities would be conducted along exiting roads and utility rights-of way. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. Impacts to surface and groundwater quality from routine operations and maintenance, such as herbicide application to control vegetation, are not expected. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

11.2.4.5. Alternatives Impact Assessment

The following section assesses potential impacts to water resources associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to water resources as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts to water resources at the programmatic level if those activities occurred on paved surfaces. Some staging or launching/landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving; however, these activities would be isolated and short term, and would likely return to baseline conditions once revegetation was complete. Additionally, project activities could result in direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites and from fuels leaking into surface or groundwater. However, spills from vehicles or machinery used during deployment tend to be associated with re-fueling operations, and as such, would likely be a few gallons or less in volume and would likely be easily contained or cleaned up, and therefore would have less than significant impacts. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Deployable Technologies Alternative would consist of routine maintenance and inspection of the deployable technologies. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. The water resources impacts would depend on the watershed, duration (chronic or short-term) and frequency (many years or a few months) the resource would be used, and the water resource’s current use (sole source for drinking water, considered exceptional value for recreation, or provides critical habitat for a species).

It is anticipated that there would be no impacts to water resources associated with routine inspections of the Deployable Technologies Alternative, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment as part of routine maintenance or inspections occurs off established access roads or corridors and near waterbodies, the resulting ground disturbance could increase sedimentation in waterbodies, potentially impacting water quality. It is assumed that routine maintenance would not include operation of vehicles or equipment in waterbodies. Finally, if ground-based deployable technologies are parked and operated with air conditioning for extended periods, the condensation water from the air conditioner could result in soil erosion that could potentially impact waterbodies if the deployables are located adjacent to waterbodies; however, due to the limited and temporary nature of the deployable activities, it is anticipated that these potential impacts would be less than significant. Site maintenance, including mowing or herbicides, may result in less than significant effects to water quality, due to the small scale of expected FirstNet activities in any particular location. In addition, the presence of new access roads could increase the overall amount of impervious surface in the area, and increase runoff effects on water resources, as explained above. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to water resources as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 11.1.4, Water Resources.

11.2.5. Wetlands

11.2.5.1. Introduction

This section describes potential impacts to wetlands in North Carolina associated with deployment and operation of the Proposed Action and Alternatives. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

11.2.5.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on wetlands were evaluated using the significance criteria presented in Table 11.2.5-1. The categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to wetlands addressed in this section are presented as a range of possible impacts.

Table 11.2.5-1: Impact Significance Rating Criteria for Wetlands

Type of Effect	Effect Characteristics	Impact Level: Potentially Significant	Impact Level: Less than Significant with BMPs and Mitigation Measures Incorporated	Impact Level: Less than Significant	Impact Level: No Impact
Direct wetland loss (fill or conversion to non-wetland)	Magnitude [a] or Intensity	Substantial loss of high-quality wetlands (e.g., those that provide critical habitat for sensitive or listed species, are rare or a high-quality example of a wetland type, are not fragmented, support a wide variety of species, etc.); violations of Section 1104 of the CWA.	Effect that is potentially significant, but with mitigation is less than significant.	Impacts to lower quality wetlands (e.g., not rare or unique, that have low productivity and species diversity, and those that are already impaired or impacted by human activity).	No direct loss of wetlands.
	Geographic Extent/Context	Watershed level, and/or within multiple watersheds.		Watershed or sub-watershed level.	NA
	Duration or Frequency	Chronic and long term changes not likely to be reversed over several years or seasons.		Periodic and/or temporary loss reversed over 1-2 growing seasons with or without active restoration.	NA
Other direct effects: vegetation clearing; ground disturbance; direct hydrologic changes (flooding or draining); direct soil changes; water quality degradation (spills or sedimentation)	Magnitude or Intensity	Substantial and measurable changes to hydrological regime of the wetland impacting salinity, pollutants, nutrients, biodiversity, ecological integrity, or water quality; introduction and establishment of invasive species to high quality wetlands.	Effect that is potentially significant, but with mitigation is less than significant.	Impacts to lower quality wetlands affecting the hydrological regime including salinity, pollutants, nutrients, biodiversity, ecological integrity, or water quality; introduction and establishment of invasive species to high quality wetlands.	No direct impacts to wetlands affecting vegetation, hydrology, soils, or water quality.
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or sub-watershed level.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
	Duration or Frequency	Long-term or permanent alteration that is not restored within 2 growing seasons, or ever.		Periodic and/or temporary loss reversed over 1-2 growing seasons with or without active restoration.	NA
Indirect effects: [b] Change in Function(s)[c] or Change in Wetland Type	Magnitude or Intensity	Changes to the functions or type of high quality wetlands (e.g., those that provide critical habitat for sensitive or listed species, are rare or a high-quality example of a wetland type, are not fragmented, support a wide variety of species, etc.).	Effect that is potentially significant, but with mitigation is less than significant.	Impacts to lower quality wetlands (e.g., not rare or unique, that have low productivity and species diversity, and those that are already impaired or impacted by human activity).	No changes in wetland function or type.
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or sub-watershed level	NA
	Duration or Frequency	Long-term or permanent.		Periodic and/or temporary loss reversed over 1-2 growing seasons with or without active restoration.	NA

[a] "Magnitude" is defined based on the type of wetland impacted, using USACE wetland categories (USACE 2014). Category 1 are the highest quality, highest functioning wetlands.
[b] Indirect effects are those resulting from direct effects, but they occur elsewhere in space and/or time. Includes indirect hydrologic effects (wetting or drying) that in turn alters wetland function or type.
[c] Wetland functions include hydrologic, ecological, geomorphic, and social functions typically assessed for wetlands as part of USACE compensatory mitigation planning. Typical functions assessed may include flood attenuation, bank stabilization, water quality, organic matter input/transport, nutrient processing, wildlife habitat, T/E species habitat, biodiversity, recreational/social value.
NA = Not Applicable

11.2.5.3. Description of Environmental Concerns

Potential Direct Wetland Loss (Fill or Conversion to Non-Wetland)

Construction-related impacts from several of the deployment activities have the potential for direct wetland impacts such as filling, draining, or conversion to a non-wetland. Examples include placement of fill in a wetland to construct a new tower, trenching through a wetland or directly connected waterway to install a cable, and placement of a structure (tower, building) within the wetland.

Wetlands regulate the quality and quantity of surface and groundwater supplies, reduce flood hazards by serving as retention basins for surface runoff, and maintain water supplies after floodwaters subside. If wetlands were filled, the entire area may be at risk for increased flooding. There could be a loss of open space to be enjoyed by the community, and decreased wildlife populations may be observed due to displacement and increased noise, light, and other human disturbance. To the extent practicable or feasible, FirstNet and/or their partners would avoid filling wetlands or altering the hydrologic regime so that wetlands would not be lost or converted to non-wetlands. Loss of high and low-quality wetlands would be less than significant given the amount of land disturbance associated with the Proposed Action locations (generally less than an acre) and the short time-frame of deployment activities. Additionally, all site-specific locations will be subject to an environmental review to help ensure environmental concerns are addressed. To minimize any potential impacts to wetlands, BMPs and mitigation measures would be implemented in compliance with any issued federal, state, and local permits. Potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures (see Chapter 16).

There are more than 4 million acres of palustrine, riverine, lacustrine, estuarine, and marine wetlands throughout North Carolina (USFWS, 2014a). Most wetlands are found in the eastern part of the state, extending inland from the short to approximately half-way through the state (see Figure 11.1.5-1).

Based on the impact significance criteria presented in Table 11.2.5-1, the deployment activities would most likely have less than significant direct impacts on wetlands at the programmatic level. Additionally, the deployment activities would not violate applicable federal, state, and local regulations.

In North Carolina, as discussed in Section 11.1.5.4, Wetlands, regulated high quality wetlands include bogs and other important wetland sites. If any of the proposed deployment activities were to occur in these high quality wetlands, potentially significant impacts could occur. High quality wetlands occur throughout the state, and are not always included on state maps; therefore, site-specific analysis would likely be needed. To minimize any potential impacts to wetlands, BMPs and mitigation measures would be implemented in compliance with any issued federal, state, and local permits. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Potential Other Direct Effects

Other direct impacts consist of altering the chemical, physical, or biological components of a wetland to the extent that changes to the wetland functions occur. However, other direct impacts would not result in a loss of total wetland acreage. Changes, for example, could include conversion of a forested wetland system to a non-forested state through chemical, mechanical, or hydrologic manipulation; altered hydrologic conditions (increases or decreases) such as storm water discharges or water withdrawals that alter the functions of the wetlands.

Based on the impact significance criteria presented in Table 11.2.5-1, construction-related deployment activities that result in long-term or permanent, substantial, and measurable changes to hydrological regime of the wetland (i.e., changes in salinity, pollutants, nutrients, biodiversity, ecological integrity, or water quality) may cause potentially significant impacts. In addition, introduction and establishment of invasive species to high quality wetlands within a watershed or multiple watersheds are potentially significant. Other direct effects to high- and low-quality wetlands would be less than significant given the amount of land disturbance associated with the Proposed Action locations (generally less than an acre) and the short time-frame of deployment activities and the application of federal, state, and local wetlands regulations. Additionally, site-specific locations will be subject to an environmental review to help ensure environmental concerns are addressed. To minimize any potential impacts to wetlands, BMPs and mitigation measures would be implemented in compliance with any issued federal, state, and local permits. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Examples of activities that could have other direct effects to wetlands in North Carolina include:

- *Vegetation Clearing*: removing existing vegetation by clearing forest and herbaceous vegetation during construction activities, grading, seeding, and mulching. Clearing and grading may include increased soil erosion and a decrease in the available habitat for wildlife.
- *Ground Disturbance*: Increased amounts of storm water runoff in wetlands could alter water level response times, depths, and duration of water detention. Reduction of watershed infiltration capacity could cause wetland water depths to rise more rapidly following storm events.
- *Direct Hydrologic Changes (flooding or draining):* Greater frequency and duration of flooding could destroy native plant communities, as could depriving them of their water supply. Hydrologic changes could make a wetland more vulnerable to pollution. Increased water depths or flooding frequency could distribute pollutants more widely through a wetland. Sediment retention in wetlands is directly related to flow characteristics, including degree and pattern of channelization, flow velocities, and storm surges.
- *Direct Soil Changes:* Changes in soil chemistry could lead to degradation of wetlands that have a specific pH range and/or other parameter.

- *Water Quality Degradation (spills or sedimentation):* The loss of wetlands results in a depletion of water quality both in the wetland and downstream. Filtering of pollutants by wetlands is an important function and benefit. High levels of suspended solids (sedimentation) could reduce light penetration, dissolved oxygen, and overall wetland productivity. Toxic materials in runoff could interfere with the biological processes of wetland plants, resulting in impaired growth, mortality, and changes in plant communities.

Indirect Effects:[135] Changes in Function(s)[136] or Change in Wetland Type

Indirect effects to wetlands could include change in wetland function or conversion of a resource to another type (i.e., wetland to an open body of water). The construction of curb and gutter systems diverts surface runoff and could cause flooding or wetlands to dry out, depending on the direction of diversion. Indirect effects to high- and low-quality wetlands would be less than significant given the amount of land disturbance associated with the Proposed Action locations (generally less than an acre) and the short time-frame of deployment activities and the application of federal, state, and local wetlands regulations. Additionally, all site-specific locations will be subject to an environmental review to help ensure environmental concerns are addressed. To minimize any potential impacts to wetlands, BMPs and mitigation measures would be implemented in compliance with any issued federal, state, and local permits. Potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures, as practicable and feasible (see Chapter 16).

- *Flood Attenuation:* Wetlands provide flood protection by holding excess runoff after storms, before slowly releasing it to surface waters. While wetlands may not prevent flooding, they could lower flood peaks by providing detention of storm flows. Correspondingly, disturbance of the wetlands (e.g., dredging or filling) could proportionately reduce water storage function.

- *Bank Stabilization:* By reducing the velocity and volume of flow, wetlands provide erosion control, floodwater retention, and reduce stream sedimentation.

- *Water Quality:* Water quality impacts on wetland soils could eventually threaten a wetland's existence. Where sediment inputs exceed rates of sediment export and soil consolidation, a wetland would gradually become filled.

- *Nutrient Processing:* Wetland forests retain ammonia during seasonal flooding. Wetlands absorb metals in the soils and by plant uptake via the roots. They also allow metabolism of oxygen-demanding materials and reduce fecal coliform populations. These pollutants are often then buried by newer plant material, isolating them in the sediments.

[135] Indirect effects are those resulting from direct effects, but they occur elsewhere in space and/or time. Includes indirect hydrologic effects (wetting or drying) that in turn alters wetland function or type.

[136] Wetland functions include hydrologic, ecological, geomorphic, and social functions typically assessed for wetlands as part of USACE compensatory mitigation planning. Typical functions assessed may include flood attenuation, bank stabilization, water quality, organic matter input/transport, nutrient processing, wildlife habitat, T/E species habitat, biodiversity, recreational/social value.

- *Wildlife Habitat:* Impacts on wetland hydrology and water quality affect wetland vegetation. While flooding could harm some wetland plant species, it promotes others. Shifts in plant communities because of hydrologic changes could have impacts on the preferred food supply and animal cover.
- *Recreational Value:* Wetlands provide recreation opportunities for people, such as hiking, bird watching, and photography.
- *Groundwater Recharge:* Wetlands retain water, allowing time for surface waters to infiltrate into soils and replenish groundwater.

According to significance criteria defined in Table 11.2.5-1, impacts to lower quality wetlands (e.g., not rare or unique, that have low productivity and species diversity, and those that are already impaired or impacted by human activity), would be considered potentially less than significant at the programmatic level. Since the majority of the 4 million acres of wetlands in North Carolina are not considered high quality, deployment activities would likely have less than significant indirect impacts on wetlands in the state. To minimize any potential impacts to wetlands, BMPs and mitigation measures would be implemented in compliance with any issued federal, state, and local permits. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

11.2.5.4. Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operation activities. To determine the magnitude of potential impacts of site-specific activities, wetland delineations could be required to determine the exact location of all wetlands, including high quality wetlands, as well as a functional assessment by an experienced wetland delineator.

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to wetlands and others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of no impacts to potentially significant impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have no impacts to wetlands under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be no impacts to wetlands since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to wetlands because there would be no ground disturbance.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures, adding equipment to satellites being launches for other purposes, and the use of portable devices that use satellite technology is not likely to impact wetlands since there would be no ground disturbance.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact wetlands, it is anticipated that this activity would have no impact on wetlands.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to wetlands because of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct effects, other direct effects, and indirect effects on wetlands. The types of deployment activities that could be part of the Preferred Alternative and result in potential impacts to wetlands include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to wetlands. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct and indirect impacts to wetlands. The amount of impact depends on the land area affected, installation technique, proximity to wetlands, and type of wetland that could be affected (e.g., high quality). Any ground disturbance could cause direct and indirect impacts wetlands, depending on the proximity to wetlands and type of wetlands that could be affected. Implementing BMPs and mitigation measures could reduce impact intensity.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in in or near bodies of water would potentially impact wetlands found along shorelines. Additional project-

specific environmental reviews would be required to assess potential impacts to wetland environments, including coastal and marine environments.

- New Build – Aerial Fiber Optic Plant: Potential impacts would be similar to Buried Fiber Optic Plant. Any ground disturbance could cause direct and indirect impacts wetlands, depending on the proximity to wetlands and type of wetlands that could be affected.
- Collocation on Existing Aerial Fiber Optic Plant: Any ground disturbance could cause direct and indirect impacts to wetlands from increased suspended solids and runoff from activities, depending on the proximity to wetlands and type of wetlands that could be affected.
- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required grading or other ground disturbance to install small boxes or hunts, or access roads, there could potentially be direct and indirect impacts to wetlands. The amount of impact from a temporary increase in the amount of suspended solids running off construction sites and into wetlands depends on the land area affected, installation technique, and location. If trenching were to occur near wetlands, it could cause impacts on wetlands. Implementing BMPs and mitigation measures could help reduce impact intensity.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security lighting, electrical feeds, and concrete foundations and pads) or access roads could potentially cause direct and indirect impacts to wetlands. The activities could cause a temporary increase in the amount of suspended solids running off construction sites and into wetlands, depending on their proximity. The amount of impact depends on the land area affected, installation technique, and proximity to wetlands, and wetland type. If trenching were to occur near wetlands, it could cause impacts on wetlands. Implementing BMPs and mitigation measures could reduce impact intensity.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to wetlands. However, if additional power units, structural hardening, and physical security measures required ground disturbance, such as grading, or excavation activities, impacts to wetlands could occur near wetlands, it could cause impacts on wetlands. Implementing BMPs and mitigation measures could reduce impact intensity.
  - Deployable Technologies: Implementation of deployable technologies could result in potential impacts to wetlands if deployment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. The amount of impact depends on the land area affected, installation technique, and location. Implementing BMPs and mitigation

measures could reduce impact intensity. The activities could also result in other direct impacts on wetlands if fuels leak into nearby waterbodies or wetlands.

- Deployment of drones, balloons, blimps, or piloted aircraft could have other direct impacts on wetlands if fuels spill or other chemicals seep into nearby waterbodies or wetlands.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or underwater cables; installation of security/safety lighting and fencing; and deployment of aerial platforms. Depending on the deployment activity for this infrastructure, potential impacts to wetlands may occur. The amount of impact depends on the land area affected, installation technique, proximity to wetlands, and type of wetland that could be affected (e.g., high quality). Any ground disturbance could cause direct and indirect impacts wetlands, depending on the proximity to wetlands and type of wetlands that could be affected. These impacts are expected to be less than significant at the programmatic level due to the small about of land disturbance (generally less than one acre) and the short timeframe of deployment activities. To minimize any potential impacts to wetlands, BMPs and mitigation measures would be implemented in compliance with any issued federal, state, and local permits. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that there could be ongoing potential other direct impacts to wetlands if heavy equipment is used for routine operations and maintenance application of herbicides occurs to control vegetation along all ROWs and near structures, depending on the proximity to wetlands. The intensity of the impact depends on the amount of herbicides used, frequency, and location of nearby sensitive wetlands. These impacts are expected to be less than significant at the programmatic level due to the limited nature of deployment activities. It is also anticipated that routine maintenance activities would be conducted on existing roads and utility ROW. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

11.2.5.5. Alternatives Impact Assessment

The following section assesses potential impacts to water resources associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to wetlands as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts to wetlands. Some staging or launching/landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in direct and indirect impacts to wetlands from a temporary increase in the amount of suspended solids running off construction sites to nearby surface waters. The amount of impact depends on the land area affected, installation technique, and proximity to wetlands, and wetland type; however, impacts are expected to be less than significant due to the small scale and temporary duration of expected FirstNet deployment activities in any one location. To minimize any potential impacts to wetlands, BMPs and mitigation measures would be implemented in compliance with any issued federal, state, and local permits. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Deployable Technologies Alternative would consist of routine maintenance and inspection of the deployable technologies. Any major infrastructure replacement as part of ongoing system maintenance could result in impacts similar to the abovementioned deployment impacts. The wetlands impacts would depend on the watershed, duration (chronic or short-term) and frequency (many years or a few months) the resource would be used, and the wetland’s quality and function.

It is anticipated that there would be less than significant impacts to wetlands at the programmatic level associated with routine inspections of the Deployable Technologies Alternative as it is likely existing roads and utility rights-of-way would be utilized for maintenance and inspection activities. Site maintenance, including mowing or herbicides, is anticipated to result in less than significant effects to wetlands due to the limited nature of site maintenance activities, including mowing and application of herbicides. To minimize any potential impacts to wetlands, BMPs and mitigation measures would be implemented in compliance with any issued federal, state, and local permits. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to wetlands from construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 11.1.5, Wetlands.

11.2.6. Biological Resources

11.2.6.1. Introduction

This Chapter describes potential impacts to terrestrial vegetation, wildlife, fisheries and aquatic habitat, and threatened and endangered species in North Carolina associated with deployment and operation of the Proposed Action and its alternatives. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

11.2.6.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on terrestrial vegetation, wildlife, fisheries, and aquatic habitats were evaluated using the significance criteria presented in Table 11.2.6-1. As described in Section 11.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to terrestrial vegetation, wildlife, and fisheries and aquatic habitat addressed in Sections 11.2.6.3, 11.2.6.4, and 11.2.6.5, respectively, are presented as a range of possible impacts. Refer to Section 11.2.6.6 for impact assessment methodology and significance criterial associated with threatened and endangered species in North Carolina.

Table 11.2.6-1: Impact Significance Rating Criteria for Terrestrial Vegetation, Wildlife, Fisheries, and Aquatic Habitats

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Direct Injury/Mortality	Magnitude or Intensity	Population-level or sub-population injury mortality effects observed for at least one species depending on the distribution and the management of said species. Events that may impact endemics, or concentrations during breeding or migratory periods. Violation of various regulations including Marine Mammal Protection Act (MMPA), Magnuson Stevens Fishery Conservation And Management Act (MSFCMA), MBTA, and Bald and Golden Eagle Protection Act (BGEPA).	Effect that is potentially significant, but with BMPs and mitigation measures is less than significant.	Individual mortality observed but not sufficient to affect population or sub-population survival.	No direct individual injury or mortality would be observed.
	Geographic Extent	Regional effects observed within North Carolina for at least one species. Anthropogenic disturbances that lead to exclusion from nutritional or habitat resources, or direct injury or mortality of endemics or a significant portion of the population or sub-population located in a small area during a specific season.		Effects realized at one location when population is widely distributed, and not concentrated in affected area.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within one to three years.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Vegetation and Habitat Loss, Alteration, or Fragmentation	Magnitude or Intensity	Population-level or sub-population effects observed for at least one species or vegetation cover type, depending on the distribution and the management of the subject species. Impacts to terrestrial, aquatic, or riparian habitat or other sensitive natural community vital for feeding, spawning/breeding, foraging, migratory rest stops, refugia, or cover from weather or predators. Violation of various regulations including MMPA, MSFCMA, MBTA, and BGEPA.	Effect that is potentially significant, but with BMPs and mitigation measures is less than significant.	Habitat alteration in locations not designated as vital or critical for any period. Temporary losses to individual plants within cover types, or small habitat alterations take place in important habitat that is widely distributed and there are no cover type losses or cumulative effects from additional projects.	Sufficient habitat would remain functional to maintain viability of all species. No damage or loss of terrestrial, aquatic, or riparian habitat from project would occur.
	Geographic Extent	Regional effects observed within North Carolina for at least one species. Anthropogenic disturbances that lead to the loss or alteration of nutritional or habitat resources for endemics or a significant portion of the population or sub-population located in a small area during a specific season.		Effects realized at one location.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within one to three years.	NA

Type of Effect	Effect Characteristics	Impact Level: Potentially Significant	Impact Level: Less than Significant with BMPs and Mitigation Measures Incorporated	Impact Level: Less than Significant	Impact Level: No Impact
Indirect Injury/Mortality	Magnitude or Intensity	Population-level or sub-population effects observed for at least one species depending on the distribution and the management of said species. Exclusion from resources necessary for the survival of one or more species and one or more life stages. Anthropogenic disturbances that lead to mortality, disorientation, the avoidance or exclusion from nutritional or habitat resources for endemics or a significant portion of the population or sub-population located in a small area during a specific season. Violation of various regulations including MMPA, MSFCMA, MBTA, and BGEPA.	Effect that is potentially significant, but with BMPs and mitigation measures is less than significant.	Individual injury/mortality observed but not sufficient to affect population or sub-population survival. Partial exclusion from resources in locations not designated as vital or critical for any given species or life stage, or exclusion from resources that takes place in important habitat that is widely distributed. Anthropogenic disturbances are measurable but minimal as determined by individual behavior and propagation, and the potential for habituation or adaptability is high given time.	No stress or avoidance of feeding or important habitat areas. No reduced population resulting from habitat abandonment.
	Geographic Extent	Regional or site-specific effects observed within North Carolina for at least one species. Behavioral reactions to anthropogenic disturbances depend on the context, the time of year age, previous experience, and activity. Anthropogenic disturbances that lead to startle responses of large groupings of individuals during haulouts, resulting in injury or mortality.		Effects realized at one location.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within one to three years.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Effects to Migration or Migratory Patterns	Magnitude or Intensity	Population-level or sub-population effects observed for at least one species depending on the distribution and the management of said species. Temporary or long-term loss of migratory pattern/path or rest stops due to anthropogenic activities. Violation of various regulations including MMPA, MSFCMA, MBTA, and BGEPA.	Effect that is potentially significant, but with BMPs and mitigation measures is less than significant.	Temporary loss of migratory rest stops due to anthropogenic activities take place in important habitat that is widely distributed and there are no cumulative effects from additional projects.	No alteration of migratory pathways, no stress or avoidance of migratory paths/patterns due to project.
	Geographic Extent	Regional effects observed within North Carolina for at least one species. Anthropogenic disturbances that lead to exclusion from nutritional or habitat resources during migration, or lead to changes of migratory routes for endemics or a significant portion of the population or sub-population located in a small area during a specific season.		Effects realized at one location when population is widely distributed, and not concentrated in affected area.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within one to three years.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Reproductive Effects	Magnitude or Intensity	Population or sub-population level effects in reproduction and productivity over several breeding/spawning seasons for at least one species depending on the distribution and the management of said species. Violation of various regulations including MMPA, MSFCMA, MBTA, and BGEPA.	Effect that is potentially significant, but with BMPs and mitigation measures is less than significant.	Effects to productivity are at the individual rather than population level. Effects are within annual variances and not sufficient to affect population or sub-population survival.	No reduced breeding or spawning success.
	Geographic Extent	Regional effects observed within North Carolina for at least one species. Anthropogenic disturbances that lead to exclusion from prey or habitat resources required for breeding/spawning or stress, abandonment, and loss of productivity for endemics or a significant portion of the population or sub-population located in a small area during the breeding/spawning season.		Effects realized at one location.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several breeding/spawning seasons for at least one species.		Temporary, isolated, or short-term effects that are reversed within one breeding season.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Invasive Species Effects	Magnitude or Intensity	Extensive increase in invasive species populations over several seasons.	Effect that is potentially significant, but with BMPs and mitigation measures is less than significant.	Mortality observed in individual native species with no measurable increase in invasive species populations.	No loss of forage and cover due to the invasion of exotic or invasive plants introduced to project sites from machinery or human activity.
	Geographic Extent	Regional impacts observed throughout North Carolina.		Effects realized at one location.	NA
	Duration or Frequency	Chronic and long-term changes not likely to be reversed over several years or seasons.		Periodic, temporary, or short-term changes that are reversed over one or two seasons.	NA

NA = Not Applicable

11.2.6.3. Terrestrial Vegetation

Impacts to terrestrial vegetation occurring in North Carolina are discussed in this section.

Description of Environmental Concerns

Direct Injury/Mortality

Direct injury/mortality effects are physical injuries, extreme physiological stress, or death of an individual organism from interactions associated with the Proposed Action. The most common direct injuries are permanent or temporary loss or disturbance of individual plants. Based on the impact significance criteria presented in Table 11.2.6-1, direct injury or mortality impacts could be significant if population-level or sub-population effects were observed for at least one species depending on the distribution and the management of the subject species. Although unlikely, direct mortality/injury to plants could occur in construction zones from land clearing, excavation activities, or vehicle traffic; however, FirstNet deployment events are expected to be relatively small in scale and therefore would have less than significant impacts at the programmatic level. The implementation of standard BMPs, mitigation measures, and avoidance measures could help to minimize or altogether avoid potential impacts to plant population survival. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Although unlikely, direct mortality/injury to plants could occur in construction zones from land clearing, excavation activities, or vehicle traffic; however, FirstNet deployment events are expected to be relatively small in scale. The implementation of standard BMPs, mitigation measures, and avoidance measures would help to minimize or altogether avoid potential impacts to plant population survival.

Vegetation and Habitat Loss, Alteration, or Fragmentation

Habitat impacts are primarily physical disturbance that result in alterations in the amount or quality of a habitat. As with all of the effects categories, the magnitude of the potential impact depends on the duration, location, and spatial scale of the system and associated activities. Habitat fragmentation is the loss or breaking down of continuous and connected habitat. About 15 percent of North Carolina has experienced extensive land use change due to cropland creation and about 14 percent of the state has experienced extensive land use change due to urbanization. However, a large portion of the state, about 46 percent, remains relatively unfragmented forest, particularly the Pisgah National Forest, Great Smoky Mountains National park, and the Croatan National Forest (NRCS, 2010).

Construction of new infrastructure and long-term facility maintenance could result in the alteration of the type of vegetative communities in these localized areas, and in some instances the permanent loss of vegetation. In general, these impacts are expected to be less than significant due to the short-term, localized nature of the deployment activities. Further, some limited amount of infrastructure may be built in sensitive or rare regional vegetative communities, in which case BMPs and mitigation measures could be recommended and consultation with appropriate resource agencies, if required, could be undertaken to minimize or avoid potential impacts. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Indirect Injury/Mortality

Indirect effects are effects that are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable (40 CFR 1508.8[b]). Indirect injury/mortality could include stress related to disturbance. The alteration of soils or hydrology within a localized area could result in stress or mortality of plants. Construction activities that remove large quantities of soil in the immediate vicinity of trees could cause undue stress to trees from root exposure, although this is unlikely to occur due to the small size of expected FirstNet activities. Indirect injury/mortality impacts vary depending on the species, time of year and duration of construction or deployment. Overall, these impacts are expected to be less than significant at the programmatic level due to the short-term and small-scale nature of deployment activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Effects to Migration or Migratory Patterns

No effects to the long-term migration or migratory patterns for terrestrial vegetation (e.g., forest migration) are expected as a result of the Proposed Action given the small scale of deployment activities.

Reproductive Effects

No reproductive effects to terrestrial vegetation are expected as a result of the Proposed Action given the small scale of deployment activities.

Invasive Species Effects

When human activity results in a species entering an ecosystem new to it, the species is classified as introduced or, depending on its ability to spread rapidly and outcompete native species, invasive. The introduction of invasive species could have a dramatic effect on natural resources and biodiversity. In North Carolina, noxious weeds are regulated by the North Carolina Department of Agriculture and Consumer Services. The State Noxious Weed Regulations, were adopted under authority of the N. C. Plant Pest Law, Article 36 § 106-419 to 423.1. They were established to prevent the widespread establishment of harmful non-native plants that are placed on the Noxious Weed List. Any plant on the Noxious Weed List is prohibited entry into the state without a permit. Noxious weeds already present in the state are contained by prohibiting movement of the plant outside of regulated areas. In addition to the plant itself, articles that could contain noxious weed propagules such as soil or hay, are also regulated.

As described in Section 16.1.6.3, when non-native species are introduced into an ecosystem in which they did not evolve, their populations sometimes increase rapidly. The potential to introduce invasive plants within construction zones and during long-term site maintenance could occur from vehicles and equipment being transported from one region to another, or when conducting revegetation of a site after deployment activities are complete. Overall, these impacts are expected to be less than significant at the programmatic level due to the small-scale and localized nature of likely FirstNet activities. BMPs could help to minimize or avoid the potential for introducing invasive plant species during implementation of the Proposed Action. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including construction/deployment and operational activities.

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to terrestrial vegetation resources and others would not. In addition, and as explained in this section, the same type of Proposed Action infrastructure could result in a range impacts, from no impacts to less than significant impacts, depending on the deployment scenario or site-specific conditions. The terrestrial vegetation that would be affected would depend on the ecoregion, the species' phenology[137], and the nature as well as the extent of the habitats affected. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

<u>Activities Likely to Have No Impacts</u>

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are expected to have no impacts to terrestrial vegetation under the conditions described below:

- Wired Projects
    - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. Although terrestrial vegetation could be impacted, it is anticipated that effects to vegetation would be minimal

[137] Phenology is the seasonal changes in plant and animal lifecycles, such as emergence of insects or migration of birds.

since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.

- Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts on terrestrial vegetation because there would be no ground disturbance.

- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures, attaching equipment to satellite launches for other purposes, and the use of portable devices that use satellite technology would not impact terrestrial vegetation because those activities would not require ground disturbance.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact biological resources, it is anticipated that this activity would have no impact on terrestrial vegetation.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to terrestrial vegetation as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct injury/mortality; vegetation and habitat loss, alteration, or fragmentation; indirect injury/mortality; and invasive species effects. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to terrestrial vegetation include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to terrestrial vegetation. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects. BMPs and mitigation measures could help to avoid or minimize potential impacts.
  - New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public ROWs or private easements as well as the construction of access roads, POPs, huts, or facilities to house outside plant equipment could result in potential impacts to terrestrial vegetation. Impacts may vary depending on the number or individual poles installed, but could include direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects. BMPs and mitigation measures could help to avoid or minimize potential impacts.

- Collocation on Existing Aerial Fiber Optic Plant: Land clearing and excavation during replacement of poles and structural hardening could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects.
- New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water would not impact terrestrial vegetation. However, impacts to terrestrial vegetation could potentially occur as a result of the construction of landings and/or facilities on shore to accept submarine cables could potentially occur as a result of land clearing, excavation activities, and heavy equipment use. Effects could include direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects. BMPs and mitigation measures could help to avoid or minimize potential impacts.
- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required construction of access roads, trenching, and/or land clearing, such disturbance could result in direct or indirect injury to plants, vegetation loss, and invasive species effects.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads), microwave facilities, or access roads could result in impacts to terrestrial vegetation. Land/vegetation clearing, excavation activities, landscape grading, and other disturbance activities during the installation of new wireless towers and associated structures or access roads could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to terrestrial vegetation. However, if additional power units, replacement towers, structural hardening, and physical security measures require land clearing or excavation activities, impacts would be similar to new wireless construction.
  - Deployable Technologies: Implementation of deployable technologies including COWs, COLTs, or SOWs could result in direct impacts to terrestrial vegetation if deployment occurs on vegetated areas, or the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects.

Deployment of drones, balloons, blimps, or piloted aircraft could potentially impact terrestrial vegetation if deployment occurs on vegetated areas. Impacts would be similar to deployment of COWs, COLTs, and SOWs.

In general the abovementioned activities could potentially involve land/vegetation clearing; topsoil removal; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or cables; heavy equipment movement; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to terrestrial vegetation associated with deployment of this infrastructure, depending on their scale, could include direct or indirect injury/mortality to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species depending on the ecoregion, the species' phenology, and the nature and extent of the vegetation affected. Despite the variability, these impacts are expected to be less than significant at the programmatic level due to the small scale and limited geographic scope of expected deployment activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operational activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. The terrestrial vegetation that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected.

It is anticipated that there would be no impacts to terrestrial vegetation associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections because there would be no ground disturbance. Site maintenance, including mowing or herbicides, may result in less than significant effects due to the small-scale of expected activities. These potential impacts could result from accidental spills from maintenance equipment or release of herbicides and because these areas would not be allowed to revert to a more natural state. If usage of heavy equipment or land clearing activities occurs off established roads or corridors as part of routine maintenance or inspections, direct or indirect injury/mortality to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species could occur to terrestrial vegetation, however impacts are expected to be less than significant due to the small-scale of expected activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Alternatives Impact Assessment

The following section assesses potential impacts to terrestrial vegetation associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to terrestrial vegetation as a result of implementation of this alternative could be as described below.

Deployment Impacts

As described above, implementation of deployable technologies could result in less than significant impacts from land/vegetation clearing, excavation, and paving activities. These activities could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects. Greater frequency and duration of deployments could change the magnitude of impacts. Nonetheless, impacts are expected to remain less than significant at the programmatic level due to the relatively small-scale of FirstNet activities at individual locations. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operational Impacts

As described above, operational activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. The impacts could vary greatly among species, vegetative community, and geographic region, but are expected to remain less than significant. As with the Preferred Alternative, it is anticipated that there would be less than significant impacts to terrestrial vegetation, at the programmatic level, associated with routine operations and maintenance due to the relatively small scale of likely FirstNet project sites. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to terrestrial vegetation as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 11.1.6.3, Terrestrial Vegetation.

11.2.6.4. Wildlife

Impacts to amphibians and reptiles, terrestrial mammals, marine mammals, birds, and terrestrial invertebrates occurring in North Carolina and North Carolina's near offshore environment (i.e., less than two miles from the edge of the coast) are discussed in this section. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Description of Environmental Concerns

Direct Injury/Mortality

Direct injury/mortality effects are physical injuries, extreme physiological stress, or death of an individual organism from interactions associated with the Proposed Action. The most common direct injuries are entanglement, vehicle or vessel strike, problems associated with accidental ingestion, and injuries incurred by sensitive animals from disturbance events.

Based on the impact significance criteria presented in Table 11.2.6-1, less than significant impacts would be anticipated at the programmatic level given that the majority of proposed deployment activities are likely to be small-scale and would be dependent on the location and type of deployment activity. Although anthropogenic disturbances may be measurable (although minimal) for some FirstNet Proposed Actions, impacts to individual behavior of animals would be short term and direct injury or mortality impacts at the population-level or sub-population effects would not likely be observed; therefore, impacts are generally expected to be less than significant at the programmatic level, as discussed further below. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

<u>Terrestrial Mammals</u>

Vehicle strikes are common sources of direct mortality or injury to both small and large mammals in North Carolina. Mammals are attracted to roads for a variety of reasons including use as a source of minerals, foraging, and migration (FHWA, 2009). Individual injury or mortality as a result of vehicle strikes associated with the Proposed Action could occur. Entanglement in fences or other barriers could be a source of mortality or injury to terrestrial mammals, though entanglements would likely be isolated, individual events.

For example, if tree-If tree-roosting bats and particularly maternity colonies are present at a site location, removal of trees during land clearing activities could result in direct injury/mortality if bats are utilizing them as roost trees or for rearing young. The scale of this impact would be expected to be small-scale and would be dependent on the location and type of deployment activity, and tree removal. Site avoidance measures could be implemented to avoid disturbance to bats.

Marine Mammals

Marine mammals swimming or hauled out on land are sensitive to boats, aircraft, and human presence. Noises, smells, sounds, and sights may elicit a flight reaction. Trampling deaths associated with haulout disturbance are known source of mortality for seals but are not anticipated from likely FirstNet deployment activities.

Entanglements from marine debris as well as ingestion of marine debris could result in injury or death to marine mammals. Marine debris is any manmade object discarded, disposed of, or abandoned that enters the marine environment. Entanglements from marine debris are not anticipated from FirstNet activities.

Birds

Mortalities from collisions or electrocutions with manmade cables and wires are environmental concerns for avian species. Generally, collision events occur to night-migrating birds, “poor” fliers (e.g., ducks), heavy birds (e.g., swans and cranes), and birds that fly in flocks; while species susceptible to electrocution are birds of prey, ravens, and thermal soarers, typically having large wing spans (FAA, 2012b) (Gehring, Kerlinger, & Manville., 2011).

Avian mortalities or injuries could also result from vehicle strikes, although typically occur as isolated events.

Direct injury and mortality of birds could occur to ground-nesting birds when nests are either disturbed or destroyed during land clearing, excavation and trenching, and other ground disturbing activities. Removal of trees during land clearing activities could also result in direct injury/mortality to forest dwelling birds if they are utilizing them as roost trees for resting or shelter from predators and inclement weather, or as nest trees for rearing young. The scale of this impact would be associated with the amount of tree removal and the abundance of forest-dwelling birds roosting/nesting in the area. These impacts could be particularly pronounced in IBAs within the state. Direct injury/mortality are not anticipated to be widespread or affect bird populations if BMPs are followed to avoid or minimize these effects.

Direct mortality and injury to birds of North Carolina are not likely to be widespread or affect populations of species as a whole; individual impacts may be realized depending on the location and type of deployment activity. Direct injury/mortality are not anticipated to be widespread or affect bird populations due to the small scale of likely FirstNet actions. If siting considerations, BMPs, and mitigation measures are implemented (Chapter 16), potential impacts could be minimized. Applicable BMPs and mitigation measures, as defined through consultation with USFWS for MBTA or BGEPA, if required, could help to avoid or minimize any potential impacts. Environmental consequences pertaining to federally listed species will be discussed in Section 11.2.6.6, Threatened and Endangered Species.

Reptiles and Amphibians

The majority of North Carolina’s amphibian and reptile species are widely distributed throughout the state; however, some species have more limited ranges (NCWRC, 2005a). Direct mortality to amphibians or reptiles could occur in construction zones either by excavation activities or by vehicle strikes; however, these effects are expected to be temporary and isolated, affecting only individual animals.

Five species of marine turtles – all listed as threatened or endangered under the ESA – occur in North Carolina's offshore environment. Environmental consequences pertaining to these reptiles are discussed in Section 11.1.6.6, Threatened and Endangered Species and Species of Conservation Concern.

Terrestrial Invertebrates

The terrestrial invertebrate populations of North Carolina are so widely distributed that injury/mortality events are not expected to affect populations of species as a whole.

Vegetation and Habitat Loss, Alteration, or Fragmentation

As described in Section 11.2.6.3, habitat loss could occur through exclusion, directly or indirectly, preventing an animal from accessing an optimal habitat (e.g., breeding, forage, or refuge), either by physically preventing use of a habitat or by causing an animal to avoid a habitat, either temporarily or long-term. It is expected that activities associated with the Proposed Action would cause exclusion effects only in very special circumstances, as in most cases an animal could fly, swim, or walk to a nearby area that would provide refuge.

In general, potential effects of vegetation and habitat loss, alteration, or fragmentation are expected to be less than significant because of the small-scale nature and limited geographic scope of expected deployment activities. These potential impacts are described for North Carolina's wildlife species below. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Terrestrial Mammals

Mammals occupy a wide range of habitats throughout North Carolina and may experience localized effects of habitat loss or fragmentation. Removal or loss of vegetation may impact large mammals (e.g., black bear) by decreasing the availability of forest for cover from predators or foraging. Loss of cover may increase predation on both breeding adults as well as their young. The loss, alteration, or fragmentation of forested habitat would also impact some small mammals (e.g., bats, foxes) that utilize these areas for roosting, foraging, sheltering, and for rearing their young. Loss of habitat or exclusions from these areas could be avoided or minimized by BMPs and mitigation measures (see Chapter 16).

Marine Mammals

Marine mammals are present year-round in estuarine and coastal waters. The most common species of marine mammal in North Carolina estuarine and nearshore waters is the bottlenose dolphin. Humpback whales are also common in nearshore North Carolina waters, particularly in late fall and winter months. Manatees and dolphins could be temporarily excluded from a resource due to the presence of humans, noise, or vessel traffic during deployment activities.

Effects on manatees from exclusion from resources would be low magnitude and temporary in duration.

Loss of habitat or exclusions from these areas for manatees, dolphins, and whales would be avoided or minimized by BMPs and mitigation measures (see Chapter 16). Environmental consequences pertaining to the endangered whales and West Indian manatee protected under the ESA are discussed in Section 11.1.6.6, Threatened and Endangered Species and Species of Conservation Concern.

Birds

The direct removal of migratory bird nests is prohibited under the MBTA. The USFWS and the North Carolina Wildlife Resources Commission (NCWRC) provide regional guidance on the most critical time periods (e.g., breeding season) to avoid vegetation clearing. The removal and loss of vegetation could affect avian species directly by loss of nesting, foraging, stopover, and cover habitat.

Noise disturbance and human activity, as discussed previously, could directly restrict birds from using their preferred resources. Greater human activity of longer duration would increase the likelihood that birds would avoid the area, possibly being excluded from essential resources. These impacts could be particularly pronounced in IBAs within the state as birds may temporarily avoid these areas (Hill, et al., 1997).

The degree to which habitat exclusion affects birds depends on many factors. The impact to passerine[138] species from disturbance or displacement from construction activities is likely to be short-term with minor effects from exclusion. Exclusion from resources concentrated in a small migratory stop area during peak migration could have major impacts to species that migrate in large flocks and concentrate at stopovers (e.g., shorebirds). BMPs and mitigation measures, including nest avoidance during construction-related activities, would help to avoid or minimize the potential impacts to birds from exclusion of resources.

Reptiles and Amphibians

Important habitats for North Carolina's amphibians and reptiles typically consist of wetlands and, in some cases as with the timber rattlesnake, the surrounding upland forest. Impacts are expected to be less than significant at the programmatic level given the short-term nature and limited geographic scope of individual activities. If proposed project sites were unable to avoid sensitive areas, BMPs and mitigation measures (see Chapter 16) would be implemented to avoid or minimize the potential impacts.

Filling or draining of wetland breeding habitat (see Section 11.2.4, Water Resources) and alterations to ground or surface water flow from development associated with the Proposed

[138]Passerines are an order of "perching" birds that have four toes, three facing forward and one backward, which allows the bird to easily cling to both horizontal and nearly vertical perches.

Action may also have effects to North Carolina's amphibian and reptile populations, though BMPs and mitigation measures would help to avoid or minimize the potential impacts.[139]

Terrestrial Invertebrates

Habitat loss and degradation are the most common causes of invertebrate species' declines; however, habitat for many common terrestrial invertebrates is generally assumed to be abundant and widely distributed across the state, therefore no significant effects to terrestrial invertebrates are expected. Impacts to sensitive invertebrate species are discussed below in Section 11.2.6.6, Threatened and Endangered Species and Species of Concern.

Indirect Injury/Mortality

Indirect injury/mortality impacts vary depending on the species, time of year and duration of deployment. Overall, impacts are expected to remain less than significant at the programmatic level due to the short-term nature and limited geographic scope of expected activities, though BMPs and mitigation measures could further help to avoid or minimize the potential impacts. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Terrestrial Mammals

Stress from repeated disturbances during critical time periods (e.g., roosting and mating) could reduce the overall fitness and productivity of young and adult terrestrial mammals. Indirect effects could occur to roosting bats from noise, light, or human disturbance causing them to leave their roosting locations or excluding them from their summer roosting/maternity colony roosts. For example, some bat species establish summer roosting or maternity colonies in the same general area that they return to year and after year. The majority of FirstNet deployment activities would be short-term in nature, and repeated disturbances would not occur. Depending on the project type and location, individual species may be disturbed resulting in less than significant impacts.

Marine Mammals

Repeated disturbance (e.g., from vessel traffic) could cause stress to individuals resulting in lower fitness and productivity. Given that the majority of FirstNet deployment activities are not expected to be located offshore or in the oceanic environment, less than significant impacts to no impacts, at the programmatic level, would be anticipated for marine mammals.

Birds

Repeated disturbance, especially during the breeding and nesting season, could cause stress to individuals lowering fitness and productivity. These impacts could be particularly pronounced in IBAs within the state. The majority of FirstNet deployment activities would be short-term in

[139] See Section 11.2.5, Wetlands, for a discussion of BMPs for wetlands.

nature, and repeated disturbances would not occur. Depending on the project type and location, individual species may be disturbed resulting in less than significant impacts at the programmatic level.

Reptiles and Amphibians

Changes in water quality, especially during the breeding seasons, could cause stress resulting in lower productivity. The majority of FirstNet deployment activities would be short-term in nature, and repeated disturbances would not occur. Depending on the project type and location, individual species may be disturbed resulting in less than significant impacts at the programmatic level.

Terrestrial Invertebrates

Terrestrial invertebrates could experience chronic stress, either by changes in habitat composition or competition for resources, resulting in lower productivity. Due to the large number of invertebrates distributed throughout North Carolina, and given the short-term nature of most of the deployment activities, this impact would likely be less than significant at the programmatic level.

Effects to Migration or Migratory Patterns

Migration is the regular movement of animals from one region to another and back again. Migratory patterns vary by species and sometimes within the same species. Overall, potential impacts are anticipated to be less than significant at the programmatic level due to the small-scale and localized nature of expected activities, which would be unlikely to result in long-term avoidance. Potential effects to migration patterns of North Carolina's amphibians and reptiles, terrestrial mammals, marine mammals, birds, and terrestrial invertebrates are described below. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Terrestrial Mammals

Some large mammals (e.g., black bears) will perform short seasonal migrations between foraging/breeding habitats and denning habitats. Some small mammals (e.g., bats) also have migratory routes that include spring and fall roosting areas between their summer maternity roosts and hibernacula[140].

Any clearance, drilling, and construction activities needed for network deployment, including noise associated with these activities, has the potential to divert mammals from these migratory routes. Impacts could vary depending on the species, time of year of construction/operation, and duration, though BMPs and mitigation measures could help to avoid or minimize the potential impacts.

[140] A location chosen by an animal for hibernation

Marine Mammals

Noise associated with the installation of cables in the near/offshore waters of coastal North Carolina could impact marine mammal migration patterns, though impacts are likely to be short-term provided the noise sources are not wide ranging and below Level A and B sound exposure thresholds[141] Marine mammals have the capacity to divert from sound sources during migration, and therefore impacts are expected to be less than significant at the programmatic level since noise generating activities would be of short duration and are not likely to result in long-term avoidance. BMPs and mitigation measures could help to further avoid or minimize the potential impacts.

Birds

Because many birds have extremely long migrations, protection efforts for critical sites along migratory routes must be coordinated over great distances often involving many different countries. For example, as a group, shorebirds migrating through North Carolina undertake some of the longest-distance migrations of all animals. North Carolina is located within the Atlantic Flyway, which spans more than 3,000 miles from the Arctic tundra to the Caribbean. There are 95 IBAs in North Carolina, covering more than 4.5 million acres in the coastal plain, piedmont, and mountain regions of the state. Thirty-two of North Carolina's IBAs are approved for global designation (Audubon Society, 2015). Many migratory routes are passed from one generation to the next. Impacts could vary (e.g., mortality of individuals or abandonment of stopover sites by whole flocks) depending on the species, time of year of construction/operation, and duration. BMPs and mitigation measures could help to avoid or minimize effects to migratory pathways.

Reptiles and Amphibians

Several species of salamanders and frogs are known to seasonally migrate. Gopher frogs (*Rana capito*) inhabit burrows in upland habitats. During breeding season, the gopher frog will travel a mile or more to breed and lay eggs in temporary ponds (FWC, 2015a). Mortality and barriers to movement could occur as result of the Proposed Action (Berven & Grudzien, 1990) (Calhoun & DeMaynadier, 2007).

Species that use streams as dispersal or migratory corridors may be impacted if these waterways are restricted or altered, but impacts are expected to be less than significant. BMPs and mitigation measures could help to further avoid or minimize the potential impacts.

Terrestrial Invertebrates

The proposed deployment activities would be expected to be short-term or temporary in nature. No effects, at the programmatic level, to migratory patterns of North Carolina's terrestrial invertebrates are expected as a result of the Proposed Action.

[141] Level A: 190 dB re 1µPa (rms) for seals and 180 dB re 1µPa (rms) for whales, dolphins, and porpoises. It is the minimum exposure criterion for injury at the level at which a single exposure is estimated to cause onset of permanent hearing loss. Level B: 160 dB re 1µPa (rms). It is defined as the onset of significant behavioral disturbance is proposed to occur at the lowest level of noise exposure that has a measurable transient effect on hearing (Southall, et al., 2007).

Reproductive Effects

Reproductive effects are considered those that either directly or indirectly reduce an animal's ability to produce offspring or reduce the rates of growth, maturation, and survival of offspring, and could affect the overall population of individuals. Overall, potential impacts are anticipated to be less than significant at the programmatic level due to the short-term and limited nature of expected activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Terrestrial Mammals

Restricted access to important winter hibernacula or summer maternity roosts for bats and dens for large mammals, such as the black bear, has the potential to negatively affect body condition and reproductive success of mammals in North Carolina. For example, pregnant black bears use certain types of habitats that allow for more effective defense of their cubs from predators (FWC, 2015b).

Disturbance from deployment and operations could also result in the abandonment of offspring leading to reduced survival, although these activities are expected to be small-scale. Reproductive effects as a result of displacement and disturbance could be minimized through the use of BMPs and mitigation measures.

Marine Mammals

Restricted access, such as the displacement of female whales from preferred calving habitats, may reduce fitness and survival of calves potentially affecting overall productivity. Additionally, disturbance to marine mammals from activities associated with the Proposed Action could result in the abandonment, or death of offspring, however, as FirstNet activities are likely to be small-scale in nature they are unlikely to impact marine mammal reproduction at the programmatic level. BMPs and mitigation measures could further help to avoid or minimize the potential impacts.

Birds

Impacts due to Proposed Action deployment and operations could include abandonment of the area and nests due to disturbance. Disturbance (visual and noise) may displace birds into less suitable habitat and thus reduce survival and reproduction. These impacts could be particularly pronounced in IBAs within the state. However, the majority of FirstNet deployment or operation activities are likely to be small-scale. Applicable BMPs and mitigation measures, as defined through consultation with USFWS for MBTA or BGEPA, if required, could help to avoid or minimize any potential impacts. Environmental consequences pertaining to federally listed species will be discussed in Section 11.2.6.6, Threatened and Endangered Species and Species of Conservation Concern.

Reptiles and Amphibians

Reproductive effects to reptile nests may occur through direct loss or disturbance of nests. For example, the loggerhead sea turtle leaves its breeding habitat in the coastal waters of the Atlantic and travels to nesting sites on sand beaches along the Atlantic coast. Additionally, reproductive effects to sub-populations of amphibians and reptiles may occur through the direct loss of vernal pools as breeding habitat if deployment activities occur near breeding pools, or alter water quality through sediment infiltration, or obstruction of natural water flow to pools. FirstNet activities that take place in or near nesting sites or that alter water quality or quantity, could affect reproductive success. However, the majority of FirstNet deployment or operation activities are likely to be small-scale and BMPs and mitigation measures could help to avoid or minimize the potential impacts.

Terrestrial Invertebrates

The majority of FirstNet deployment or operation activities are likely to be short-term in nature; therefore, no reproductive effects to terrestrial invertebrates are expected at the programmatic level as a result of the Proposed Action.

Invasive Species Effects

When human activity results in a species entering an ecosystem new to it, the species is classified as introduced or invasive. The introduction of invasive species could have a dramatic effect on natural resources. Exotic wildlife species are regulated by NCWRC. Specifically, the importation, exportation, purchase, possession or selling of tongueless frogs or African Clawed frogs (*Xenopus laevis*) is prohibited (North Carolina State University, 2015).

FirstNet deployment or operation activities could result in short-term or temporary changes to specific project sites, although these sites are expected to return to their natural state in a year or two. Invasive species are not expected to be introduced to project sites as part of the deployment activities from machinery or construction workers. Therefore, potential impacts are expected to be less than significant.

Potential invasive species effects to North Carolina's wildlife are described below.

Terrestrial Mammals

In North Carolina, feral hogs adversely impact wildlife and vegetation. They feed on young mammals, destroy native vegetation resulting in erosion and water resource concerns, and could carry/transmit disease to livestock and humans (NCWRC, 2013). FirstNet deployment or operation activities could result in short-term or temporary changes to specific project sites, although these sites are expected to return to their natural state in a year or two. Additionally, FirstNet deployment activities are not expected to introduce terrestrial mammal species to project sites, as these activities are temporary and would not provide a mechanism for transport of invasive terrestrial mammals to project sites from other locations.

Marine Mammals

No invasive marine mammals are regulated in North Carolina.

Birds

In North Carolina, European starlings and House sparrows are invasive bird species. These two bird species could out compete native secondary cavity nesters for breeding opportunities (Carolina Bird Club, 2016b) (Carolina Bird Club, 2016a).

FirstNet deployment activities could result in short-term or temporary changes to specific project sites, although these sites are expected to return to their natural state in a year or two. Additionally, invasive bird species are not expected to be introduced at project sites as part of the deployment activities. Invasive species effects to birds could be minimized or avoided following the BMPs described in Chapter 16.

Reptiles and Amphibians

No invasive reptiles or amphibians are regulated in North Carolina.

Terrestrial Invertebrates

Terrestrial invertebrate populations are susceptible to invasive plant species that may change or alter the community composition of specific plants on which they depend. Effects from invasive plant species to terrestrial invertebrates would be similar to those described for habitat loss and degradation.

Invasive insects pose a large threat to forest and agricultural resources (USFS, 2016). Species such as the gypsy moth and Emerald ash borer are known to cause irreversible damage to native forests in North Carolina (NCFS, 2016). The potential to introduce invasive invertebrates within construction zones and during long-term site maintenance could occur from vehicles and equipment being transported from one region to another, or when conducting revegetation of a site after deployment activities are complete. BMPs and mitigation measures (see Chapter 16) could help to avoid or minimize the potential for introducing invasive plant species.

Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including construction/deployment and operational activities.

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to wildlife resources and others would not. In addition, and as described in this section, infrastructure developed under the Preferred Alternative could result in a range of impacts, from no impacts to less than significant impacts, depending on the deployment scenario or site-specific conditions. The wildlife that would be affected would depend on the ecoregion, the species' phenology and the nature and extent of the habitats affected. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are expected to have no impacts to wildlife resources under the conditions described below:

- Wired Projects
    - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. Noise generated by equipment required to install fiber would be infrequent and of short duration, and unlikely to produce measurable changes in wildlife behavior. It is anticipated that effects to wildlife would be temporary and would not result in any perceptible change.
    - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts on wildlife resources because there would be no ground disturbance.
- Satellites and Other Technologies
    - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures, attaching equipment to satellites launched for other purposes, and the use of portable devices that use satellite technology would not impact wildlife if those activities would not require ground disturbance.
    - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact wildlife resources, it is anticipated that this activity would have no impact on wildlife resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to wildlife resources as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct injury/mortality; vegetation and habitat loss, alteration, or fragmentation; effects to migratory patterns; indirect injury/mortality; reproductive effects; and invasive species effects. The types of infrastructure deployment activities are anticipated to be less than significant to wildlife resources:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to wildlife resources. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct injury/mortalities of wildlife that are not mobile enough to avoid construction activities (e.g., reptiles, small mammals, and young individuals), that utilize burrows (e.g., ground squirrels), or that are defending nest sites (such as ground-nesting birds). Disturbance, including noise, associated with the above activities involving heavy equipment or land clearing could result in habitat loss, effects to migration patterns, indirect injury/mortality, reproductive effects, and invasive species effects. Implementation of BMPs and mitigation measures could help to avoid or minimize potential impacts.
  - New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public ROWs or private easements as well as the construction of access roads, POPs, huts, or facilitates to house outside plant equipment could result in potential impacts to wildlife resources. Impacts may vary depending on the number or individual poles installed and the extent of ground disturbance, but could include direct injury/mortality of individuals as described above; habitat loss, alteration, or fragmentation; effects to migratory patterns; indirect injury/mortality; and invasive species effects.
  - Collocation on Existing Aerial Fiber Optic Plant: Land clearing and excavation during replacement of poles and structural hardening could result in direct injury/mortality, habitat loss or alteration, effects to migratory patterns, indirect injury/mortality, and invasive species effects. Noise disturbance from heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in migratory effects and indirect injury/mortality.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water and construction of landings and/or facilities on the shore to accept the submarine cables could potentially impact wildlife, marine mammals in particular (see Section 11.2.4, Water Resources, for a discussion of potential impacts to water resources). Potential effects could include direct injury/mortality, habitat loss, alteration, or fragmentation depending on the site location. If activities occurred during critical time periods, effects to migratory patterns as well as reproductive effects and indirect injury/mortality could occur.
  - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required construction of access roads, trenching, and/or land clearing, such disturbance could result in direct injury/mortality of wildlife as described for other New Build activities. Habitat loss, alteration and fragmentation; effects to migration or migratory patterns, indirect injury/mortality, and invasive species effects could occur as a result of construction and resulting disturbance.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (e.g., generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to wildlife resources. Land/vegetation clearing, excavation activities, landscape grading, and other disturbance activities during the installation of new wireless towers and associated structures or access roads could result in direct injury/mortality, habitat loss, alteration or fragmentation, and effects to migratory patterns. Security lighting and fencing could result in direct and indirect injury or mortality, effects to migratory patterns, as well as reproductive effects. For a discussion of RF emissions, refer to Section 2.4, Radio Frequency Emissions.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to wildlife. However, if new power units, replacement towers, or structural hardening were required, impacts would be similar to new wireless construction. For a discussion of RF emissions, refer to Section 2.4, Radio Frequency Emissions.
  - Deployable Technologies: Implementation of deployable technologies including COWs, COLTs, or SOWs could result in direct injury/mortalities to wildlife on roadways from vehicular movement. If external generators are used, noise disturbance could potentially impact migratory patterns of wildlife. RF hazards could result in indirect injury or mortality as well as reproductive effects depending on duration and magnitude of operations. For a discussion of RF emissions, refer to Section 2.4, Radio Frequency Emissions.
  - Deployment of drones, balloons, blimps, or piloted aircraft could potentially impact wildlife by direct or indirect injury/mortality from collision, entanglement or ingestion and effects to migratory patterns and reproductive effects from disturbance and/or displacement due to noise. The magnitude of these effects depends on the timing and frequency of deployments.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers or poles; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to wildlife resources associated with deployment of this infrastructure are anticipated to be less than significant at the programmatic level given the small scale of likely individual FirstNet projects; however, some deployment activities could include direct injury/mortality, habitat loss, indirect injury/mortality, effects to migration, reproductive effects, and effects of invasive species depending on the project type, location, ecoregion, the species' phenology, and the nature and extent of the habitats affected. As stated above, these impacts would likely be limited to individual wildlife species and unlikely to cause population-level impacts. The specific deployment activity and where the deployment will take place will be determined based on location-specific conditions and the results of site-specific environmental reviews. Proposed FirstNet actions at some individual sites may have a higher level of impacts due to location-specific conditions, and therefore those proposed activities would undergo site-specific environmental review. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, *Proposed Action Infrastructure*, operational activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. The wildlife that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected.

It is anticipated that there would be less than significant impacts to wildlife resources at the programmatic level with routine inspections of the Preferred Alternative. Site maintenance would be infrequent, including mowing or limited application of herbicides, may result in less than significant effects to wildlife including direct injury/mortality to less mobile wildlife, or exposure to contaminants from accidental spills from maintenance equipment or release of pesticides. Potential spills of these materials would be expected to be in small quantities.

During operations, direct injury/mortality of wildlife could occur from collisions and/or entanglements with transmission lines, towers, and aerial platforms.

Wildlife resources could still be affected by the reduction in habitat quality associated with habitat fragmentation from the presence of access roads, transmission corridors, and support facilities. These features could also continue to disrupt movements of terrestrial wildlife, particularly during migrations between winter and summer ranges or in calving areas.

In addition, the presence of new access roads and transmission line ROWs may increase human use of the surrounding areas, which could increase disturbance to wildlife resulting in effects to migratory pathways, indirect injury/mortalities, reproductive effects, as well as the potential introduction and spread of invasive species as explained above. As stated above, these impacts would likely be limited to individuals and unlikely to cause population-level impacts, and therefore would likely than less than significant at the programmatic level given the short-term nature and limited geographic scope for individual activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Alternatives Impact Assessment

The following section assesses potential impacts to wildlife resources associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to wildlife resources as a result of implementation of this alternative could be as described below.

<u>Deployment Impacts</u>

As described above, implementation of deployable technologies could result in less than significant impacts from direct and indirect injury or mortality events, changes in migratory patterns, disturbance, or displacement. Greater frequency and duration of deployments could change the magnitude of impacts depending on species, life history, and region of North Carolina. However, impacts are expected to remain less than significant at the programmatic level because deployment activities are expected to be temporary and localized, likely affecting only a small number of wildlife. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

<u>Operational Impacts</u>

As described above, operational activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be less than significant at the programmatic level because deployable activities are expected to be temporary and likely affecting only a small number of wildlife. Proposed FirstNet actions at specific individual sites may have a higher level of impacts due to location-specific conditions, and therefore those proposed activities would undergo site-specific environmental review. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the nationwide, interoperable, public safety broadband network would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to wildlife resources as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 11.1.6.4, Terrestrial Wildlife.

11.2.6.5. Fisheries and Aquatic Habitats

Impacts to fisheries and aquatic habitats occurring in North Carolina and North Carolina's near offshore environment are discussed in this section. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Description of Environmental Concerns

Direct Injury/Mortality

Direct injury/mortality effects are physical injuries, extreme physiological stress, or death of an individual organism from interactions associated with the Proposed Action. The most common direct injuries are entanglement, vessel strike, problems associated with accidental ingestion, and injuries incurred by sensitive animals from disturbance events (USEPA, 2012f).

Based on the impact significance criteria presented in Table 11.2.6-1, less than significant impacts would be anticipated at the programmatic level given that the majority of proposed deployment activities are likely to be small-scale and potential impacts would be dependent on the location and type of deployment activity. Although anthropogenic disturbances may be measurable (although minimal) for some FirstNet projects, direct injury or mortality impacts at the population-level or sub-population-level would not likely be observed. BMPs and mitigation measures could help to avoid or further minimize potential impacts to fisheries and aquatic invertebrate population survival.

Vegetation and Habitat Loss, Alteration, or Fragmentation

As with all of the effects categories, the magnitude of the impact depends on the duration, location, and spatial scale of the system and associated activities. Habitat fragmentation is the breaking down of continuous and connected habitat, and impeding access to resources and mates.

Depending on the location, the construction of new infrastructure and long-term facility maintenance could result in the shoreline habitat alteration in localized areas; in some instances, the permanent loss of riparian vegetation could occur, which could lead to water quality impacts and in turn aquatic habitat alteration. Habitat loss is not likely to be widespread or affect populations of species as a whole; fish species would be expected to swim to a nearby location depending on the nature of the deployment activity. Therefore, potential impacts are expected to be less than significant. Additionally, deployment activities with the potential for impacts under the MSFCMA or other sensitive aquatic habitats could be addressed through BMPs and mitigation measures as defined through consultation with the appropriate resource agency.

Indirect Injury/Mortality

Erosion or sedimentation from land clearing and excavation activities near or within riparian areas, floodplains, wetlands, streams, and other aquatic habitats could have potential impacts on water quality. Exposure to contaminants from accidental spills from vehicles and equipment could also potentially affect water quality. These potential effects could result in changes to habitat, food sources, or prey resulting in indirect mortality/injury to fish and aquatic invertebrates. Indirect injury/mortality impacts vary depending on the species, time of year, and duration of deployment. Nonetheless, these impacts are expected to be less than significant at the programmatic level due to the short-term nature and limited geographic scope of deployment activities. These impacts are expected to be less than significant, and BMPs and mitigation measures to protect water resources (see Section 11.2.4, Water Resources) could help to minimize or avoid potential impacts.

Effects to Migration or Migratory Patterns

Migration is the regular movement of animals from one region to another and back again. Migratory patterns vary by species and sometimes within the same species. For example, restrictions or alterations to waterways could alter migration patterns, limit fish passage, or affect foraging and spawning site access. Impacts would vary depending on the species, time of year, and duration of deployment, but would be localized and small-scale, and therefore are expected to be less than significant at the programmatic level. BMPs and mitigation measures could help to further avoid or minimize the potential impacts.

Reproductive Effects

Reproductive effects are those that either directly or indirectly reduce an animal's ability to produce offspring or reduce the rates of growth, maturation, and survival of offspring, which could affect the overall population of individuals. Restrictions to spawning/breeding areas for fish and aquatic invertebrates and the alteration of water quality through sediment infiltration, obstruction of natural water flow, or loss of submerged vegetation resulting from the deployment of various types of infrastructure, are not anticipated, and therefore impacts are expected to be less than significant at the programmatic level. BMPs and mitigation measures could help to further avoid or minimize any potential impacts.

Invasive Species Effects

The potential to introduce invasive plants within construction zones could occur from vessels and equipment being transported from one region to another, or when conducting revegetation of a site after deployment activities are complete. FirstNet deployment activities could result in short-term or temporary changes to specific project sites, although these sites are expected to return to their natural state in a year or two. Invasive species are not expected to be introduced to project sites as part of the deployment activities from machinery or construction workers. Therefore, impacts are expected to be less than significant at the programmatic level. BMPs and mitigation measures would help to avoid or minimize the potential for introducing invasive aquatic plant and animal species during implementation of the Proposed Action.

Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including construction/deployment and operational activities.

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to fisheries and aquatic habitats and others would not. In addition, and as explained in this section, the same type of Proposed Action infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions. The fisheries and aquatic habitats that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

<u>Activities Likely to Have No Impacts</u>

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are expected to have no impacts to fisheries and aquatic habitats under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance, including noise, associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that effects to fisheries and aquatic habitats would be temporary and would not result in any perceptible change.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts on fisheries and aquatic habitats because there would be no ground disturbance.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact fisheries and aquatic habitats if those activities would not require ground disturbance.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact fisheries, it is anticipated that this activity would have no impact on the aquatic environment.

<u>Activities with the Potential to Have Impacts</u>

Potential/deployment-related impacts to fisheries and aquatic habitats as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct injury/mortality; vegetation and habitat loss, alteration, or fragmentation; effects to migratory patterns; indirect injury/mortality; reproductive effects; and invasive species effects. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to fisheries and aquatic habitats include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to fisheries and aquatic habitats. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities, particularly if they occur adjacent to water resources that support fish, could result in habitat loss, alteration and fragmentation; indirect injury/mortality; and invasive species effects. BMPs and mitigation measures could help to avoid or minimize potential impacts.
  - New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public ROWs or private easements as well as the construction of access roads, POPs, huts, or facilitates to house outside plant equipment could result in potential impacts to fisheries and aquatic habitats if activities occur near water resources that support fish. Impacts may vary depending on the number or individual poles installed or if access roads or stream crossings are needed, but could include habitat loss, alteration and fragmentation; indirect injury/mortality; and invasive species effects.
  - Collocation on Existing Aerial Fiber Optic Plant: Land clearing and excavation during replacement of poles and structural hardening could, if conducted near water resources that support fish, result in habitat loss, alteration and fragmentation; indirect injury/mortality; and invasive species effects.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water and construction of landings and/or facilities on the shore to accept submarine cables could result in direct injury/mortalities of fisheries and aquatic invertebrates that are not mobile enough to avoid construction activities (e.g., mussels), that utilize burrows (e.g., crayfish), or that are defending nest sites (some fish). Disturbance, including noise, associated with the above activities could result in habitat loss, effects to migration patterns, indirect injury/mortality, reproductive effects, and invasive species. BMPs and mitigation measures could help to avoid or minimize potential impacts.
  - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required construction of access roads, trenching, and/or land clearing, particularly near water resources that support fish, such disturbance could result in habitat loss, alteration and fragmentation; indirect injury/mortality, and invasive species effects.
- Wireless Projects

- New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads is not expected to result in impacts to fisheries and aquatic habitats as towers and structures would not be constructed in waterbodies. Land/vegetation clearing, excavation activities, landscape grading, and other disturbance activities during the installation of new wireless towers and associated structures or access roads, particularly if they occur near waterbodies that support fish, could result in habitat loss or indirect injury/mortality, and invasive species effects, although highly unlikely. Refer to Section 2.4, Radio Frequency Emissions, for more information on RF emissions.
- Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to fisheries and aquatic habitats. However, if new power units, replacement towers, structural hardening, or physical security measures required ground disturbance, impacts would be similar to new wireless construction. For a discussion of RF emissions, refer to Section 2.4, Radio Frequency Emissions.
- Deployable Technologies: Implementation of deployable technologies including COWs, COLTs, or SOWs could result in habitat loss, alteration and fragmentation; indirect injury/mortality, and invasive species effects if new access roads or other ground disturbing activities are necessary that generate erosion, sedimentation, or water quality impacts. For a discussion of RF emissions refer to Section 2.4, Radio Frequency Emissions.
- Deployment of drones, balloons, blimps, or piloted aircraft could potentially impact fisheries and aquatic habitat if deployment occurs within or adjacent to water resources. The magnitude of these effects depends on the timing and frequency of deployments, and could result in result in habitat loss, alteration and fragmentation, indirect injury/mortality, and invasive species effects.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or underwater cables; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to fisheries and aquatic habitats associated with deployment of this infrastructure could include direct injury/mortality, habitat loss, indirect injury/mortality, effects to migration, reproductive effects, and effects of invasive species depending on the ecoregion, the species' phenology, and the nature and extent of the habitats affected. These impacts are anticipated to be less than significant at the programmatic level due to the small scale and localized nature of deployment activities that have the potential to impact aquatic habitats. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operational activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. The fisheries and aquatic habitats that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected.

It is anticipated at the programmatic level,, that there would be less than significant impacts to fisheries and aquatic habitats associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. Construction of new access roads could cause erosion concerns. Site maintenance near fish habitat may result in less than significant effects to fisheries and aquatic habitats, due to accidental spills from maintenance equipment or pesticide runoff.

Fisheries and aquatic habitat could still be affected by the reduction in habitat quality associated with habitat fragmentation from the presence of access roads, transmission corridors, and support facilities. These features could also continue to disrupt movements of fish passage. In addition, the presence of new access roads and transmission line ROWs near water resources may increase human use of the surrounding areas, which could increase disturbance to fisheries and aquatic habitats resulting in effects to migratory pathways, indirect injury/mortalities, reproductive effects, as well as the potential introduction and spread of invasive species as explained above. Fisheries and aquatic habitat may also be impacted if increased access leads to an increase in the legal or illegal take of biota. However, impacts are expected to be less than significant at the programmatic level due to the small scale of expected activities with the potential to affect fisheries and aquatic habitat. As a result of the small scale, only a limited number of individuals are anticipated to be impacted, furthermore, habitat impacts would also be minimal in scale. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Alternatives Impact Assessment

The following section assesses potential impacts to fisheries and aquatic habitats associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to fisheries and aquatic habitats as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts from habitat loss, alteration and fragmentation, indirect injury/mortality, and invasive species effects. Greater frequency and duration of deployments could change the magnitude of impacts depending on species, life history, and region of North Carolina. However, impacts are expected to remain less than significant at the programmatic level due to the limited nature of expected deployment activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operational Impacts

Operational activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, the impacts could vary greatly among species and geographic region. Nonetheless, it is anticipated that there would be less than significant impacts to fisheries and aquatic habitats associated with routine operations and maintenance due to the limited nature of expected deployment activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the nationwide, interoperable, public safety broadband network would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to fisheries and aquatic habitats as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 11.1.6.5, Fisheries and Aquatic Habitats.

11.2.6.6. Threatened and Endangered Species and Species of Conservation Concern

This section describes potential impacts to threatened and endangered species in North Carolina and North Carolina's offshore environment associated with deployment and operation of the Proposed Action and alternatives. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on threatened and endangered species and their habitat were evaluated using the significance criteria presented in Table 11.2.6-2. The categories of impacts for threatened and endangered species and their habitats are defined as may affect, likely to adversely affect; may affect, not likely to adversely affect; and no effect. Characteristics of each effect type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes across the state, the potential impacts to threatened and endangered species addressed below are presented as a range of possible impacts.

Table 11.2.6-2: Impact Significance Rating Criteria for Threatened and Endangered Species

Type of Effect	Effect Characteristics	Impact Level		
		May Affect, Likely to Adversely Affect	**May Affect, Not Likely to Adversely Affect**	**No Effect**
Injury/Mortality of a Listed Species	Magnitude or Intensity	As per the ESA, this impact threshold applies at the individual level so applies to any mortality of a listed species and any impact that has more than a negligible potential to result in unpermitted take of an individual of a listed species. Excludes permitted take.	Does not apply in the case of mortality (any mortality unless related to authorized take falls under likely to adversely affect category). Applies to a negligible injury that does not meet the threshold of take due to its low level of effect and/or ability to fully mitigate the effect. Includes permitted take.	No measurable effects on listed species.
	Geographic Extent	Any geographic extent of mortality or any extent of injury that could result in take of a listed species.	Any geographic extent that does not meet the threshold of take due to its low level of effect and/or ability to fully mitigate the effect. Typically applies to one or very few locations.	
	Duration or Frequency	Any duration or frequency that could result in take of a listed species.	Any duration or frequency that does not meet the threshold of take due to its low level of effect and/or ability to fully mitigate the effect. Typically applies to infrequent, temporary, and short-term effects.	
Reproductive Effects	Magnitude or Intensity	Any reduction in breeding success of a listed species.	Changes in breeding behavior (e.g., minor change in breeding timing or location) that are not expected to result in reduced reproductive success.	No measurable effects on listed species.
	Geographic Extent	Reduced breeding success of a listed species at any geographic extent.	Changes in breeding behavior at any geographic extent that are not expected to result in reduced reproductive success of listed species. Typically applies to one or very few locations.	
	Duration or Frequency	Any duration or frequency that could result in reduced breeding success of a listed species.	Infrequent, temporary, or short-term changes in breeding behavior that do not reduce breeding success of a listed species within a breeding season.	

Type of Effect	Effect Characteristics	Impact Level		
		May Affect, Likely to Adversely Affect	May Affect, Not Likely to Adversely Affect	No Effect
Behavioral Changes	Magnitude or Intensity	Disruption of normal behavior patterns (e.g., breeding, feeding, or sheltering) that could result in take of a listed species.	Minor behavioral changes that would not result in take of a listed species.	No measurable effects on listed species.
	Geographic Extent	Any geographic extent that could result in take of a listed species.	Changes in behavior at any geographic scale that are not expected to result in take of a listed species. Typically applies to one or very few locations.	
	Duration or Frequency	Any duration or frequency that could result in take of a listed species.	Infrequent, temporary, or short-term changes that are not expected to result in take of a listed species.	
Loss or Degradation of Designated Critical Habitat	Magnitude or Intensity	Effects to any of the essential features of designated critical habitat that would diminish the value of the habitat for the survival and recovery of the listed species for which the habitat was designated.	Effects to designated critical habitat that would not diminish the functions or values of the habitat for the species for which the habitat was designated.	No measurable effects on designated critical habitat.
	Geographic Extent	Effects to designated critical habitat at any geographic extent that would diminish the value of the habitat for listed species. Note that the likely to adversely affect threshold for geographic extent depends on the nature of the effect. Some effects could occur at a large scale but still not appreciably diminish the habitat function or value for a listed species. Other effects could occur at a very small geographic scale but have a large adverse effect on habitat value for a listed species.	Effects realized at any geographic extent that would not diminish the functions and values of the habitat for which the habitat was designated. Typically applies to one or few locations within a designated critical habitat.	
	Duration or Frequency	Any duration or frequency that could result in reduction in critical habitat function or value for a listed species.	Any duration or frequency that would not diminish the functions and values of the habitat for which the habitat was designated. Typically applies to Infrequent, temporary, or short-term changes.	

Description of Environmental Concerns

Injury/Mortality of a Listed Species

Direct injury/mortality effects are physical injuries, extreme physiological stress, or death of an individual organism from interactions associated with the Proposed Action. The most common direct injuries are entanglement, vehicle strike, problems associated with accidental ingestion, and injuries incurred by sensitive animals from disturbance events.

Based on the impact significance criteria presented in Table 11.2.6 2, any direct injury or mortality of a listed species at the individual-level, as well as any impact that has the potential to result in unpermitted take of an individual species at any geographic extent, duration, or frequency, may affect and likely adversely affect a listed species. Direct injury/mortality environmental concerns pertaining to federally listed terrestrial mammals, marine mammals, birds, reptiles and amphibians, fish, invertebrates, and plants with known occurrence in North Carolina are described below. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

<u>Terrestrial Mammals</u>

Five endangered and one threatened terrestrial mammal species are federally listed and known to occur in North Carolina; they are the Carolina northern flying squirrel, gray bat, Indiana bat, northern long-eared bat, red wolf, and Virginia big-eared bat.

Direct mortality or injury to the federally listed Carolina northern flying squirrel, Indiana bat, or northern long-eared bat could occur if tree clearing activities occurred while there species were present (USFWS, 1990e) (USFWS, 2012b). Direct mortality or injury to the federally listed gray bat or Virginia big-eared bat could occur if caves were flooded or blocked off while bats were present (USFWS, 1984d) (USFWS, 1997d). While projects would not likely directly affect winter hibernacula (e.g., caves), human disturbance in and around these sites when bats are present could lead to adverse effects to these species; when disturbed by noise or light, bats awaken resulting in a loss of body fat needed to help them survive in the spring (USFWS, 1997d).

Direct mortality or injury to the federally listed red wolf could occur from vehicle strikes as wolves are occasionally found along transportation corridors. Entanglement in fences or other barriers could also be a source of mortality or injury to this species. Impacts would likely be isolated, individual events and therefore may affect, but are not likely to adversely affect, a listed species.

BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Marine Mammals

One federally listed marine mammal species is known to occur in North Carolina's near offshore environment; the West Indian manatee. Entanglements from marine debris as well as ingestion of marine debris are unlikely due to the limited nature of expected FirstNet activities in a marine environment. Impacts would likely be isolated, individual events. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Birds

Two endangered and three threatened bird species are federally listed and known to occur in North Carolina; they are the piping plover, red knot, red-cockaded woodpecker, roseate tern, and wood stork. Depending on the project type and location, direct mortality or injury to these birds could occur from collisions or electrocutions with manmade cables and wires, vehicle strikes, or by disturbance or destruction of nests during ground disturbing activities. However, these potential impacts may affect, but are not likely to adversely affect, listed species as FirstNet would attempt to avoid deployment activities in areas where they are known to nest. If proposed project sites were unable to avoid sensitive areas, BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Fish

Four endangered and two threatened fish species are federally listed and known to occur in North Carolina; they are the Atlantic sturgeon, Cape Fear shiner, Roanoke logperch, shortnose sturgeon, sicklefin redhorse, spotfin chub, and Waccamaw silverside. The majority of FirstNet deployment projects would not occur in an aquatic environment. Therefore, potential impacts may affect, but are not likely to adversely affect, listed species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Reptiles and Amphibians

Four endangered and one threatened marine reptiles are federally listed and known to occur in the coastal area and offshore environment of North Carolina; they include the hawksbill sea turtle, green sea turtle, Kemp's ridley sea turtle, leatherback sea turtle, and loggerhead sea turtle. The majority of FirstNet deployment projects would not occur in an aquatic environment. Direct mortality or injury could occur from accidental trampling at nest sites if eggs are present during deployment of the Proposed Action.

No federally listed amphibians or terrestrial reptiles are known to occur in North Carolina.

Invertebrates

Nine endangered and one threatened invertebrate species are federally listed and known to occur in North Carolina (Table 11.1.6-10). Nine of these species are mollusks. Three of these species are terrestrial invertebrates. The majority of FirstNet deployment projects would not occur in an aquatic environment. Direct mortality or injury to this species are unlikely but could occur from entanglements resulting from the Proposed Action. Potential impacts may affect, but are not likely to adversely affect, the listed species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Plants

Eighteen endangered and nine threatened plant species are federally listed and known to occur in North Carolina (Table 11.1.6-11). Direct mortality to federally listed plants could occur if land clearing or excavation activities associated with the Proposed Action occur in an area inhabited by one of these species. FirstNet would attempt to avoid areas where these species may occur; therefore, potential impacts may affect, but are not likely to adversely affect, listed species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Reproductive Effects

Reproductive effects are considered those that either directly or indirectly reduce the breeding success of a listed species either by altering its breeding timing or location, or reducing the rates of growth, maturation, and survival of offspring, which could affect the breeding success. Potential effects to federally listed terrestrial mammals, marine mammals, birds, terrestrial reptiles and marine reptiles, amphibians, fish, invertebrates, and plants with known occurrence in North Carolina are described below.

Terrestrial Mammals

Noise, light, and other human disturbances associated with the Proposed Action could affect federally listed terrestrial mammals within or in the vicinity of project activities. Impacts would be directly related to the frequency, intensity, and duration of these activities; however, they are anticipated to be small-scale and localized. Additionally, FirstNet would attempt to avoid these areas. Therefore, potential impacts may affect, but are not likely to adversely affect, listed species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Marine Mammals

The West Indian manatee often uses secluded canals, creeks, embayments, and lagoons, particularly near the mouths of coastal rivers and sloughs, for feeding, resting, mating, and calving (USFWS, 2001c). Noise, light, and other human disturbances associated with the Proposed Action could adversely affect manatees within or in the vicinity of project activities. Impacts would be directly related to the frequency, intensity, and duration of these activities. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Chapter 16, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Birds

Noise, light, or human disturbance within nesting areas could cause federally listed birds to relocate to less desirable locations, or cause stress to individuals reducing survival and reproduction. FirstNet would attempt to avoid these areas. Therefore, potential impacts may affect, but are not likely to adversely affect, listed species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Fish

Deployment activities resulting in increased disturbance (e.g., humans, noise), especially during spawning activity, and changes in water quality could cause stress resulting in lower productivity (see Section 11.2.4, Water Resources, for a discussion of potential impacts to water resources). Effects to reproduction of the federally listed fish species in North Carolina are unlikely as the majority of FirstNet deployment projects would not occur in an aquatic environment and FirstNet would attempt to avoid these areas. Therefore, potential impacts may affect, but are not likely to adversely affect, listed species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Reptiles and Amphibians

Five of the six federally listed sea turtles found in the offshore areas of North Carolina use North Carolina's beaches and barrier islands as nesting habitat. Changes in water quality, especially during the breeding seasons, could cause stress resulting in lower productivity. Further, land clearing activities, noise, and human disturbance during the critical time periods (e.g., mating, nesting) could lower fitness and productivity. FirstNet would attempt to avoid these areas. Therefore, potential impacts may affect, but are not likely to adversely affect, listed species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

No federally listed amphibians or terrestrial reptiles are known to occur in North Carolina.

Invertebrates

Changes in water quality could cause stress resulting in lower productivity for federally listed mussel species known to occur in North Carolina. In addition, introduction of invasive aquatic species could indirectly affect mussels as a result of fish populations that they rely on for their reproductive cycle being altered (USFWS, 2012c). Impacts to food sources utilized by the federally listed terrestrial invertebrates could lead to potential adverse effects on these species (USFWS, 2015cd). Potential impacts to federally listed invertebrate species may affect, but are not likely to adversely affect, those species, as FirstNet would attempt to avoid these areas. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Plants

Potential impacts could occur from ground-disturbing activities to listed plant species as a result of the Proposed Action. However, FirstNet would attempt to avoid these areas. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Behavioral Changes

Effects to normal behavior patterns that could lead to disruptions in breeding, feeding, or sheltering, resulting in take of a listed species would be considered potentially significant. Potential effects to federally listed terrestrial and marine mammals, birds, reptiles and amphibians, fish, invertebrates, and plants with known occurrence in North Carolina are described below.

Terrestrial Mammals

Noise associated with the Proposed Action could adversely affect federally listed terrestrial mammals within or in the vicinity of Proposed Project activities in North Carolina. Impacts would be directly related to the frequency, intensity, and duration of these activities. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Terrestrial mammals have the capacity to divert from sound sources during feeding and migration. FirstNet would attempt to avoid areas where these species are known to occur; therefore, potential impacts may affect, but would likely not adversely affect, these species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Marine Mammals

Noise associated with the installation of cables in the near/offshore waters of coastal North Carolina could affect marine mammal migration patterns, though impacts are likely to be short-term provided the noise sources are not wide ranging and below Level A and B sound exposure thresholds. 'Marine mammals have the capacity to divert from sound sources during migration. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Birds

Because many birds have extremely long migrations, protection efforts for critical sites along migratory routes must be coordinated over long distances often involving many different countries. For example, the red knot has been found to fly up to 9,300 miles from their breeding and wintering sites and often return to the same sites year and after year in North Carolina. Disturbance in stopover, foraging, or breeding areas (visual or noise) or habitat loss/fragmentation could cause stress to individuals causing them to abandon areas for less desirable habitat and potentially reduce over fitness and productivity. Activities related to the Proposed Action, such as aerial deployment or construction activities, could result in effects to federally listed birds. FirstNet would attempt to avoid areas where these species are known to occur; therefore, potential impacts may affect, but would likely not adversely affect, these species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Fish

Changes in water quality could impact food sources for the federally fish species in North Carolina. Further, increased human disturbance, noise, and vessel traffic could cause stress to these species causing them to abandon spawning locations or altering migration patterns. Behavioral changes to these listed species are unlikely as the majority of FirstNet deployment projects would not occur in aquatic environment. Therefore, potential impacts may affect, but are not likely to adversely affect, these species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Reptiles and Amphibians

Habitat loss or alteration, particularly from fragmentation or invasive species, could affect nesting and foraging sites of the federally listed marine reptile species, resulting in reduced survival and productivity; however, the localized nature of disturbance during deployment activities are not anticipated to stress federally listed reptiles. FirstNet would attempt to avoid areas where these species are known to occur; therefore, potential impacts may affect, but would likely not adversely affect, these species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

No federally listed amphibians or terrestrial reptiles are known to occur in North Carolina.

Invertebrates

Changes in water quality, habitat loss or alternation, and introduction of aquatic invasive species could impact food sources for federally listed mussels resulting in lower productivity. Disturbances to food sources utilized by the federally listed terrestrial species, especially during the breeding season, could impact foraging behavior. FirstNet would attempt to avoid areas where these species are known to occur; therefore, potential impacts may affect, but would likely not adversely affect, these species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Plants

No behavioral effects to federally listed plants are expected as a result of the Proposed Action.

Loss or Degradation of Designated Critical Habitat

Effects to designated critical habitat and any of its essential features that could diminish the value of the habitat for the listed species or its survival and recovery would be considered an adverse effect and could be potentially significant. Depending on the species or habitat, the adverse effect threshold would vary for geographic extent. In some cases, large-scale impacts could occur that would not diminish the functions and values of the habitat, while in other cases, small-scale changes could lead to potentially significant adverse effects, such as impacts to designated critical habitat for a listed species that is only known to occur in one specific location geographically. Potential effects to federally listed birds, reptiles, fish, invertebrates, and plants with designated critical habitat in North Carolina are described below.

Terrestrial Mammals

There is no designated critical habitat in North Carolina for terrestrial mammals.

Marine Mammals

No designated critical habitat occurs in North Carolina for the manatee.

Birds

Only one of the federally listed bird species has federally designated critical habitat in North Carolina. Critical habitat for the piping plover includes 18 units within Dare, Hyde, Carteret, Onslow, Pender, New Hanover, and Brunswick Counties. FirstNet would attempt to avoid areas where these species are known to occur; therefore, potential impacts may affect, but would likely not adversely affect, designated critical habitat. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

No critical habitat has been designated for the other federally listed bird species in North Carolina.

Reptiles and Amphibians

Of the six threatened and endangered reptiles, one species has federally designated critical habitat in North Carolina. Critical habitat for the loggerhead sea turtle has been designated in the coastal areas of Brunswick, Carteret, New Hanover, Onslow, and Pender Counties in North Carolina, as well as floating sargassum mats in the Atlantic Ocean.

Land clearing, excavation activities, and other ground disturbing activities in this region of North Carolina could lead to habitat loss or degradation, which could lead to adverse effects to these sea turtle species depending on the duration, location, and spatial scale of the associated activities. FirstNet would attempt to avoid areas where these species are known to occur; therefore, potential impacts may affect, but would likely not adversely affect, designated critical habitat. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Critical habitat in North Carolina has not been designated for the other federally listed reptile species and there are no federally listed amphibians.

Fish

Three of the federally listed fish species in North Carolina have federally designated critical habitat in North Carolina. Critical habitat for the Cape Fear shiner was designated in Chatham, Lee, Moore, and Randolph Counties. Critical habitat for the spotfin chub was designated in the Little Tennessee River main channel. Critical habitat for the Waccamaw silverside was designated in Columbus County. Although FirstNet deployment activities could result in short-term or temporary changes to specific project sites, these sites are expected to return to their natural state in a year or two. Invasive reptile or amphibian species are not expected to be introduced at project sites from machinery or laborers during deployment operationsFirstNet would attempt to avoid areas where these species are known to occur; therefore, potential impacts may affect, but would likely not adversely affect, designated critical habitat. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

No critical habitat has been designated for the other federally listed fish species in North Carolina.

Invertebrates

Three of the federally listed invertebrate species in North Carolina have federally designated critical habitat in North Carolina. Critical habitat for the Appalachian elktoe was designated in eight counties in western North Carolina. Critical habitat for the Carolina heelsplitter was designated in Goose Creek, Duck Creek, and Waxhaw Creek in Union County. Critical habitat for the spruce-fir moss spider was designated in five counties in western North Carolina. FirstNet would attempt to avoid areas where these species are known to occur; therefore, potential impacts may affect, but would likely not adversely affect, designated critical habitat. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

No critical habitat has been designated for the other federally listed invertebrate species in North Carolina.

Plants

Two of the federally listed plant species in North Carolina have federally designated critical habitat. Critical habitat for the golden sedge was designated in Onslow and Pender Counties, and critical habitat for the mountain golden heather was designated in Burke County.

Land clearing, excavation activities, and other ground disturbing activities in these regions of North Carolina could lead to habitat loss or degradation, which could affect these plants depending on the duration, location, and spatial scale of the associated activities. FirstNet would attempt to avoid areas where these species are known to occur; therefore, potential impacts may affect, but would likely not adversely affect, designated critical habitat. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

No critical habitat has been designated for the other federally listed plant species in North Carolina.

Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operational activities.

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential effects to threatened and endangered species and others would not. In addition, and as explained in this section, the same type of Proposed Action infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions. The threatened and endangered species that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Activities Likely to Have No Effect

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are expected to have no effect on threatened and endangered species or their habitat under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance, including noise, associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. Although threatened and endangered species and their habitat could be impacted, it is anticipated that effects to threatened and endangered species would be temporary, infrequent, and likely not conducted in locations designated as vital or critical for any period.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts on threatened and endangered species or their habitat because there would be no ground disturbance and very limited human activity.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact threatened and endangered if those activities would not require ground disturbance.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact protected species, it is anticipated that this activity would have no effect on protected species.

Activities with the Potential to Affect Listed Species

Potential deployment-related effects to threatened and endangered species and their habitats as a result of implementation of the Preferred Alternative would encompass a range of effects that could occur, including direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential effects to threatened and endangered species include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to threatened and endangered species. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct injury/mortalities of threatened and endangered species that are not mobile enough to avoid construction activities (e.g., mollusks, small

mammals, and young). Disturbance, including noise, associated with the above activities could result in direct injury/mortality, reproductive effects, or behavioral changes, and loss/degradation of designated critical habitat.

- New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public ROWs or private easements as well as the construction of access roads, POPs, huts, or facilitates to house outside plant equipment could result in potential effects to threatened and endangered species and their habitat. Impacts may vary depending on the number or individual poles installed, but could include direct injury/mortality, reproductive effects, and behavioral changes.
- Collocation on Existing Aerial Fiber Optic Plant: Land clearing and excavation during replacement of poles and structural hardening could result in direct injury/mortality, reproductive effects, behavioral changes. Noise disturbance from heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in reproductive effects or behavior changes.
- New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water and construction of landings and/or facilities on the shore to accept submarine cables could potentially affect threatened and endangered species and their habitat, particularly aquatic species (see Section 11.2.4, Water Resources, for a discussion of potential impacts to water resources). Effects could include direct injury/mortality, and if activities occurred during critical time periods, reproductive effects and behavioral changes could occur.
- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts, there would be no impacts to threatened and endangered species or their habitats. If installation of transmission equipment required construction of access roads, trenching, and/or land clearing, such disturbance could result in direct injury/mortality of threatened and endangered species as described for other New Build activities. Reproductive effects and behavioral changes could also occur as a result of construction and resulting disturbance.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to threatened and endangered species and their habitat. Land/vegetation clearing, excavation activities, landscape grading, and other disturbance activities during the installation of new wireless towers and associated structures or access roads could result in direct injury/mortality, reproductive effects, or behavioral changes. Security lighting and fencing could result in direct injury/mortality, disruption of normal behavior patterns, as well as reproductive effects. For a discussion of RF emissions, refer to Section 2.4, Radio Frequency Emissions.

- Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower; FirstNet activities would be infrequent, temporary, or short-term in nature and are unlikely to result in direct injury/mortality or behavioral changes to threatened and endangered species. However, if replacement towers or structural hardening are required, impacts could be similar to new wireless construction. Hazards related security/safety lighting and fencing may produce direct injury/mortality, reproductive effects, and behavioral changes. For a discussion of RF emissions, refer to Section 2.4, Radio Frequency Emissions.
- Deployable Technologies: Implementation of land-based deployable technologies including COWs, COLTs, or SOWs could result in direct injury/mortalities to threatened and endangered species on roadways. If external generators are used, noise disturbance could potentially result in reproductive effects or behavioral changes to threatened and endangered species. For a discussion of RF emissions, refer to Section 2.4, Radio Frequency Emissions.
- Deployment of drones, balloons, piloted aircraft, or blimps could potentially impact threatened and endangered species by direct injury/mortality, reproductive effects, or behavioral changes. The magnitude of these effects depends on the timing and frequency of deployments.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or underwater cables; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to threatened and endangered species associated with deployment of this infrastructure could include direct injury/mortality, reproductive effects, behavioral changes. FirstNet would attempt to avoid areas where these species are known to occur; therefore, potential impacts may affect, but are not likely adversely affect protected species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operational activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. Site maintenance, including mowing or application of herbicides, may affect, but are not likely to adversely affect threatened and endangered species, as they would be conducted infrequently, and BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

It is anticipated that operational activities are not likely to adversely affect threatened and endangered species through activities associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. Site maintenance, including mowing or herbicides, may affect, but is not likely to adversely affect the federally listed bats, as they would be conducted infrequently and in compliance with BMPs and mitigation measures developed through consultation with the appropriate resource agency.

During operations, direct injury/mortality of threatened and endangered species could occur from collisions and/or entanglements with transmission lines, towers, and aerial platforms. FirstNet would attempt to avoid areas where these species are known to occur. Therefore, listed species may be affected, but are not likely to be adversely affected. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Chapter 16, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Threatened and endangered species may be affected, but are not likely to be adversely affected, by the reduction in habitat quality associated with habitat fragmentation from the presence of access roads, transmission corridors, and support facilities. These features could also continue to disrupt movements of some species, particularly during migrations between winter and summer ranges. FirstNet would attempt to avoid areas where these species are known to occur. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Alternatives Impact Assessment

The following section assesses potential effects to threatened and endangered species associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential effects to threatened and endangered species as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies may affect, but is not likely to adversely affect, threatened and endangered species as a result of direct injury/mortality, reproductive effects and behavioral changes. Greater frequency and duration of deployments could change the magnitude of impacts depending on species, life history, and region of North Carolina. FirstNet would attempt to avoid areas where these species are known to occur. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Operational Impacts

As explained above, operational activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that activities may affect, but are not likely to adversely affect, threatened and endangered species and their habitats as a result of routine operations, management, and monitoring. FirstNet would attempt to avoid areas where these species are known to occur. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the nationwide, interoperable, public safety broadband network would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no effect on threatened and endangered species as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 11.1.6.6, Threatened and Endangered Species and Species of Concern.

11.2.7. Land Use, Recreation, and Airspace

11.2.7.1. Introduction

This section describes potential impacts to land use, recreation, and airspace resources in North Carolina associated with deployment and operation of the Proposed Action and Alternatives. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

11.2.7.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on land use, recreation, and airspace resources were evaluated using the significance criteria presented in Table 11.1.7-1. The categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to land use, recreation, and airspace resources addressed in this section are presented as a range of possible impacts.

Table 11.2.7-1: Impact Significance Rating Criteria for Land Use, Recreation, and Airspace

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less Than Significant with BMPs and Mitigation Measures Incorporated**	**Less Than Significant**	**No Impact**
Direct land use change	Magnitude or Intensity	Change in designated/permitted land use that conflicts with existing permitted uses, and/or would require a change in zoning. Conversion of prime or unique agricultural lands.	Effect that is potentially significant, but with mitigation is less than significant.	Minimal changes in existing land use, or change that is permitted by-right, through variance, or through special exception.	No changes to existing development, land use, land use plans, or policies. No conversion of prime or unique agricultural lands.
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Permanent: Land use altered indefinitely.		Short-Term: Land use altered for as long as the entire construction phase or a portion of the operations phase.	NA
Indirect land use change	Magnitude or Intensity	New land use directly conflicts with surrounding land use pattern, and/or causes substantial restriction of land use options for surrounding land uses.	Effect that is potentially significant, but with mitigation is less than significant.	New land use differs from, but is not inconsistent with, surrounding land use pattern; minimal restriction of land use options for surrounding land uses.	No conflicts with adjacent existing or planned land uses.
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Permanent: Land use altered indefinitely.		Short-Term: Land use altered for as long as the entire construction phase or a portion of the operations phase.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less Than Significant with BMPs and Mitigation Measures Incorporated**	**Less Than Significant**	**No Impact**
Loss of access to public or private recreation land or activities	Magnitude or Intensity	Total loss of access to recreation land or activities.	Effect that is potentially significant, but with mitigation is less than significant.	Restricted access to recreation land or activities.	No disruption or loss of access to recreational lands or activities.
	Geographic Extent	Most or all recreational land/sites in a state or territory; recreational lands/sites that are of national significance.		Effects realized at one or multiple isolated locations; recreational lands that are not nationally significant, but that are significant within the state/territory.	NA
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA
Loss of enjoyment of public or private recreation land (due to visual, noise, or other impacts that make recreational activity less desirable)	Magnitude or Intensity	Total loss of enjoyment of recreational activities; substantial reduction in the factors that contribute to the value of the recreational resource, resulting in avoidance of activity at one or more sites.	Effect that is potentially significant, but with mitigation is less than significant.	Small reductions in visitation or duration of recreational activity.	No loss of enjoyment of recreational activities or areas; no change to factors that contribute to the value of the resource.
	Geographic Extent	Most or all recreational land/sites in a state or territory; recreational lands/sites that are of national significance.		Effects realized at one or multiple isolated locations; recreational lands that are not nationally significant, but that are significant within the state/territory.	NA
	Duration or Frequency	Persists during or beyond the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less Than Significant with BMPs and Mitigation Measures Incorporated**	**Less Than Significant**	**No Impact**
Use of airspace	Magnitude or Intensity	Measurable, substantial change in flight patterns and/or use of airspace.	Effect that is potentially significant, but with mitigation is less than significant.	Alteration to airspace usage is minimal.	No alterations in airspace usage or flight patterns.
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Permanent: Airspace altered indefinitely.		Short-Term: Airspace altered for as long as the entire construction phase or a portion of the operations phase.	NA

NA = Not Applicable

11.2.7.3. Description of Environmental Concerns

Direct Land Use Change

Changes in land use could be influenced by the deployment, operation, and maintenance of facilities or other infrastructure, and the acquisition of rights-of-way or easement. The deployment, operation, and maintenance of structures, towers, roads, and other permanent features could conflict with exiting development or land use. The installation of poles, towers, structures, or other aboveground facilities or assets could have short- or long-term effects to existing development or land use based on the characteristics of the structures or facilities, such as the location, type, or height. In addition, the acquisition of ROWs or easements and the construction of roads to access facilities and locations could influence changes in land use. The effects from these actions would depend on the geographic location; compatibility with existing land uses; and characteristics of the right-of-way, easement, or access road. These characteristics, such as the length, width, and location could change the existing land use to another category or result in the short- or long-term loss of the existing land use.

Based on the impact significance criteria presented in Table 11.1.7-1, less than significant impacts would be anticipated given the size and nature of the majority of the proposed deployment activities. Direct land use changes would be minimized and isolated at specific locations and all required permits would be obtained; only short-term impacts during the construction phase would be expected

Indirect Land Use Change

Changes in surrounding land use patterns and options for surrounding land uses could be influenced by the deployment, operation, and maintenance of facilities and the acquisition of rights-of-way or easement. The deployment, operation, and maintenance of structures, towers, roads, and other permanent features could conflict with surrounding land use patterns and options for surrounding land uses. The installation of poles, towers, structures, or other aboveground facilities or assets could have short- or long-term effects to surrounding land use patterns or options for surrounding land uses based on the characteristics of the structures or facilities, such as the location, type, or height. In addition, the acquisition of ROWs or easements and the construction of roads to access facilities and locations could influence changes in surrounding land uses. The effects from these actions would depend on the geographic location; compatibility with surrounding land uses; and characteristics of the ROW, easement, or access road. These characteristics, such as the length, width, and location could conflict with surrounding land use patterns or restrict options for surrounding land uses.

Based on the impact significance criteria presented in Table 11.2.7-1, less than significant impacts would be anticipated, as any new land use would be small-scale and short-term during the construction phase.

Loss of Access to Public or Private Recreation Land or Activities

The deployment, operation, and maintenance of facilities and the acquisition of rights-of-way or easement could influence access to public or private recreation land or activities. Localized, short-term accessibility to recreation land or activities could be impacted by the deployment and maintenance of structures, towers, roads, and other permanent features. In the long-term, the deployment and installation of poles, towers, structures, or other aboveground facilities could alter the types and locations of recreation activities.

Based on the impact significance criteria presented in Table 11.2.7-1, less than significant impacts would be anticipated as restricted access or a loss of access to recreation areas would not occur; only short-term impacts or small-scale limitations during the construction phase would be expected.

Loss of Enjoyment of Public or Private Recreation Land

The deployment of new towers, and the resulting built tower, could influence the enjoyment of public or private recreation land. Enjoyment of recreation land could be temporarily impacted by crews accessing the site during the deployment and maintenance of structures, towers, roads, and other permanent features. The deployment of poles, towers, structures, or other aboveground facilities could affect the enjoyment of recreational land based on the characteristics of the structures or facilities, including permanent impacts to scenery, short-term noise impacts, and the presence of deployment or maintenance crews.

Based on the impact significance criteria presented in Table 11.2.7-1, less than significant impacts would be anticipated as only small reductions, if any, in recreational visits or durations would occur due to the relatively small-scale nature of likely FirstNet activities. Only short-term impacts during the construction phase would be expected.

Use of Airspace

Primary concerns to airspace include the following: if aspects of the Proposed Action would result in violation of FAA regulations; undermine the safety of civilian, military, or commercial aviation; or infringe on flight activity and flight corridors. Potential impacts could include air routes or flight paths, available flight altitudes, disruption of normal flight patterns, and restrictions to flight activities. Construction of new towers or alternations to existing towers could obstruct navigable airspace depending on the tower location. Use of aerial technologies could result in SUA considerations.

Based on impact significance criteria presented in Table 11.2.7-1, airspace impacts are not likely to change or alter flight patterns or airspace usage. As drones, balloons, and piloted aircraft would likely only be deployed in an emergency and for a short period, FirstNet would be unlikely to have a significant impact on airspace resources.

Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operation activities.

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure, and the specific deployment requirements, some activities would result in potential impacts to land use, recreation, and airspace resources and others would not. In addition, and as explained in this section, the same type of Proposed Action could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have no impacts to land use, recreation, and airspace resources under the conditions described below:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring alongside the road in utility corridors or within public road rights-of-way.
    - Land Use: See *Activities With the Potential to Have Impacts* below.
    - Recreation: See *Activities With the Potential to Have Impacts* below.
    - Airspace: No impacts to airspace would be anticipated since the activities would not affect flight patterns or cause obstructions that would require FAA and/or North Carolina review based on FAR 14 CFR, Part 77, Safe, Efficient Use, and Preservation of the Navigable Airspace (See Section 11.1.7.5 Obstructions to Airspace Considerations).
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas.
    - Land Use: It is anticipated that there would be no impacts to land use since the activities that would be conducted would not directly or indirectly result in changes to existing and surrounding land uses.
    - Recreation: See *Activities With the Potential to Have Impacts* below.
    - Airspace: It is anticipated that there would be no impacts to airspace since the activities would not affect flight patterns or cause obstructions that would require FAA and/or state review based on FAR 14 CFR, Part 77, *Safe, Efficient Use, and Preservation of the Navigable Airspace* (See Section 11.1.7.5 Obstructions to Airspace Considerations).

- New Build – Aerial Fiber Optic Plant: Installing new poles and hanging cables on previously disturbed or new (undisturbed) ROWs or easements and the potential construction of access roads.
  - Land Use: See *Activities With the Potential to Have Impacts* below.
  - Recreation: See *Activities With the Potential to Have Impacts* below.
  - Airspace: Installation of new poles would not have an effect on airspace because utility poles are an average of 40 feet in height and do not intrude into useable airspace.
- Collocation on Existing Aerial Fiber Optic Plant: Installation of new fiber on existing poles would be limited to previously disturbed areas.
  - Land Use: It is anticipated that there would be no impacts to land use since the activities that would be conducted would not directly or indirectly result in changes to existing and surrounding land uses.
  - Recreation: No impacts to recreation would be anticipated since the activities that would be conducted would not cause disruption or loss of access to recreational lands or activities or the enjoyment of those lands or activities.
  - Airspace: No impacts are anticipated to airspace from collocations.
- Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber and installation of new equipment in existing huts.
  - Land Use: It is anticipated that there would be no impacts to land use since the activities would not directly or indirectly result in changes to existing and surrounding land uses.
  - Recreation: Use of existing dark fiber would not impact recreation because it would not impede access to recreational resources.
  - Airspace: Lighting of dark fiber would have no impacts to airspace.
- New Build – Submarine Fiber Optic Plant: Installing cables in or near bodies of water and the constructing landings and/or facilities on shores or the banks of waterbodies that accept submarine cable.
  - Land Use: See *Activities With the Potential to Have Impacts* below.
  - Recreation: See *Activities With the Potential to Have Impacts* below.
  - Airspace: The installation of cables in or near bodies of water and construction of landings and/or facilities on shores or the banks of water bodies that accept submarine cable would not impact flight patterns or cause obstructions that would require FAA and/or North Carolina review based on FAR 14 CFR, Part 77, Safe, Efficient Use, and Preservation of the Navigable Airspace (See Section 11.1.7.5 Obstructions to Airspace Considerations).

  - Installation of Optical Transmission or Centralized Transmission Equipment: Installation of transmission equipment would occur in existing boxes or huts. The section below addresses potential impacts to land use, recreation resources, and airspace if deployment of new boxes, huts, or access roads is required.
    - Land Use: See *Activities With the Potential to Have Impacts* below.
    - Recreation: See *Activities With the Potential to Have Impacts* below.
    - Airspace: No impacts to airspace would be anticipated since the activities would not affect flight patterns or cause obstructions that would require FAA and/or state review based on FAR 14 CFR, Part 77, Safe, Efficient Use, and Preservation of the Navigable Airspace (See Section 11.1.7.5 Obstructions to Airspace Considerations).
- Wireless Projects
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, structure, or building.
    - Land Use: There would be no impacts to existing and surrounding land uses. The potential addition of power units, structural hardening, and physical security measures would not impact existing or surrounding land uses.
    - Recreation: See *Activities With the Potential to Have Impacts* below.
    - Airspace: See *Activities With the Potential to Have Impacts* below.
- Deployable Technologies
  - Deployable Technologies: These technologies would be used where permanent, fixed infrastructure cannot be deployed due to a variety of factors such as the need to supplement coverage or to avoid or mitigate permanent impacts to sensitive resources or receptors.
    - Land Use: It is anticipated that there would be no impacts to existing or surrounding land uses because these technologies would be temporarily located in areas compatible with other land uses.
    - Recreation: No impacts to recreation are anticipated as deployable technologies would not affect the use or enjoyment of recreational lands.
    - Airspace: Use of land-based deployable technologies (COWs, COLTs, and SOWs) is not expected to result in impacts to airspace, provided antenna masts do not exceed 200 feet AGL or do not trigger any of the other FAA obstruction to airspace criteria listed in Section 11.1.7.5 Obstructions to Airspace Considerations.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: Installation of permanent equipment on existing structures and the use of portable devices that use satellite technology.

    - Land Use: It is anticipated that there would be no impacts to existing or surrounding land uses because these technologies would be temporarily located in areas compatible with other land uses.
    - Recreation: It is anticipated that there would be no impacts to recreational uses because these technologies would be temporarily deployed but would not restrict access to, or enjoyment of, recreational lands.
    - Airspace: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact airspace because those activities would not result in changes to flight patterns and airspace usage or result in obstructions to airspace.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact land use, recreation, or airspace, it is anticipated that this activity would have no impact on land use, recreation, or airspace.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to land use, recreation resources, or airspace as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including changes to existing and surrounding land uses. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to land use resources include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring alongside the road in utility corridors or within public road rights-of-way.
    - Land Use: Construction activities could temporarily restrict existing and surrounding land uses at isolated locations.
    - Recreation: It is anticipated that plowing, trenching, or directional boring may cause temporary, localized restrictions to recreational land or activities, which may persist during the deployment phase. It is reasonable to anticipate that small reductions in visitation to localized areas may occur during the deployment phase.
    - Airspace: No impacts are anticipated – see previous section.
  - New Build – Aerial Fiber Optic Plant: Installing new poles and hanging cables on previously disturbed or new (undisturbed) rights-of-way or easements and the potential construction of access roads.
    - Land Use: These activities could result in term potential impacts to land uses. Construction activities could temporarily restrict existing and surrounding land uses at isolated locations. New structures, poles, or access roads on previously

undisturbed rights-of-way or easements could have long-term impacts to existing and surrounding land uses. The magnitude of the impact would depend on the specific location and the compatibility of the new structures with existing and surrounding land uses.

    - Recreation: Deployment activities may cause temporary, localized restricted access to recreation land or activities, which may persist for the duration of the deployment phase. Small reductions to visitation during the deployment phase may be anticipated.
    - Airspace: No impacts are anticipated – see previous section.

  - New Build – Submarine Fiber Optic Plant: Installing cables in or near bodies of water and the constructing landings and/or facilities on shores or the banks of waterbodies that accept the submarine cable.
    - Land Use: Construction activities could temporarily restrict existing and surrounding land uses at isolated locations. New landings and/or facilities on shore could have long-term impacts to existing and surrounding land uses. The magnitude of the impact would depend on the specific location and the compatibility of the new facilities with existing and surrounding land uses.
    - Recreation: Deployment may temporarily restrict recreation on or within bodies of water and the surrounding area during the deployment phase. Reductions in visitation may result during deployment.
    - Airspace: No impacts are anticipated – see previous section.
  - Installation of Optical Transmission or Centralized Transmission Equipment: Installation of equipment including construction of new boxes, huts, or access roads.
    - Land Use: Construction activities could temporarily restrict existing and surrounding land uses at isolated locations. New boxes, huts, or access roads could have long-term impacts to existing and surrounding land uses. The magnitude of the impact would depend on the specific location and the compatibility of the new facilities with existing and surrounding land uses.
    - Recreation: Deployment of installation equipment and the construction of boxes, huts, or access roads may restrict access to recreation land or activities. Reductions in visitation during deployment may occur.
    - Airspace: No impacts are anticipated – see previous section.
- Wireless Projects
  - New Wireless Communication Towers: Installing new wireless towers, associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads.
    - Land Use: Construction activities could temporarily restrict existing and surrounding land uses at isolated locations. New wireless towers, associated structures, or access

roads could have long-term impacts to existing and surrounding land uses. The magnitude of the impact would depend on the specific location and the compatibility of the new facilities with existing and surrounding land uses.

    - Recreation: Deployment of new towers and associated structures could result in temporary, localized restricted access for recreation land or activities for the duration of the deployment phase. Reductions in visitation or duration of recreational activity may result from restricted access.
    - Airspace: Installation of new wireless towers could result in impacts to airspace if towers exceed 200 feet AGL or meets the other criteria listed in Section 11.1.7.5 Obstructions to Airspace Considerations. An OE/AAA could be required for the FAA to determine if the proposed construction does affect navigable airways or flight patterns of an airport if the aerial fiber optic plant is located in proximity to one of North Carolina's airports.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower.
    - Land Use: No impacts are anticipated – see previous section.
    - Recreation: Installation of antennas or microwaves to existing towers may cause temporary, localized restricted access to recreation lands or activities during installation, which may cause small reductions in visitation for the duration of installation.
    - Airspace: Collocation of mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, addition of power units, structural hardening, and physical security measures could result in impacts if located near airports or air navigation facilities.
- Deployable Technologies
  - Deployable Technologies: These technologies would be used where permanent, fixed infrastructure cannot be deployed due to a variety of factors such as the need to supplement coverage or to avoid or mitigate permanent impacts to sensitive resources or receptors.
    - Land Use: No impacts are anticipated – see previous section.
    - Recreation: No impacts are anticipated – see previous section.
    - Airspace: Implementation of deployable aerial communications architecture could result in temporary or intermittent impacts to airspace. Deployment of tethered systems (such as balloons or blimps) could pose an obstruction hazard if deployed above 200 feet and near North Carolina airports (See obstruction criteria in Section 11.1.7.5 Obstructions to Airspace Considerations). Potential impacts to airspace (such as SUAs and MTRs) may be possible depending on the planned use of drones,

piloted aircraft, untethered balloons, and blimps (e.g., frequency of deployment, altitudes, proximity to airports and airspaces classes/types, length of deployment, etc.). Coordination with the FAA would be required to determine the actual impact and the required certifications. It is expected that FirstNet would attempt to avoid changes to airspace and the flight profiles (boundaries, flight altitudes, operating hours, etc.).

- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: The installation of permanent equipment on existing structures and the use of portable devices that use satellite technology.
    - Land Use: No impacts are anticipated – see previous section
    - Recreation: It is anticipated the installation of equipment on existing structures may cause temporary, localized restricted access to recreation lands or activities during installation, which may cause small reductions in visitation for the duration of installation.
    - Airspace: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology may impact airspace if equipment creates an obstruction

In general, the abovementioned activities could potentially involve construction activities. Potential impacts to land uses associated with deployment could include temporary restrictions to existing and surrounding land uses in isolated locations. Potential impacts to recreation land and activities could include temporary, localized restricted access and reductions in visitation or duration of recreational activities. Potential impacts to airspace could include obstruction. These potential impacts are expected to be less than significant due to the temporary and small-scale nature of deployment activities. Additionally FirstNet (or its network partners), would prepare an OE/AAA for any proposed tower that might affect navigable airways or flight patterns of an airport. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. It is anticipated that there would be no impacts to land use, recreation resources, or airspace associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for temporary, short-term inspections because there would be no ground disturbance, no airspace activity, and no access restrictions to recreational lands. If routine maintenance or inspection activities would conflict with existing or surrounding land uses, impact recreation resources, or conflict with airspace, impacts could result as explained above.

Operation of the Deployable Technologies options of the Preferred Alternative could result in the temporary presence of deployable vehicles and equipment (including airborne equipment), potentially for up to two years in some cases. Operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. It is anticipated that there would be no impacts to land use, recreation resources, or airspace associated with routine inspections, assuming that the same access roads used for deployment are also used for temporary, short-term inspections because there would be no ground disturbance, no airspace activity, and no access restrictions to recreational lands.

The degree of change in the visual environment (see Section 11.2.8, Visual Resources)—and therefore the potential indirect impact on a landowner's ability to use or sell of their land as desired—would be highly dependent on the specific deployment location and length of deployment. The use of deployable aerial communications architecture could temporarily add new air traffic or aerial navigation hazards. The magnitude of these effects would depend on the specific location of airborne resources along with the duration of their use. FirstNet would coordinate with the FAA to review required certifications. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

11.2.7.4. Alternatives Impact Assessment

The following section assesses potential impacts to land use, recreation resources, and airspace associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to land use, recreation, and airspace resources as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts to land use. While a single deployable technology may have imperceptible impact, multiple technologies operating in close proximity for longer periods could impact existing and surrounding land uses. There could be impacts to recreation activities during the deployment of technologies if such deployment were to occur within or near designated recreation areas. Enjoyment of activities dependent upon the visibility of wildlife or scenic vistas may be affected, however, impacts would be less than significant due to the temporary nature of likely deployment activities. If deployment triggers any obstruction criterion or result in changes to flight patterns and airspace restrictions, FirstNet (or its partners) would consult with the FAA to determine how to proceed. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be no impacts to land use, recreation resources, or airspace associated with routine inspections of the Deployable Technologies Alternative, assuming that the same access roads used for deployment are also used for inspections. Operation of deployable technologies would result in land use, land ownership, airspace, and recreation (access and enjoyment) similar in type to those described for the Preferred Alternative. The frequency and extent of those potential impacts would be greater than for the Proposed Action because under this Alternative, deployable technologies would be the only options available. As a result, this alternative would require a larger number of terrestrial and airborne deployable vehicles and a larger number of deployment locations in—all of which would potentially affect a larger number of properties and/or areas of airspace. Overall, these potential impacts would be less than significant due to the temporary nature of deployment activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure, or satellites and other technologies. As a result, there would be no impacts to land use, recreation resources, or airspace. Environmental conditions would therefore be the same as those described in Section 11.1.7, Land Use, Recreation, and Airspace.

11.2.8. Visual Resources

11.2.8.1. Introduction

This section describes potential impacts to visual resources in North Carolina associated with deployment and operation of the Proposed Action and Alternatives. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

11.2.8.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on visual resources were evaluated using the significance criteria presented in Table 11.1.8-1. The categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to visual resources addressed in this section are presented as a range of possible impacts.

Table 11.2.8-1: Impact Significance Rating Criteria for Visual Resources

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Adverse change in aesthetic character of scenic resources or viewsheds	Magnitude or Intensity	Fundamental and irreversibly negative change in aesthetic character.	Effect that is potentially significant, but with mitigation is less than significant.	Intermittently noticeable change in aesthetic character that is marginally negative.	No visible effects.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated locations.	No visible effects.
	Duration or Frequency	Permanent or persistent changes to aesthetic character lasting throughout or beyond the construction or deployment phase.		Persisting through the construction and deployment phase, but aesthetics of the area would be returned to original state following the construction and deployment phase.	Transient or no visible effects.
Nighttime lighting	Magnitude or Intensity	Lighting dramatically alters night-sky conditions.	Effect that is potentially significant, but with mitigation is less than significant.	Lighting alters night-sky conditions to a degree that is only intermittently noticeable.	Lighting does not noticeably alter night-sky conditions.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated locations.	No visible effects.
	Duration or Frequency	Permanent or persistent changes to night-sky conditions lasting throughout or beyond the construction or deployment phase.		Persisting through the construction and deployment phase, but lighting would be removed and night-sky conditions would be returned to original state following the construction and deployment phase.	Transient or no visible effects.

11.2.8.3. Description of Environmental Concerns

Adverse Change in Aesthetic Character of Scenic Resources or Viewsheds

A primary concern during and following construction of structures, towers, roads or other permanent features is the long-term disruption of scenery and viewsheds. In North Carolina, residents and visitors travel to many national monuments, historic sites, and national and state parks, view its scenic viewsheds, mountains, coast, and beaches. If lands considered visually significant or scenic were subject to vegetation loss or removal, short- or long-term effects to viewsheds or scenic resources could occur. Bare ground or interruption of a landscape due to vegetation removal could be considered an adverse change in the aesthetic character of scenic resources or viewsheds. New towers or structures constructed within scenic areas could disrupt the perceived aesthetic character or scenery of an area. If new towers were constructed to a height that required lighting, nighttime vistas could be affected in areas where the night skies do not have light disruptions or are within unpopulated areas.

Based on the impact significance criteria presented in Table 11.2.8-1, impacts to the aesthetic character of scenic resources or viewsheds would be considered potentially significant if landscapes were permanently removed or fragmented, or if damage to historic or cultural resources occurred. Given the small scale of likely FirstNet activities, impacts are expected to be less than significant.

Nighttime Lighting

If new towers or facilities were constructed to a height that required lighting, nighttime vistas could be affected in areas where the night skies do not have light disruptions or are within unpopulated areas. If nighttime lighting were necessary for the operation or function of a facility that caused regional impacts or permanent changes to night sky conditions, those effects could be considered potentially significant.

Based on the impact significance criteria presented in Table 11.2.8 1, lighting that illuminates the night sky, diminishes night sky viewing over long distances, and persists over the long-term could be considered potentially significant. Although likely FirstNet actions are expected to be small-scale, certain discrete locations may experience potentially significant impacts to night skies, although potentially minimized to less than significant with implementation of BMPs and mitigation measures, as defined in Chapter 16, BMPs and Mitigation Measures. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented.

11.2.8.4. Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operation activities.

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to visual resources and others would not. In addition, and as explained in this section, the same type of Proposed Action could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have no impacts to visual resources under the conditions described below:

- Wired Projects
  - Collocation on Existing Aerial Fiber Optic Plant: While the addition of new aerial fiber optic plant to an existing aerial fiber optic transmission system would likely be visible, the change associated with this option is so small as to be essentially imperceptible. This option would involve no new nighttime lighting and pole replacement would be limited.
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be no impacts to visual resources since the activities would be conducted at small entry and exit points and are not likely to produce perceptible changes, and would not require nighttime lighting.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to visual resources because there would be no ground disturbance, would not require nighttime lighting, and would not produce any perceptible changes.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact visual resources since those activities would not require ground disturbance or vegetation removal.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact visual resources, it is anticipated that this activity would have no impact on visual resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to visual resources as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur as a result of ground disturbance, vegetation removal, or installation of permanent structures if development occurs in scenic areas. The types of deployment activities that could be part of the Preferred Alternative and result in potential impacts to visual resources include the following:

- Wired Projects
    - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to visual resources. The degree of impact would depend on the timing, location, and type of Proposed Actions; installation of a hut or POP would be permanent, whereas ground-disturbing activities would be short-term. In most cases, development located next to existing roadways would not affect visual resources unless vegetation were removed or excavation occurred in scenic areas.
    - New Build – Aerial Fiber Optic Plant: Construction and installation of new or replacement poles and hanging cables could result in impacts to the aesthetic character of scenic resources or viewsheds depending on the location of the installation. In most cases, development in public rights-of-ways would not affect visual resources unless vegetation were removed or construction occurred in scenic areas. If new lighting were necessary, impacts to night skies could occur. Construction of new roadways could result in linear disruptions to the landscape, surface disturbance, and vegetation removal; all of which could impact the aesthetic character of scenic resources or viewsheds, depending on the location of the installation.
    - New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water would not impact visual resources. However, impacts to the aesthetic character of scenic resources or viewsheds could potentially occur as result of the construction of landings and/or facilities on shore to accept submarine cable.
    - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required grading, vegetation removal, or other ground disturbance to install small boxes or huts, or access roads, potential impacts to visual resources could occur but effects would be temporary and localized.
- Wireless Projects
    - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to visual resources. Land/vegetation clearing, excavation activities, landscape grading, and other surface disturbing activities during the installation of new wireless towers and associated structures or access roads could result in the degradation of the aesthetic character of scenic resources or viewsheds. Impacts may be experienced by

viewers if new towers were located in or near a national park unit or other sensitive area. If new towers were constructed to a height that required aviation lighting, nighttime vistas could be impacted in areas where the night skies do not have light disruptions or are within unpopulated areas. If new towers were constructed to a height that required aviation lighting, nighttime vistas could be impacted in areas where the night skies do not have light disruptions or are within unpopulated areas. If nighttime lighting were necessary for the operation or function of a facility, impacts to night sky conditions could occur.

- Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower and would not likely result in additional impacts to visual resources. However, if additional power units, structural hardening, or physical security measures required ground disturbance or removal of vegetation, impacts to the aesthetic character of scenic resources or viewsheds could occur.
- Deployable Technologies: Implementation of deployable technologies could result in potential impacts to visual resources if long-term deployment occurs in scenic areas, or if the implementation requires minor construction of staging or landing areas, results in vegetation removal, areas of surface disturbance, or additional nighttime lightning.

In general, the abovementioned activities could potentially involve land/vegetation clearing, and potential scenic intrusion of towers, poles, roads, infrastructure, and other structures. Potential impacts to visual resources associated with deployment could include interruptions of landscapes, degradation of the aesthetic character of scenic resources or viewsheds, and overall changes in valued scenic resources, particularly for permanent fixtures such as towers or facilities. These impacts are expected to be less than significant, although certain discrete locations could have potentially greater impacts to night skies or as a result of new towers. As discussed above, potential impacts to night skies from lighting are expected to be less than significant at the programmatic level with BMPs and mitigation measures incorporated. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that there would be no impacts to visual resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. Nighttime lighting in isolated rural areas or if sited near a national park would be less than significant with BMPs and mitigation measures incorporated during operations. Additionally, FirstNet would work closely with the NPS to address any concerns they might have if a tower needed to be placed in an area that might affect the nighttime sky at a NPS unit. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

11.2.8.5. Alternatives Impact Assessment

The following section assesses potential impacts to visual resources associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to infrastructure as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in potential impacts to visual resources if long-term deployment occurs in scenic areas. If staging or landing areas (depending on the type of technology) require surface disturbance or vegetation clearing, or if these areas were within scenic landscapes or required new nighttime lighting, impacts could occur to the aesthetic character of scenic resources or viewsheds. These impacts are expected to be less than significant as generally they would be limited to the deployment location and could often be screened or otherwise blocked from view. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be no impacts to visual resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. The potential visual impacts—including aesthetic conditions and nighttime lighting—of the operation of deployable technologies would be less than significant given the limited geographic scope for individual activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to visual resources as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 11.1.8, Visual Resources.

11.2.9. Socioeconomics

11.2.9.1. Introduction

This section describes potential impacts to socioeconomics in North Carolina associated with deployment and operation of the Proposed Action and Alternatives. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

11.2.9.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on socioeconomics were evaluated using the significance criteria presented in Table 11.2.9-1. The categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to socioeconomics addressed in this section are presented as a range of possible impacts.

Table 11.2.9-1: Impact Significance Rating Criteria for Socioeconomics

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with Mitigation Measures Incorporated	Less than Significant	No Impact
Impacts to real estate (could be positive or negative)	Magnitude or Intensity	Changes in property values and/or rental fees, constituting a significant market shift.	Effect that is potentially significant, but with mitigation is less than significant.	Indiscernible impact to property values and/or rental fees.	No impacts to real estate in the form of changes to property values or rental fees.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA
Changes to spending, income, industries, and public revenues	Magnitude or Intensity	Economic change that constitutes a market shift.	Effect that is potentially significant, but with mitigation is less than significant.	Indiscernible economic change.	No change to tax revenues, wages, major industries, or direct spending.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated cities/towns.	NA
	Duration or Frequency	Persists during or beyond the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA
Impacts to employment	Magnitude or Intensity	High level of job creation at the state or territory level.	Effect that is potentially significant, but with mitigation is less than significant.	Low level of job creation at the state/territory level.	No job creation due to project activities at the state/territory level.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated cities/towns.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA
Changes in population number or composition	Magnitude or Intensity	Substantial increases in population, or changes in population composition (age, race, gender).	Effect that is potentially significant, but with mitigation is less than significant.	Minor increases in population or population composition.	No changes in population or population composition.
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA

NA = Not Applicable

11.2.9.3. Description of Environmental Concerns

This section discusses at a high level the types of socioeconomic impacts that could result from deployment of the NPSBN. Socioeconomic impacts could be negative or positive. Subsections below address socioeconomic impacts in four general areas, following the breakdown of the significance rating criteria in the table above:

- Impacts to Real Estate;
- Economic Benefits or Adverse Impacts related to Changes in Spending, Income, Industries, and Public Revenues;
- Impacts to Employment; and
- Changes in Population Number or Composition.

In addition to the specific impacts noted below, the Proposed Action would likely have broad, beneficial impacts to all four areas in times of disaster, by improving the response of public safety personnel. Reduced damages and faster recovery would result. This would support property values; maintain corporate income, personal income, and government revenues; preserve jobs; and reduce disruptions to populations.

Impacts to Real Estate

Deployment of the NPSBN has the potential to improve property values in areas that have property values below typical market values due to below average public safety communication services. Improved services would reduce response times and improve responses (provide a better fit of the response to the need). These effects would reduce the potential for economic losses and thus support investments in property and greater market value for property. Any increases in property values are most likely in areas that have low property values and below average public safety communication services. Increases are less likely in areas that already have higher property value. As discussed in Affected Environment, property values vary across North Carolina. Median values of owner-occupied housing units in the 2009–2013 period ranged from $226,000 in the greater Raleigh area, to just under $123,000 in the Hickory area. These figures are general indicators only. Property values are probably both higher and lower in specific localities. Any property value effects of deployment of the NPSBN would occur at a localized level.

Some telecommunications infrastructure, such as wireless communications towers, may adversely affect property values, depending on infrastructure location and other characteristics. Researchers believe these negative impacts relate to perceptions of the aesthetics of towers, or fears over electromagnetic radiation. Economists and appraisers have studied this issue and use a statistical analysis methodology known as hedonic pricing, or hedonic modelling, to assess how different attributes of properties such as distance from a tower affect property value (Bond, Sims, & Dent, 2013). Essentially, analysts compare the value of multiple properties while statistically controlling for differences in property attributes, in order to isolate the effect of a specific attribute such as proximity of a communications tower.

A recent literature review examined such studies in the United States, Germany, and New Zealand (Bond, Sims, & Dent, 2013). These studies all focused on residential properties. One study identified a positive effect on price in one neighborhood due to the presence of a wireless communications tower. Most studies identified negative effects on price. Generally, these negative effects were small: an approximately two percent decrease in property price. In one case, the average reduction in price was 15 percent. In all cases, the effects declined rapidly with distance, with some cases showing no effect beyond 100 meters (328 feet) and one case showing effects up to about 300 meters (984 feet).

Based on review of the particulars of each study, the literature review authors hypothesize that many additional factors regarding communications towers, besides distance, may affect property value. These include the type, height, size, and appearance of communication towers; grouping of towers; the level of activity in the property market at the time properties are listed or sold; and the level of negative local media focus on potential health effects of communication towers at the time properties are listed or sold.

Economic Benefits or Adverse Impacts related to Changes in Spending, Income, Industries, and Public Revenues

Developing the NPSBN may increase economic activity as governments and contractors make expenditures to deploy, operate, and maintain telecommunications and broadband infrastructure. Funds for such expenditures would come primarily from federal, state, and local government sources or through private entities under a written agreement with such governmental entities. FirstNet has three primary sources of funding to carry out its mission: (1) up to $7 billion in cash funded by proceeds of incentive auctions authorized by the Act; (2) network user or subscriber fees; and (3) fees from covered leasing agreements that allow FirstNet to permit a secondary users to access network capacity on a secondary basis for non-public safety services only. The use of NPSBN capacity on a secondary basis for non-public safety services, including commercial services, by parties entering into a covered leasing agreement with FirstNet may also increase economic activity and generation of income for such party.

Direct spending of federal, state, and private sector funds to deploy and operate the NPSBN would likely represent new income to businesses that provide goods and services for the network, resulting in a positive impact. This direct impact would lead to indirect impacts (as directly impacted businesses purchase supporting goods and services) and induced impacts (as the employees of all affected businesses spend the wages they have earned). Because most FirstNet infrastructure investments would be dispersed across the nation, the business income and wages generated in any particular state or community would generally be small relative to the overall state or community economy, but measurable. Based on the significance criteria above, the business income and wage impacts would be considered positive and less than significant. It is also highly unlikely that these impacts would lead to significant market shifts or other significant changes to local/regional economic structure.

Spending and income generation related to developing the NPSBN would also result in changes to public revenues. Property taxes may change as property values increase or decrease due to the installation of new infrastructure. General and selective sales taxes may change (most likely increase), reflecting expenditures during system development and maintenance. Public utility tax revenues may change. These taxes are a subcategory of selective sales taxes that includes taxes on providers of land and mobile telephone, telegraph, cable, and internet services (U.S. Census Bureau, 2006). These service providers may obtain new taxable revenues from operation of components of the public safety broadband network. In such cases, public utility tax revenues may increase, but they could also remain the same or decrease if providers are granted tax breaks in return for operating portions of the network. Individual and corporate income taxes may change as FirstNet infrastructure development and operation creates new taxable income for involved companies and workers.

FirstNet's partner(s) may be given the right to use excess NPSBN capacity commercially. This would result in additional economic activity and generation of income. In turn, this could have revenue implications for federal and state governments, through taxes on sales and on corporate income generated by commercial use of the network.

FirstNet may have an additional, non-revenue benefit to the public sector. The network is likely to create operational cost savings and increased productivity for public safety personnel.

Impacts to Employment

Private companies and government organizations that receive income from deploying and operating the NPSBN would use portions of that income to hire the employees they need to provide their support to the network. This generation of new employment could be a minor, direct, beneficial impact of expenditures on FirstNet. Additional, indirect employment increases would occur as additional businesses hire workers to provide supporting goods and services. For instance, FirstNet partner(s) and their subcontractors and vendors would need engineers and information technology professionals, project managers, construction workers, manufacturing workers, maintenance workers, and other technical and administrative staff. Further employment gains would occur as businesses throughout the economy benefit from consumer spending by wage-earners in direct and indirectly affected businesses.

For the most part, employment gains in any particular state or community would generally be measurable, but small relative to the overall state or community economy. This is because FirstNet infrastructure investments would be dispersed across the nation. Based on the significance criteria above, the employment impacts would be considered positive and less than significant. However, even small employment gains are beneficial, and would be especially welcomed in areas that have high unemployment. As discussed in Affected Environment, unemployment rates (as shown by the unemployment rate map and selected economic indicators table) vary considerably across North Carolina. The average unemployment rate in 2014 was 6.1 percent, slightly lower than the national rate of 6.2 percent. Counties with unemployment rates below the national average (that is, better employment performance) were often located in and around large population concentrations, such as Raleigh, Durham, Charlotte, and Asheville, but also occurred outside of these population concentrations. Counties with unemployment rates above the national average occurred in many parts of the state.

Large companies that win major contracts for deploying and operating the NPSBN may have concentrations of employees in some specific locations; for instance, engineers and other system designers may be located in one or a few specific offices. While such employment concentrations could be important to specific communities, these and other employment impacts would still not be significant based on the criteria in Table 11.2.9-1because they would not constitute a "high level of job creation at the state or territory level."

Changes in Population Number or Composition

In general, changes in population numbers occur when employment increases or decreases to a degree that affects the decisions of workers on where they could find employment; that is, when workers and their families move to or leave an area because of employment opportunities or the lack thereof. As noted above, deployment and operation of the NPSBN is likely to generate new employment opportunities (directly and indirectly), but employment changes would not be large enough in any state to be considered significant. Therefore, it is highly unlikely that the NPSBN would lead to significant changes in population numbers according to the significance criteria table above. Further, it is unlikely that the NPSBN would lead to any measurable changes in population numbers in any geographic areas, with the possible exception of cities where companies that win major NPSBN contracts establish centers for NPSBN deployment and operation activities. Smaller numbers of employees in any area would not produce measurable population changes because population is always in flux due to births, deaths, and in-migration and out-migration for other reasons.

Population composition refers to age, gender, race, ethnicity, and other characteristics of the individuals making up a population. Given the low potential for changes to population numbers, it is highly unlikely that the NPSBN would lead to any changes in population composition.

11.2.9.4. Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operation activities.

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could deploy various types of facilities or infrastructure. Almost all deployment activities would have socioeconomic impacts, because all represent economic activity that would result, for instance, in expenditures and generation of income. These effects are measurable by economists, even if very small, but their significance is determined by application of the criteria in Table 11.2.9-1. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Activities Likely to Have No Impacts

- Satellites and Other Technologies
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact socioeconomics, it is anticipated that this activity would have no impact on socioeconomic resources.

Activities with the Potential to Have Impacts

Potential impacts to socioeconomics for the Preferred Alternative would encompass a range of impacts that could result from deployment activities. The discussion below indicates which of the four types of socioeconomic impacts discussed above and listed again here apply to each type of deployment activity. For greater detail on the nature of these impacts, see the Description of Environmental Concerns section above.

- Impacts to Real Estate;
- Changes to Spending, Income, Industries, and Public Revenues;
- Impacts to Employment; and
- Changes in Population Number or Composition.

Positive impacts on property values would generally not result from one or a few particular activities, but instead would result from the totality of the new NPSBN infrastructure and operational systems that enable improved public safety services to currently underserved areas. Similarly, any change to population numbers in a few locations as discussed above would result from large contract awards and contractor decisions about employee locations, not from specific deployment activities. Therefore, these types of impacts are not included in the activity-focused discussions below.

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Installation of fiber optic cable in existing conduit would have the following types of socioeconomic impacts:
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
  - Collocation on Existing Aerial Fiber Optic Plant: Collocation of new aerial fiber optic plant on existing utility poles and other structures would have the following types of socioeconomic impacts:

    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber would be conducted electronically through existing infrastructure, and would have the following types of socioeconomic impacts:
    - Changes to Spending, Income, Industries, and Public Revenues – Labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water, and associated onshore activities at existing or new facilities would have the following types of socioeconomic impacts:
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
  - Installation of Optical Transmission or Centralized Transmission Equipment: Installation of transmission equipment through existing or new boxes or huts would have the following types of socioeconomic impacts:
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.

- New Build – Buried Fiber Optic Plant: New fiber optic cable installation usually requires construction activities and would have the following types of socioeconomic impacts:
  - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
  - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
- New Build – Aerial Fiber Optic Plant: Pole/structure installation would have the following types of socioeconomic impacts:
  - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
  - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures, such as generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads, or access roads would have the following types of socioeconomic impacts:
    - Impacts to Real Estate – As discussed above, communication towers sometimes have adverse impacts on nearby property values (Bond, Sims, & Dent, 2013). Such impacts, if they occur, would be limited to a small area around each project and would generally be a small percentage reduction in property value; thus the impacts would be less than significant.
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would include mounting or installing equipment (such as antennas) on an existing facility would have the following types of socioeconomic impacts. While communication towers sometimes have adverse impacts on nearby property values (Bond, Sims, & Dent, 2013),

the impacts of existing wireless towers are presumably already factored into property values and would not be affected by the addition of new equipment.

    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.

  - Deployable Technologies: COWs, COLTs, and SOWs and aerial deployable technologies require storage, staging, and (for aerial deployables) launch/landing areas. Development of such areas, or enlargement of existing areas to accommodate FirstNet equipment, would have the following types of socioeconomic impacts:
    - Impacts to Real Estate – It is possible that development or enlargement of storage, staging, and launch/landing areas could have adverse impacts on nearby property values. This is because such facilities may have adverse aesthetic aspects (e.g., large areas of pavement and large numbers of parked vehicles), equipment maintenance activities at such facilities may generate noise, and operational activities may generate traffic. Such factors could affect nearby property values. These impacts, if they occur, would occur within a limited distance of each site, and would be limited to a relatively small number of sites within the region and state. Therefore, these impacts would be less than significant.
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.

- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the deployment of such devices and equipment would be similar to collocation of wireless equipment on existing wireless towers, structures, or buildings, and would have the following types of socioeconomic impacts.
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.

- Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.

In general, the abovementioned activities would have less than significant beneficial socioeconomic impacts. The discussion above characterized the impacts of each type of activity. The socioeconomic impacts of all activities considered together would also be less than significant. Even when considered together, the impacts would be very small relative to the total economic activity and property value of any region or the state. In addition, with the possible exception of property values, all deployment impacts would be limited to the construction phase. To the extent that certain activities could have adverse impacts to property values, those impacts are also expected to be less than significant, as described above. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of primarily of routine maintenance and inspection of fixed infrastructure. As with deployment activities, all operational activities would have socioeconomic impacts, because all represent economic activity. Public or private sector employees would conduct all operational activities, and therefore support employment and involve payment of wages. Even if these economic effects are very small for each operational activity and not significant across the entire state, they are measurable socioeconomic impacts.

Potential socioeconomic impacts would primarily be beneficial, and generally of these types:

- Changes to Spending, Income, Industries, and Public Revenues – Operational activities would require expenditures, which then generate business income and employee wages, and may result in new public sector revenues such as taxes on sales and income. All such effects would be small in scale relative to the regional and state economy; their impacts would be less than significant.
- Impacts to Employment – Public and private sector organizations responsible for operating the NPSBN would sustain existing employees and/or hire new employees to carry out operational activities. They would generate a less than significant number of jobs regionally and statewide.

The potential negative impacts on property values mentioned above for deployment of new wireless communication towers and deployable technology storage, staging, and launch/landing areas may also apply in the operations phase. The ongoing presence of such facilities has aesthetic and other effects that may reduce nearby property values, relative to values in the absence of such facilities. These impacts, if they occur, would be less than significant as they would occur within a limited distance of each site, and would be limited to a relatively small number of sites within the region and District. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

11.2.9.5. Alternatives Impact Assessment

The following section assesses potential impacts to socioeconomics associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to socioeconomics resulting from implementation of this alternative could be as described below.

Deployment Impacts

As explained above, all deployment activities represent economic activity and thus have socioeconomic impacts. These impacts would primarily be beneficial, such as generation of business income and employee wages, and creation or sustainment of jobs. The impacts would be small for each activity and, therefore, less than significant.

Deployable technologies such as COWs, COLTs, and SOWs, along with aerial deployable technologies, would require storage, staging, and launch/landing areas. Development or enlargement of these facilities could have adverse impacts on nearby property values. The potential for such impacts is higher under this alternative than the Preferred Alternative because it is likely that these facilities would be implemented in greater numbers and over a larger geographic extent. These potential impacts are anticipated to be less than significant as described above. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

All operational activities represent economic activity and thus have socioeconomic impacts. These impacts would primarily be beneficial, and because they are small individually, overall impacts would be less than significant at the programmatic level.

The ongoing presence of facilities for housing and maintaining deployable technologies may have adverse aesthetic aspects (e.g., large areas of pavement and large numbers of parked vehicles) or other aspects (e.g., noise and traffic) that could negatively affect the value of surrounding properties. The potential for such impacts is higher under this alternative than the Preferred Alternative because it is likely that these facilities would be more numerous, present over a larger geographic extent, and used with greater frequency and duration. These impacts, if they occur, would be less than significant as they would be limited to a relatively small number of sites within the region and state. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed. Therefore, there would be no associated deployment or installation activities to deploy wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to socioeconomics from deployment and operation of the No Action Alternative. Socioeconomic conditions would therefore be the same as those described in Section 11.1.9, Socioeconomics.

11.2.10. Environmental Justice

11.2.10.1. Introduction

This section describes potential impacts to environmental justice in North Carolina associated with deployment and operation of the Proposed Action and Alternatives. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

11.2.10.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on environmental justice were evaluated using the significance criteria presented in Table 11.2.10-1. The categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to environmental justice addressed in this section are presented as a range of possible impacts.

Table 11.2.10-1: Impact Significance Rating Criteria for Environmental Justice

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Effects associated with other resource areas (e. g., human health and safety, cultural resources, socioeconomics) that have a disproportionately high and adverse impact on low-income populations and minority populations	Magnitude or Intensity	Direct and disproportionately high and adverse effects on environmental justice communities (as defined by EO 12898) that cannot be fully mitigated.	Effect that is potentially significant, but with mitigation is less than significant.	Direct effects on environmental justice communities (as defined by EO 12898) that are not disproportionately high and adverse, and therefore do not require mitigation.	No direct effects on environmental justice communities, as defined by EO 12898.
	Geographic Extent	Effects realized within counties at the Census Block Group level.		Effects realized within counties at the Census Block Group level.	Effects realized within counties at the Census Block Group level.
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA

NA = Not Applicable

11.2.10.3. Description of Environmental Concerns

Effects Associated with Other Resource Areas that Have a Disproportionately High and Adverse Impact on Low-Income Populations and Minority Populations

EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (Executive Office of the President, 1994), and guidance from CEQ, require federal agencies to evaluate potential human health and environmental effects on environmental justice populations. Specifically, "Such effects may include ecological, cultural, human health, economic, or social impacts on minority communities, low-income communities, or Indian tribes when those impacts are interrelated to impacts on the natural or physical environment" (CEQ, 1997b). Thus, effects associated with other resource areas are of interest from an environmental justice perspective. This includes Human Health and Safety, Cultural Resources, Socioeconomics, Noise, Aesthetics and Visual Resources, and other resources.

Potential concerns noted in the impact analyses for these resources include dust, noise, traffic, and other adverse impacts of construction activities. New wireless communication towers sometimes have adverse impacts on nearby property values (Bond, Sims, & Dent, 2013). (See Socioeconomics Environmental Consequences for additional discussion). The presence and operation of large storage, staging, and launch/landing areas for deployable technologies could raise environmental justice concerns as described below. American Indian tribes are considered environmental justice populations (CEQ, 1997b); thus, impacts on tribal cultural resources (for instance, due to construction) could be a concern from an environmental justice perspective.

Impacts are considered environmental justice impacts only if they are *both* "adverse" and "disproportionately high" in their incidence on environmental justice populations relative to the general population (CEQ, 1997b). The focus in environmental justice impact assessments is always, by definition, on adverse effects. However, telecommunications projects, such as those proposed by FirstNet, could have beneficial effects. These effects may include better provision of police, fire, and emergency medical services; improvements in property values; and the generation of jobs and income. These impacts are considered in the Socioeconomics Environmental Consequences (Section 11.2.9).

Construction impacts are localized, and property value impacts of wireless telecommunications projects rarely extend beyond 300 meters (984 feet) of a communications tower (Bond, Sims, & Dent, 2013). In addition, impacts related to deployment are of short duration. The potential for significant environmental justice impacts from the FirstNet deployment activities would be limited. Most, but not all, of the FirstNet operational activities have very limited potential for impacts as these activities are limited in scale and short in their duration.

Before FirstNet deploys Proposed Actions, additional site-specific analyses to identify specific environmental justice populations and assess specific impacts on those populations may be necessary. Such analyses could tier-off the methodology and results of this PEIS. The areas shown in the environmental justice-screening map of Affected Environment (Section 11.1.10.4) as having moderate potential or high potential for environmental justice populations would particularly warrant further screening. As discussed in Section 11.1.10.3, the Black/African

American percentage of the population in North Carolina was higher than that of the region and considerably higher than that of the nation. The state's percentage of All Minorities was somewhat lower than the percentage for the region or nation. The poverty rate of North Carolina was slightly below the rate for the region and above the rate for the nation. A very large proportion of North Carolina has high potential for environmental justice populations. The distribution of these high potential areas is somewhat uneven across the state, with more high potential areas in the eastern half of the state. High potential environmental justice areas occur both within and outside of the 10 largest population concentrations. Areas with moderate and low potential for environmental justice populations are somewhat more prevalent in the western part of the state. Further analysis using the data developed for the screening analysis in Section 11.1.10.4, Environmental Justice Screening Results, may be useful. In addition, USEPA's EJSCREEN tool and USEPA's lists of environmental justice grant and cooperative agreement recipients may help identify local environmental justice populations (USEPA, 2015g; USEPA, 2016b).

A site-specific analysis would also evaluate whether an actual environmental justice impact on those populations would be likely to occur. Analysts could use the evaluation presented below under "Activities with the Potential to Have Impacts" as a starting point. Analysts should bear in mind that any such activities that are problematic based on the adverse impact criterion of environmental justice may also have beneficial impacts on those same environmental justice communities.

11.2.10.4. Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operation activities.

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could deploy various types of facilities or infrastructure. Depending on the physical nature and location of FirstNet facilities or infrastructure and the specific Proposed Action, some activities would result in potential impacts to environmental justice communities and others would not. In addition, and as explained in this section, the same type of Proposed Action infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have no impacts to environmental justice under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Installation of fiber optic cable in existing conduit would be through existing hand holes, pulling vaults, junction boxes, huts, and POP structures. Activities at these small entry points would be limited and temporary and thus are not likely to produce perceptible changes affecting any surrounding communities. Therefore, they would not affect environmental justice communities.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber would be conducted electronically through existing infrastructure, and therefore would have no impacts to environmental justice. If physical access were required to light dark fiber, it would likely be through existing hand holes, pulling vaults, junction boxes, huts, and similar existing structures, with no resulting impacts on environmental justice communities.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the deployment of such devices and equipment would not involve new ground disturbance, impacts to environmental justice communities would not occur. Impacts associated with satellite-enabled devices requiring construction activities are addressed below.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact environmental justice, it is anticipated that this activity would have no impact on environmental justice.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to environmental justice for the Preferred Alternative would encompass a range of impacts that could occur as a result of disturbance to communities from construction activities, such as noise, dust, and traffic. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to environmental justice communities include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: New fiber optic cable installation usually requires construction activities such as trenching, plowing (including vibratory plowing), or directional boring, as well as construction of hand holes, pulling vaults, junction boxes, huts, and POP structures. These activities could temporarily generate noise and dust, or disrupt traffic. If such impacts occur disproportionately to environmental justice communities, they would be considered environmental justice impacts.
  - New Build – Aerial Fiber Optic Plant: Pole/structure installation could temporarily generate noise and dust, or disrupt traffic. If these effects occur disproportionately in

environmental justice communities, they would be considered environmental justice impacts.

- New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water would not impact environmental justice because there would be no ground disturbance or other impacts associated with this activity that would adversely impact communities. Associated onshore activities occurring at existing facilities such as staging of equipment and materials, or connection of cables, would be small in scale and temporary; thus, they would not impact environmental justice communities. Construction of new landings and/or facilities onshore to accept submarine cable could temporarily generate noise and dust, or disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.
- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts, there would be no adverse impacts on surrounding communities, and thus no potential for environmental justice impacts. Installation of optical transmission equipment or centralized transmission equipment requiring construction of new utility poles, hand holes, pulling vaults, junction boxes, huts, and POP structures could temporarily generate noise and dust, or disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures, such as generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads, or access roads requires construction activities that could temporarily generate noise and dust, or disrupt traffic. New communication towers sometimes have adverse impacts on nearby property values (Bond, Sims, & Dent, 2013). (See Socioeconomics Environmental Consequences for additional discussion). If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would include mounting or installing equipment (such as antennas) on an existing facility. This activity would be small in scale, temporary, and highly unlikely to produce adverse human health or environmental impacts on the surrounding community. Thus, it would not impact environmental justice communities. If collocation requires construction for additional power units, structural hardening, and physical security measures, the construction activity could temporarily generate noise and dust and disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.

- Deployable Technologies: COWs, COLTs, and SOWs and aerial deployable technologies require storage, staging, and (for aerial deployables) launch and landing areas. To the extent such areas require new construction, noise and dust could be temporarily generated, and traffic could be disrupted. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.

In general, the impacts from the abovementioned activities would be short-term and could potentially involve objectionable dust, noise, traffic, or other localized impacts due to construction activities. In some cases, these effects and aesthetic effects could potentially impact property values, particularly from new towers. These impacts are expected to be less than significant, but are problematic from an environmental justice perspective if they occur disproportionately in environmental justice communities. Since environmental justice impacts occur at the site-specific level, analyses of individual Proposed Actions would help determine potential impacts to specific environmental justice communities. BMPs and mitigation measures may be required to address potential impacts to environmental justice communities at the site-specific level. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

Activities Likely to Have No Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of primarily of routine maintenance and inspection of fixed infrastructure. It is anticipated that such activities would not result in environmental justice impacts, as the intensity of these activities would be low (low potential for objectionable effects such as noise and dust) and their duration would be very short. Routine maintenance and inspection would not adversely affect property values, for the same reasons. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment activities that involve construction. Impacts are expected to be less than significant. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

11.2.10.5. Alternatives Impact Assessment

The following section assesses potential impacts to environmental justice associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to environmental justice communities resulting from implementation of this alternative could be as described below.

Deployment Impacts

As explained above, deployable technologies such as COWs, COLTs, and SOWs, along with aerial deployable technologies, could require storage, staging, and launch/landing areas. To the extent such areas require new construction, noise and dust could be generated temporarily, and traffic could be disrupted. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts. Impacts are expected to be less than significant because they would be temporary in nature. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

The ongoing presence of facilities for housing and maintaining deployable technologies may have adverse aesthetic aspects (e.g., large areas of pavement and large numbers of parked vehicles) that could negatively affect the value of surrounding properties. In addition, equipment maintenance activities at such facilities may temporarily generate noise, and operational activities may generate traffic. These effects may be adverse in themselves, and may impact property values. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts. Impacts are expected to be less than significant as operations are expected to be temporary in nature. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed. Therefore, there would be no associated construction or installation activities to deploy wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to environmental justice as a result of deployment and operation of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 11.1.10, Environmental Justice.

11.2.11. Cultural Resources

11.2.11.1. Introduction

This section describes potential impacts to cultural resources in North Carolina associated with deployment and operation of the Proposed Action and Alternatives. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

11.2.11.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on cultural resources were evaluated using the significance criteria presented in Table 11.2.11-1. As described in Section 11.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to cultural resources addressed in this section are presented as a range of possible impacts.

Table 11.2.11-1: Impact Significance Rating Criteria for Cultural Resources

Type of Effect	Effect Characteristics	Impact Level			
		Adverse Effect	Mitigated Adverse Effect [a]	Effect, but not Adverse	No Effect
Physical damage to and/or destruction of historic properties [b]	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	Adverse effect that has been procedurally mitigated through Section 116 process.	Effects to a non-contributing portion of a single or many historic properties.	No direct effects to historic properties.
	Geographic Extent	Direct effects APE.		Direct effects APE.	Direct effects APE.
	Duration or Frequency	Permanent direct effects to a contributing portion of a single or many historic properties.		Permanent direct effects to a non-contributing portion of a single or many historic properties.	No direct effects to historic properties.
Indirect effects to historic properties (i.e., visual, noise, vibration, atmospheric)	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	Adverse effect that has been procedurally mitigated through Section 116 process.	Effects to a contributing or non-contributing portion of a single or many historic properties.	No indirect effects to historic properties.
	Geographic Extent	Indirect effects APE.		Indirect effects APE.	Indirect effects APE.
	Duration or Frequency	Long-term or permanent indirect effects to a single or many historic properties.		Infrequent, temporary, or short- or long-term or permanent indirect effects to a single or many historic properties.	No indirect effects to historic properties.
Loss of character defining attributes of historic properties	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	Adverse effect that has been procedurally mitigated through Section 116 process.	Effects to a non-contributing portion of a single or many historic properties.	No direct or indirect effects to historic properties.
	Geographic Extent	Direct and/or indirect effects APE.		Direct and/or indirect effects APE.	Direct and/or indirect effects APE.

Type of Effect	Effect Characteristics	Impact Level			
		Adverse Effect	**Mitigated Adverse Effect [a]**	**Effect, but not Adverse**	**No Effect**
	Duration or Frequency	Long-term or permanent loss of character defining attributes of a single or many historic properties.		Infrequent, temporary, or short-term changes to character defining attributes of a single or many historic properties.	No direct or indirect effects to historic properties.
Loss of access to historic properties	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	Adverse effect that has been procedurally mitigated through Section 116 process.	Effects to a non-contributing portion of a single or many historic properties.	No segregation or loss of access to historic properties.
	Geographic Extent	Any area surrounding historic properties that would cause segregation or loss of access to a single or many historic properties.		Any area surrounding historic properties that could cause segregation or loss of access to a single or many historic properties.	No segregation or loss of access to historic properties.
	Duration or Frequency	Long-term or permanent segregation or loss of access to a single or many historic properties.		Infrequent, temporary, or short-term changes in access to a single or many historic properties.	No segregation or loss of access to historic properties.

[a] Whereas mitigation measures for other resources discussed in this PEIS may be developed to achieve an impact that is "Less than Significant with Mitigation Incorporated," historic properties are considered to be "non-renewable resources," given their very nature. As such, any and all unavoidable adverse effects to historic properties, per Section 116 of the NHPA (as codified in 36 CFR Part 800.6), would require FirstNet to consult with the SHPO/Tribal Historic Preservation Office (THPO) and other consulting parties, including American Indian tribes and Native Hawaiian Organizations, to develop appropriate mitigation.
[b] Per NHPA, a "historic property" is defined as any district, archaeological site, building, structure, or object that is either listed or eligible for listing in the NRHP. Cultural resources present within a project's APE are not historic properties if they do not meet the eligibility requirements for listing in the NRHP. Sites of religious and/or cultural significance refer to areas of concern to American Indian tribes and other consulting parties that, in consultation with the respective party (ies), may or may not be eligible for listing in the NRHP. These sites may also be considered TCPs. Therefore, by definition, these significance criteria only apply to cultural resources that are historic properties, significant sites of religious and/or cultural significance, or TCPs. For the purposes of brevity, the term historic property is used here to refer to either historic properties, significant sites of religious and/or cultural significance, or TCPs.

11.2.11.3. Description of Environmental Concerns

Physical Damage to and/or Destruction of Historic Properties

One of the primary environmental concerns during deployment activities is damage to or destruction of historic and cultural resources. Deployment involving ground disturbance has the potential to damage or destroy archaeological sites, and the attachment of communications equipment to historic building and structures has the potential to cause damage to features that are historically significant.

Based on the impact significance criteria presented in Table 11.2.11-1, direct deployment impacts could be potentially significant if FirstNet's deployment locations were in areas with moderate to high probabilities for archaeological deposits, within historic districts, or at historic properties. To the extent practicable, FirstNet would attempt to minimize activities in areas with archaeological deposits or within historic districts. However, given archaeological sites and historic properties are present throughout North Carolina, some deployment activities may be in these areas, in which case BMPs (see Chapter 16) would help avoid or minimize the potential impacts.

Indirect Effects to Historic Properties (i.e., visual, noise, vibration, atmospheric)

The potential for indirect effects to historic properties would be present during deployment of the proposed facilities/infrastructure and during trenching, grading, and/or foundation excavation activities. Indirect effects include the introduction of visual, noise, atmospheric, and/or vibration effects that diminish a property's historic integrity. The greatest likelihood of potentially significant impacts from indirect effects would be from the deployment of equipment in areas that would cause adverse visual effects to historic properties. To the extent practicable, FirstNet would attempt to minimize activities in areas within or adjacent to historic districts or properties.

Loss of Character Defining Attributes of Historic Properties

Deployment of FirstNet equipment has the potential to cause the loss of character defining attributes of historic properties; such attributes are the features of historic properties that define their NRHP eligibility. Examples of such impacts would be the loss of integrity of archaeological sites through ground disturbing activities, and direct impacts to historic buildings from equipment deployment that adversely alter historic architectural features. Significant impacts such as these could be avoided or minimized through BMPs (see Chapter 16).

Loss of Access to Historic Properties

The deployment of equipment requiring a secure area has the potential to cause the loss of access to historic properties. The highest potential for this type of significant impact would be from the deployment of equipment in secure areas that impact the access to sites of cultural importance to America Indians. It is anticipated that FirstNet would identify potential impacts to such areas by conducting research on particular areas and through the NHPA consultation process, and would minimize deployment activities that would cause such loss of access.

11.2.11.4. Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operation activities.

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to cultural resources, while others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have no impacts to cultural resources under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be no impacts to cultural resources since the activities that would be conducted at these small entry and exit points are not likely to produce impacts.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to cultural. If required, and if done in existing huts with no ground disturbance, installation of new associated equipment would also have no impacts to cultural resources because there would be no ground disturbance and no perceptible visual changes.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact cultural resources because those activities would not require ground disturbance or create perceptible visual effects.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact cultural resources, it is anticipated that this activity would have no impact on cultural resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to cultural resources as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur as a result of ground disturbance activities, including destruction of cultural or historic artifacts. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to cultural resources include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POP, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to cultural resources. Soil disturbance and heavy equipment use associated with plowing, trenching, or directional boring as well as land/vegetation clearing, excavation activities, and landscape grading associated with construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in the disturbance of archaeological sites, and the associated structures could have visual effects on historic properties.
  - New Build – Aerial Fiber Optic Plant: Ground disturbance during the installation of new utility poles and the use of heavy equipment during the installation of new utility poles and hanging of cables could result in the disturbance of archaeological sites, and the associated structures could have visual effects on historic properties and structures within North Carolina.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water could impact cultural resources, as coastal areas of North Carolina where sea level was lower during glacial periods (generally the Middle Archaic Period and earlier) have the potential to contain archaeological sites. Impacts to cultural resources could also potentially occur as result of the construction of landings and/or facilities on shore to accept submarine cable, which could result in the disturbance of archaeological and historical sites (archaeological deposits are frequently associated with bodies of water), and the associated network structures could have visual effects on historic properties.
  - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts and require no ground disturbance, there would be no impacts to cultural resources. If installation of transmission equipment required grading or other ground disturbance to install small boxes or huts, or access roads, there could potentially be impacts to cultural resources. Ground disturbance could impact archaeological sites, and the associated structures could have visual effects on historic properties.
  - Collocation on Existing Aerial Fiber Optic Plant: Soil excavation and excavated material placement during the replacement of poles and structural hardening could result in direct and indirect effects to cultural resources, although any effects to access would be short-term. Heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in direct and indirect effects to cultural resources.

- Wireless Projects
  - New Wireless Communication Towers: Deployment of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to historic properties. Land/vegetation clearing, excavation activities, landscape grading, and other ground disturbance activities during the deployment of new wireless towers and associated structures or access roads, could result in the disturbance of archaeological sites. The deployment of new wireless communication towers and their associated structures could result in visual impacts to historic properties or the loss of access to historic properties.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower could result in impacts to historic properties. Ground disturbance activities could result in the disturbance of archaeological sites, and the deployment of collocated equipment could result in visual impacts or physical damage to historic properties, especially in urban areas, such as Charlotte, that have larger numbers of historic public buildings.
  - Deployable Technologies: Implementation of deployable technologies could result in potential impacts to cultural resources if deployment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. In addition, impacts to historic properties could occur if the deployment is long-term, or if the deployment involves aerial technologies with the potential for visual or other indirect impacts.

In general, the abovementioned activities could potentially involve ground disturbance, construction of access roads and other impervious surfaces, landscape grading, and heavy equipment movement. Potential impacts to cultural resources associated with deployment could include physical damage to or destruction of historic properties, indirect impacts including visual effects, the loss of access to historic properties, or the loss of character-defining features of historic properties. These activities could affect, but not adversely affect, cultural resources as the potential adverse effects would be temporary and limited to the area near individual Proposed Action deployment site. Additionally, some equipment proposed to be installed on or near properties that are listed or eligible for listing on the NRHP could potentially be removed. Additionally appropriate, FirstNet would engage in consultation as required under Section 106 of the NHPA. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major communications infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. It is anticipated that there would be no effect to cultural resources associated with routine inspections of the Preferred Alternative. If usage of heavy equipment as part of routine maintenance or inspections occurs off established access roads or corridors, or if the acceptable load of the surface is exceeded, ground disturbance impacts on archaeological sites could result as explained above. These potential impacts would be associated with ground disturbance or modifications of properties, however, due to the small scale of expected activities, these actions could affect but would not likely adversely affect, cultural resources. In the event that maintenance and inspection activities occur off existing roads, FirstNet would engage in consultation as required under Section 106 of the NHPA. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

11.2.11.5. Alternatives Impact Assessment

The following section assesses potential impacts to cultural resources associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to cultural resources as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in impacts to cultural resources if deployment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in impacts to archaeological sites. These activities could affect, but not adversely affect, cultural resources due to the limited amount of expected ground disturbing activities and the short-term nature of deployment activities. However, in the event that land/vegetation clearing is required, FirstNet would engage in consultation as required under Section 106 of the NHPA. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the deployment impacts, it is anticipated that there would be effects, but no adverse effects to historic properties associated with implementation/running of the deployable technology. No adverse effects would be expected to either site access or viewsheds due to the temporary nature of expected activities. As with the Preferred Alternative, it is anticipated that there would be no effects to cultural resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment as part of routine maintenance or inspections occurs off established access roads or corridors, impacts to archaeological sites could occur, however, in the event that this is required, FirstNet would engage in consultation as required under Section 106 of the NHPA. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to cultural resources as a result of deployment and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 11.1.11, Cultural Resources.

11.2.12. Air Quality

11.2.12.1. Introduction

This section describes potential impacts to North Carolina's air quality from deployment and operation of the Proposed Action and Alternatives. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on North Carolina's air quality were evaluated using the significance criteria presented in Table 11.2.12-1. The categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to North Carolina's air quality addressed in this section are presented as a range of possible impacts.

Table 11.2.12-1: Impact Significance Rating Criteria for Air Quality

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Increased air emissions	Magnitude or Intensity	Pollutant concentrations would exceed one or more NAAQS in nonattainment and maintenance areas. Emissions in attainment areas would cause an area to be out of attainment for any NAAQS. Projects do not conform to the SIP covering nonattainment and maintenance areas.	Effect that is potentially significant, but with mitigation is less than significant.	Negligible emissions would occur for any criteria pollutants within an attainment area but would not cause a NAAQS exceedance.	Action would not cause pollutant concentrations to exceed the NAAQS in nonattainment and maintenance areas. Emissions in attainment areas would not cause air quality to go out of attainment for any NAAQS. Projects are *de minimis* or conform to the SIP covering nonattainment and maintenance areas.
	Geographic Extent/Context	NA		NA	NA
	Duration or Frequency	Permanent or long-term.		Short term.	Temporary.

NA = Not Applicable

11.2.12.2. Description of Environmental Concerns

Increased Air Emissions

The Proposed Action has the potential to generate air pollutant emissions. These emissions could be above and beyond what is typically generated in a given area and may alter ambient air quality. Deployment activities may involve the use of vehicles, heavy equipment, and other equipment that could emit exhaust and create fugitive dust in localized areas. During operations, routine maintenance and other use of generators at tower facilities may emit exhaust for specific durations (maintenance) or unpredictable timeframes (if power is lost to a site, for example). Impacts are likely to be less than significant due to the mobile nature of the sources and the temporary and short-term duration of deployment activities. Although unlikely, the emissions of criteria pollutants could impair the air quality of the region and potentially affect human health. Potential impacts to air quality from emissions may occur in areas where the current air quality exceeds, or has a history of exceeding, one or more NAAQS. Areas exist in North Carolina that are in maintenance or nonattainment for one or more criteria pollutants, particularly; ozone is a statewide issue (see Section 11.1.12, Air Quality).

Based on the significance criteria presented in Table 11.2.12-1, air emission impacts would likely be less than significant given the size and nature of the majority of the proposed deployment activities. The majority of FirstNet's deployment activities would not be located in sensitive areas nor would a large number of emission sources be deployed/operated long-term in the same area from fixed or mobile sources or construction activities. Less than significant emissions could occur for any of the criteria pollutants within attainment areas in North Carolina; however, NAAQS exceedances are not anticipated. To the extent practicable, FirstNet would likely attempt to avoid areas in nonattainment and maintenance. Given that nonattainment areas are present in North Carolina (Figure 11.1.12-1), FirstNet would try to minimize potential emissions where possible and would recommend the implementation of BMPs, where feasible and practicable, to avoid or minimize potential impacts.

11.2.12.3. Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including construction, deployment, and operation activities.

Deployment and Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementing the Preferred Alternative could result in deploying various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to air quality and others would not. The potential impacts could range from no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have no impacts to air quality under the conditions described below:

- Wired Projects
    - Use of Existing Conduit – New Buried Fiber Optic Plant: Activities associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit. Gaining access to the conduit and installing the cable may result in minor disturbance at entry and exit points; however, this activity would be temporary and infrequent, and is not expected to produce any perceptible changes in air emissions.
    - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up dark fiber would require no construction and have no short or long-term emissions to air quality because it would create no new sources of emissions.
- Satellites and Other Technologies
    - Satellite Enabled Devices and Equipment: The duration of construction activities associated with installing permanent equipment on existing structures would most likely be short-term. It is anticipated that insignificant concentrations of criteria pollutants would be emitted during installment of this equipment from the use of machinery. Deployment and operation of satellite-enabled devices and portable equipment are expected to have minimal to no impact on ambient air quality concentrations.
    - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact air quality resources, it is anticipated that this activity would have no impact on those resources.

Activities with Potential Impacts to Air Quality

Construction, deployment, and operation activities related to the Preferred Alternative could impact air quality by generating various quantities of criteria and air pollutant emissions. It is expected that such impacts would be less than significant due to the shorter duration and localized nature of the activities. The types of infrastructure deployment scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to air quality include the following:

- Wired Projects
    - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber as well as land/vegetation clearing, excavation activities, and

landscape grading could result in fugitive dust and products of combustion from the use of vehicles and heavy equipment.

- New Build – Aerial Fiber Optic Plant: The use of heavy equipment during the installation of new poles and hanging cables, as well as constructing access roads, POP huts, or other associated facilities to house plant equipment could result in products of combustion from the use of vehicles and machinery, as well as fugitive dust emissions from site preparation.
- Collocation on Existing Aerial Fiber Optic Plant: Excavation equipment used during pole replacement, and other heavy equipment used for structural hardening or reinforcement, could result in products of combustion from the use of vehicles and heavy equipment, as well as fugitive dust from site preparation.
- New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water could generate products of combustion from vessels used to lay the cable. In addition, the construction of landings and/or facilities on shore to accept submarine cable could result in products of combustion and fugitive dust from heavy equipment used for grading, foundation excavation, or other ground disturbing activities.
- Installation of Optical Transmission or Centralized Transmission Equipment: Emissions associated with the installation of optical transmission or centralized transmission equipment would be limited to the short-term, temporary use of vehicle and construction equipment. Long-term impacts are unlikely, as the power requirements for optical networks are relatively low.

- Wireless Projects
  - New Wireless Communication Towers: Activities associated with installing new wireless towers and associated structures (e.g., generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in products of combustion. Operating vehicles and other heavy equipment, running generators while conducing excavation activities and landscape grading to install new wireless towers and associated structures or access roads could result in products of combustion and fugitive dust.
  - Collocation on Existing Wireless Tower, Structure, or Building: Vehicles and equipment used to mount or install equipment, such as antennas or microwave dishes, on an existing tower could impact air quality. If additional power units, structural hardening, and physical security measures required grading or excavation, then exhaust and fugitive dust from heavy equipment used for these activities could also result in increased air emissions.
  - Deployable Technologies: The type of deployable technology used would dictate the types of air pollutants generated. For example, mobile equipment deployed via heavy trucks could generate products of combustion from the internal combustion engines associated with the vehicles and onboard generators. These units may also generate fugitive dust depending on the type of road traveled during deployment (i.e., paved

versus unpaved roads). Aerial platforms (e.g., UASs or other aircraft) would generate pollutants during all phases of flight.

In general, the pollutants of concern from the abovementioned activities would be products of combustion from burning fossil fuels in internal combustion engines and fugitive dust from site preparation activities and vehicles traveling on unpaved road surfaces. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the construction impacts. These impacts are anticipated to be less than significant due to the limited nature of the deployment. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major communications infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. It is anticipated that there would be less than significant impacts to air quality associated with routine inspections of the Preferred Alternative due to the limited nature of the activity. If usage of heavy equipment as part of routine maintenance or inspections occurs off established access roads or corridors additional air quality impacts may occur, however, they would be less than significant as they would still be limited in nature. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

11.2.12.4. Alternatives Impact Assessment

The following section assesses potential impacts to air quality associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific equipment associated with the Deployable Technologies Alternative could include heavy trucks with onboard generators, aerial vehicles (e.g., UASs or other aircraft), and ground support vehicles and other equipment for aerial deployment. The stand-alone Deployable Technologies Alternative differs from the Preferred Alterative in the number of mobile and aerial vehicles likely to deploy, the distances traveled from storage locations, and the duration of deployment. The potential impacts to air quality are as follows:

Deployment and Operation Impacts to Air Quality

Implementing deployable technologies could result in products of combustion from mobile equipment deployed via heavy trucks using internal combustion engines associated with the vehicles and onboard generators. While a single deployable vehicle may have an insignificant impact, multiple vehicles operating for longer periods, in close proximity, may have a greater cumulative impact, although this is expected to be less than significant based on the defined significance criteria, since activities would be temporary and short-term. These vehicles may also produce fugitive dust if traveling on unpaved roads. Some staging or landing areas (depending on the type of technology) may require excavation, site preparation, and paving. Heavy equipment used for these activities could emit products of combustion as a result of burning fossil fuels in internal combustion engines. The deployment and operation of aerial technology is anticipated to generate pollutants during all phases of flight, except for balloons. The products of combustion from ground support vehicles, as well as the duration of ground support operations and travel between storage and deployment locations, would dictate the concentrations and associated impacts. Additionally, routine maintenance and inspections of the deployable technologies are anticipated to be less than significant, given that these activities are of low-intensity and short duration. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, FirstNet would not deploy the NPSBN and there would be no impact to ambient air quality. By not deploying NPSBN, FirstNet would avoid generating emissions from construction, installation, or operation of wired, wireless, or deployable infrastructure or technologies; satellites; and other technologies.

11.2.13. Noise

11.2.13.1. Introduction

This section describes potential noise impacts from construction, deployment, and operation of the Proposed Action and Alternatives in North Carolina. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

11.2.13.2. Impact Assessment Methodology and Significance Criteria

The noise impacts of the Proposed Action were evaluated using the significance criteria presented in Table 11.2.13-1. The categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential noise impacts to North Carolina addressed in this section are presented as a range of possible impacts.

Table 11.2.13-1: Impact Significance Rating Criteria for Noise

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Increased noise levels	Magnitude or Intensity	Noise levels would exceed typical noise levels from construction equipment and generators. Noise levels at noise sensitive receptors (such as residences, hotels/motels/inns, hospitals, and recreational areas) would exceed 55 dBA or specific state noise limits. Noise levels plus baseline noise levels would exceeds 10 dBA increase from baseline noise levels (i.e., louder). Project noise levels near noise receptors at national parks would exceed 65 dBA.	Effect that is potentially significant, but with mitigation is less than significant.	Noise levels resulting from project activities would exceed natural sounds, but would not exceed typical noise levels from construction equipment or generators.	Natural sounds would prevail. Noise generated by the action (whether it be construction or operation) would be infrequent or absent, mostly immeasurable.
	Geographic Extent/Context	County or local.		County or local.	County or local.
	Duration or Frequency	Permanent or long-term.		Short term.	Temporary.

11.2.13.3. Description of Environmental Concerns

Increased Noise Levels

The Proposed Action has the potential to generate noise during construction and operation of various equipment used for deployment. These noise levels could be above what is typically generated in a given area and may alter the ambient acoustical environment. If significant, the noise could cause impacts on residential areas, or other facilities that are sensitive to noise, such as churches, hospitals, or schools. The construction activities for deploying some of the various equipment evaluated under the Proposed Action could cause short-term impacts to nearby populations. However, it is likely that there would be less long-term effects from operational use of the proposed equipment (see Section 11.1.13, Noise).

Based on the significance criteria presented in Table 11.2.13-1, noise impacts would likely be less than significant given the size and nature of the majority of the proposed deployment activities. The majority of FirstNet's deployment activities would not be located in sensitive areas nor would a large number of noise sources be deployed/operated long-term in the same area. Noise levels from deployment activities are not expected to exceed typical noise levels for short-term/temporary construction equipment or generators.

To the extent practicable, FirstNet would attempt to mitigate or minimize noise effects during construction or operation. BMPs and mitigation measures could help to limit impacts on nearby noise-sensitive receptors. However, given that much of the concentration and setup of equipment would often occur in populated areas, FirstNet operations would not be able to completely avoid noise impacts due to construction and operations at various receptors.

11.2.13.4. Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including construction, deployment, and operation activities.

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementing the Preferred Alternative could result in deploying various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential noise impacts and while others would not.

In addition, the same type of Proposed Action Infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have no noise impacts under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. Noise generated by equipment required to install fiber would be infrequent and of short duration, and is not expected to create perceptible impacts.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up dark fiber would require no construction or installation activities, and therefore would have no noise impacts.
- Satellites and Other Technologies
  - Satellite Enabled Devices and Equipment: The duration of construction activities associated with installing permanent equipment on existing structures would most likely be short-term. It is anticipated that insignificant levels of noise would be emitted during installment of this equipment. Noise caused by these construction and installation activities would be similar to other construction activities in the area, such as the installation of cell phone towers or other communication equipment. Deployment and operation of satellite-enabled devices and equipment are expected to have minimal to no impact on the noise environment.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact noise resources, it is anticipated that this activity would have no impact on those resources.

Activities with the Potential for Noise Impacts

Construction, deployment, and operation activities related to the Preferred Alternative could create noise impacts from either the construction or operation of the infrastructure. The types of infrastructure deployment scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to air quality include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber as well as land/vegetation clearing, excavation activities, and landscape grading could result in high noise levels from the use of heavy equipment and machinery.

- New Build – Aerial Fiber Optic Plant: The use of heavy equipment during the installation of new poles and hanging cables, as well as constructing access roads, POP huts, or other associated facilities to house plant equipment would be short-term and could result in increased noise levels from the use of vehicles and machinery.
- Collocation on Existing Aerial Fiber Optic Plant: Excavation equipment used during potential pole replacement, and other heavy equipment used for structural hardening or reinforcement, could result in temporary increases in higher noise levels from the use of heavy equipment and machinery.
- Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Installation of new associated huts or equipment, if required, could result in short-term and temporarily higher noise levels if the activity required the use of heavy equipment for grading or other purposes.
- New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water could generate noise if vessels are used to lay the cable. In addition, the construction of landings and/or facilities on shore to accept submarine cable could result in short-term and temporarily increased noise levels to local residents and other noise sensitive receptors from heavy equipment used for grading, foundation excavation, or other ground disturbing activities.
- Installation of Optical Transmission or Centralized Transmission Equipment: Noise associated with the installation of optical transmission or centralized transmission equipment would be limited to the short-term, temporary use of vehicle and construction equipment. Long-term impacts are unlikely, as the noise emissions from optical networks are relatively low. Heavy equipment used to grade and construct access roads could generate increased levels of noise over baseline levels temporarily.

- Wireless Projects
    - New Wireless Communication Towers: Activities associated with installing new wireless towers and associated structures (e.g., generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in localized construction noise. Operating vehicles, other heavy equipment, and generators would be used on a short-term basis and could increase noise levels.
    - Collocation on Existing Wireless Tower, Structure, or Building: Vehicles and equipment used to mount or install equipment, or to grade or excavate additional land on sites for installation of equipment, such as antennas or microwave dishes on an existing tower, could impact the local noise environment temporarily.
    - Deployable Technologies: The type of deployable technology used would dictate the types of noise generated. For example, mobile equipment deployed via heavy trucks could generate noise from the internal combustion engines associated with the vehicles and onboard generators. With the exception of balloons, aerial platforms (e.g., UASs or other aircraft, except balloons) generate noise during all phases of flight, including

takeoff, landing, and flight operations over necessary areas that could impact the local noise environment.

In general, noise from the abovementioned activities would be products of site preparation, installation, and construction activities, as well as additional construction vehicles traveling on nearby roads and localized generator use. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the construction impacts. These impacts are expected to be less than significant due to the temporary duration of deployment activities. Additionally, pre-existing noise levels achieved after some months (typically less than a year but could be a few hours for linear activities such as pole construction). Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

Operation activities associated with the Preferred Alternative would be less than significant for routine maintenance and inspection of the facilities because of the temporary nature of the activities, which would not create new permanent sources of noise. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that potential noise impacts would be similar to or less than those described for the deployment activities. If usage of vehicles or heavy equipment as part of routine maintenance or inspections or onsite generator use occurs, potential noise impacts could result as explained above. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

11.2.13.5. Alternatives Impact Assessment

The following section assesses potential noise impacts associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific equipment associated with the Deployable Technologies Alternative would be heavy trucks with onboard generators, aerial vehicles (e.g., UASs or other aircraft), and ground support vehicles and equipment for aerial deployment. The stand-alone Deployable Technologies Alternative differs from the Preferred Alterative in the number of mobile and aerial vehicles likely to deploy, the distances traveled from storage locations and the duration of deployment. The potential noise impacts are as follows.

Deployment Impacts

Implementing deployable technologies could result in noise from mobile equipment deployed via heavy trucks, including not only onboard generators, but also the vehicles themselves. While a single deployable vehicle may have an insignificant impact, multiple vehicles operating for longer periods, in close proximity, may increase localized noise levels. Several vehicles traveling together could also create short-term noise impacts on residences or other noise-sensitive receptors as they pass by. With the exception of balloons, the deployment of aerial technology is anticipated to generate noise during all phases of flight. Aerial technologies would have the highest level of noise impact if they are required to fly above residential areas, areas with a high concentration of noise-sensitive receptors (i.e., schools or churches), or over national parks or other areas where there is an expectation of quiet and serenity on their way to their final destinations. Residences near deployment areas for aerial technologies (i.e., airports or smaller airfields) could also be affected during takeoff and landing operations. Additionally, routine maintenance and inspections of the deployable technologies are anticipated to be less than significant, given that these activities are of low-intensity and short duration. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

Operation activities associated with the Deployable Technologies Alternative would be similar to several of the deployment activities related to routine maintenance and inspection of the facilities. Operation of generators could also generate noise in the area. However, deployable technologies could be deployed to areas with few existing facilities, so noise impacts could be minimal in those areas. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that potential noise impacts would be the same as those described for the deployment activities. If usage of vehicles or heavy equipment as part of routine maintenance or inspections occurs, potential noise impacts could result as explained above.

Operational impacts from aerial technologies would include repeated flyovers by UAS vehicles while they are needed in the area. This could generate less than significant, short-term impacts on any residential areas or other noise-sensitive receptors under the flight path of these vehicles. However, once these operations cease, noise levels would quickly return to baseline levels. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, FirstNet would not deploy the NPSBN and there would be no impact to ambient noise. By not deploying the NPSBN, FirstNet would avoid generating noise from construction, installation, or operation of wired, wireless, deployable infrastructure or satellites and other technologies.

11.2.14. Climate Change

11.2.14.1. Introduction

This section describes potential impacts to climate and climate change-vulnerable FirstNet installations and infrastructure in North Carolina associated with deployment and operation of the Proposed Action and Alternatives. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

11.2.14.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on climate and potential climate change impacts on the Proposed Action's installations and infrastructure were evaluated using the significance criteria presented in Table 11.2.14-1. The categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to climate and climate change-vulnerable resources addressed in this section are presented as a range of possible impacts.

CEQ requires the consideration of climate change from two perspectives. The first is the potential for impacts on climate change through GHG emissions resulting from the Proposed Action or Alternatives. The second is related to the implications and possible effects of climate change on the environmental consequences of the Proposed Action or Alternatives. This extends to the impacts of climate change on facilities and infrastructure that would be part of the Proposed Action or Alternatives (CEQ, 2014).

CEQ has established the significance criteria for GHG emissions at 25,000 MT CO_2e on an annual basis, with the requirement that if projected emissions exceed this threshold, a GHG emissions quantitative analysis is warranted (CEQ, 2014). Although 25,000 MT is a very small fraction (one 266,920th) of the total U.S. emissions of 6,673 MMT CO_2e in 2013 (USEPA, 2015r), the sum of additional emissions as a consequence of the deployment of FirstNet, combined with multiple new sources of CO_2 and other GHGs from other projects and human activities, could be significant.

CEQ guidance for the consideration of effects of climate change on the environmental consequences of the Proposed Action is more general. In addition to the consideration of climate change's effects on environmental consequences, it also includes the impact that climate change may have on the projects themselves (CEQ, 2014). Projects located in areas that are vulnerable to the effects of climate change (e.g., sea level rise) may be at risk. Analysis of these risks through the NEPA process could provide useful information to the project planning to ensure these projects are resilient to the impacts of climate change.

Table 11.2.14-1: Impact Significance Rating Criteria for Climate Change

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less Than Significant with Mitigation Measures Incorporated	Less Than Significant	No Impact
Contribution to climate change through GHG emissions	Magnitude or Intensity	Exceedance of 25,000 metric tons of CO_2e/year, and global level effects observed.	Effect that is potentially significant, but with mitigation is less than significant.	Only slight change observed.	No increase in greenhouse gas emissions or related changes to the climate as a result of project activities.
	Geographic Extent	Global impacts observed.		Global impacts observed.	NA
	Duration or Frequency	Long-term changes. Changes cannot be reversed in a short term.		Changes occur on a longer time scale. Changes cannot be reversed in the short term.	NA
Effect of climate change on FirstNet installations and infrastructure	Magnitude or Intensity	Climate change effects (such as sea level rise or temperature change) negatively impact FirstNet infrastructure.	Effect that is potentially significant, but with mitigation is less than significant.	Only slight change observed.	No measurable impact of climate change on FirstNet installations or infrastructure.
	Geographic Extent	Local and regional impacts observed.		Local and regional impacts observed.	NA
	Duration or Frequency	Long-term changes. Changes cannot be reversed in a short term.		Changes occur on a longer time scale. Changes cannot be reversed in the short term.	NA

NA = Not Applicable

11.2.14.3. Projected Future Climate

There have been increasing numbers of days above 95 °F and nights above 75 °F, and decreasing numbers of extremely cold days since 1970 in the Southeast. Temperatures across this section of the United States are expected to increase during this century. Major consequences of warming include significant increases in the number of hot days, defined as 95 °F or above, and decreases in freezing events. (USGCRP, 2014a)

Air Temperature

Figure 11.2.14-1 and Figure 11.2.14-2 illustrate the anticipated temperature changes for low and high GHG emission scenarios for North Carolina from a 1969 to 1971 baseline.

Cfa **–** Figure 11.2.14-1 shows that by mid-century (2040 to 2059), temperatures in the Cfa region of North Carolina under a low-emissions scenario would increase by approximately 4 °F in much of the state and in the eastern area of the region, temperature is expected to increase by 3 °F. By the end of the century (2080 to 2099) under a low emissions scenario temperatures in this region would increase by approximately 5 °F in the majority of the state and by 4 °F on the east coast. (USGCRP, 2009)

Figure 11.2.14-2 shows that under a high emissions scenario for the period (2040 to 2059), temperatures would increase by approximately 4 °F. Under a high emissions scenario for the period (2080 to 2099) in the Cfa region of North Carolina, temperatures would increase by approximately 8 °F in the majority of the state and by 7 °F on the coast. (USGCRP, 2009)

Cfb **–** Temperatures in the Cfb region are expected to increase by mid-century (2040 to 2059) under a low emissions scenario by 4 °F and by the end of the century (2080 to 2099) by 5 °F. (USGCRP, 2009). Under a high emissions scenario, temperatures in the Cfb region are expected to increase 5 °F by mid-century, and 8 °F by the end-of the century. (USGCRP, 2009)

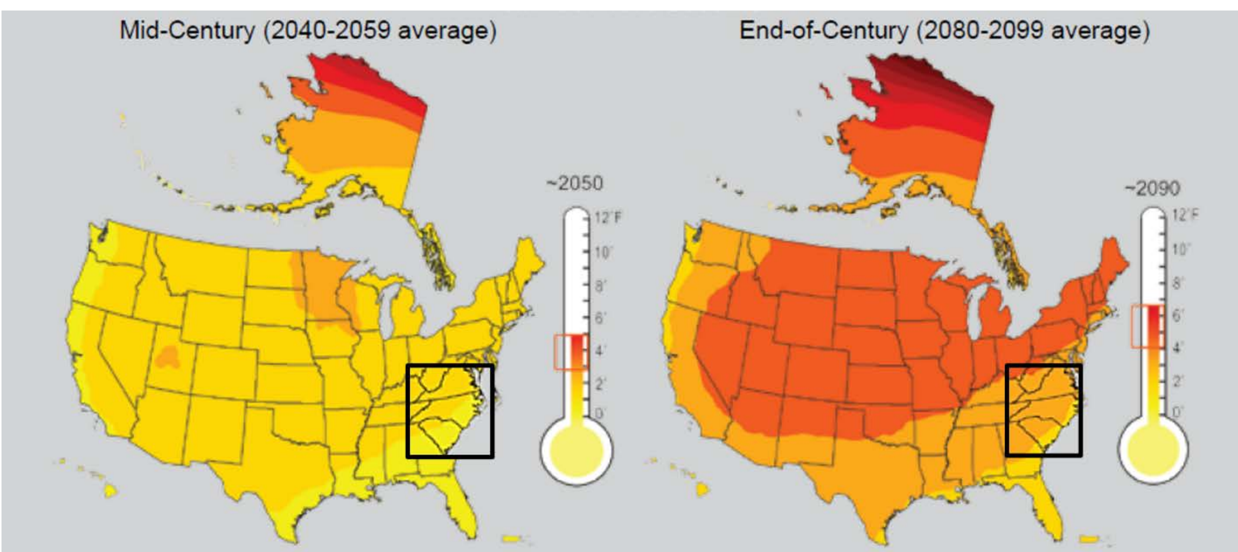

Figure 11.2.14-1: North Carolina Low Emission Scenario Projected Temperature Change

Source: (USGCRP, 2009)

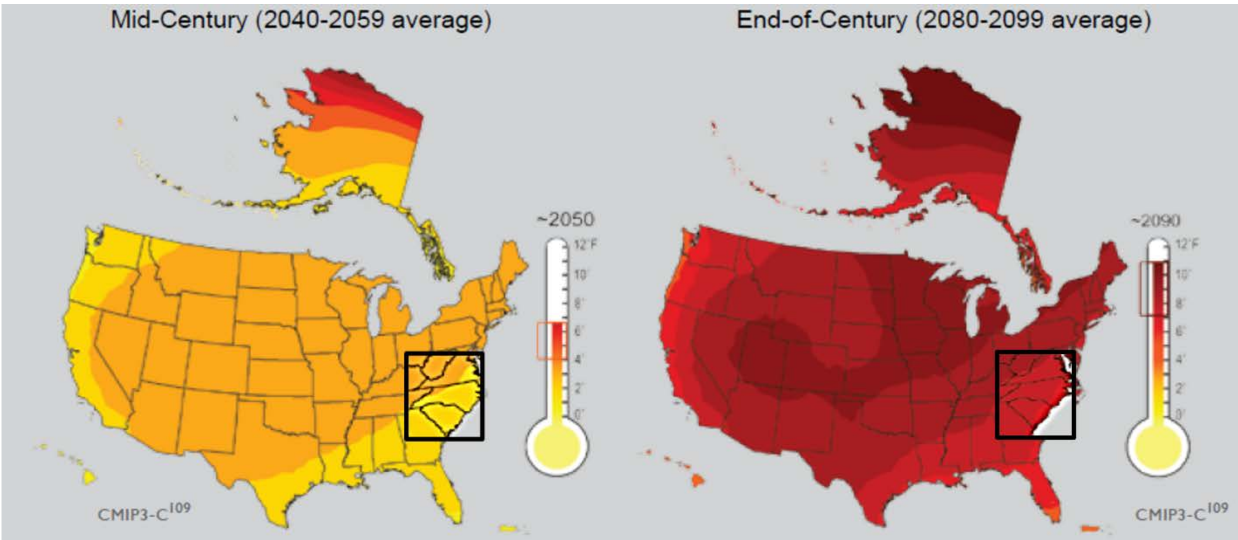

Figure 11.2.14-2: North Carolina High Emission Scenario Projected Temperature Change

Source: (USGCRP, 2009)

Precipitation

Predicting future precipitation patterns in the Southeast are much less certain that projections for temperature. The Southeast is located in the transition zone between projected wetter conditions to the north and drier conditions to the southwest; therefore, many of the model projections show only small changes relative to natural variations. However, many models do project drier conditions in the far southwest portion of the region and wetter conditions in the far northeast portion of the region. (USGCRP, 2014a)

Figure 11.2.14-3 and Figure 11.2.14-4 show predicted seasonal precipitation change for an approximate 30-year period of 2071 to 2099 compared to a 1970 to 1999 approximate 30-year baseline. Figure 11.2.14-3 shows seasonal changes in a low emissions scenario, which assumes rapid reductions in emissions (where rapid reductions means more than 70 percent cuts from current levels by 2050) (USGCRP, 2014b).

Figure 11.2.14-4 shows a high emissions scenario, which assumes continued increases in emissions, with associated large increases in warming and major precipitation changes. (Note: white areas in the figures indicate that the changes are not projected to be larger than could be expected from natural variability.) (USGCRP, 2014b)

Cfa – Figure 11.2.14-3 shows that in a high emissions reduction scenario in the 30-year period for 2071 to 2099, precipitation would increase by 10 percent in spring and summer for the entire state. There are no expected changes in precipitation in winter other than fluctuations due to natural variability. Fall precipitation is expected to increase by 10 percent in some areas of the Cfa region and in other areas of the region there are no expected changes to precipitation. (USGCRP, 2014b)

Figure 11.2.14-4 shows that if emissions continue to increase, winter precipitation could increase as much as 20 percent in much of the state and 10 percent in the southwest corner over the period 2071 to 2099. In spring and fall, precipitation in this scenario is expected to increase 10 percent. Summer precipitation is anticipated to increase 10 percent in the majority of the state with no significant changes expected in a portion of the region on the coast. (USGCRP, 2014b)

Cfb **–** Precipitation changes for the Cfb region are consistent with projected changes for the Cfa region in winter, spring, summer, and fall under a low emissions scenario. In fall, there are no expected changes in precipitation. (USGCRP, 2009)

Under a high emissions scenario winter precipitation is projected to increase 20 percent. In spring and summer, precipitation is anticipated to increase by 10 percent. Fall precipitation is expected to remain the same or increase 10 percent depending on the area of the Cfb region. (USGCRP, 2009)

Sea Level

Several factors would continue to affect sea level rise in the future. Glacier melt adds water to the ocean, and increasing ocean temperatures result in thermal expansion. Worldwide, “glaciers have generally shrunk since the 1960s, and the rate at which glaciers are melting has accelerated over the last decade. The loss of ice from glaciers has contributed to the observed rise in sea level” (USEPA, 2012e). When water warms, it also expands, which contributes to sea level rise in the world’s oceans. “Several studies have shown that the amount of heat stored in the ocean has increased substantially since the 1950s.” (USEPA, 2012e). Sea level and currents could be influenced by the amount of heat stored in the ocean. (USEPA, 2012e).

The amount of sea level rise will vary in the future along different stretches of the U.S. coastline and under different absolute global sea level rise scenarios. Variation in sea level rise along different stretches of coast is mostly due to varying rates of land subsidence (also known as relative sea level rise). In the National Climate Assessment (NCA) potential sea level rise scenarios were reported. These scenarios were developed based on varying degrees of ocean warming and ice sheet loss as estimated by organizations like IPCC (NOAA; USGS; SERPD; and USACE, 2012). Figure 11.2.14-5 and Figure 11.2.14-6 show feet of sea level above 1992 levels at different tide gauge stations. Figure 11.2.14-5 shows an eight inch global sea level rise above 1992 levels by 2050 and Figure 11.2.14-6 shows a 1.24 foot global sea level rise above 1992 levels by 2050 (USGCRP, 2014c).

Cfa **–** Figure 11.2.14-5 presents an 8-inch global average sea level rise above 1992 levels, resulting in a 0.7 to 1 foot sea level rise in 2050 along the coast of North Carolina. Figure 11.2.14-6 indicates that a 1.24-foot sea level rise above 1992 level would result in a 1.3 to 1.7 foot sea level rise in 2050 along the coast. (USGCRP, 2014c)

Cfb **–** This region is not affected by sea level rise.

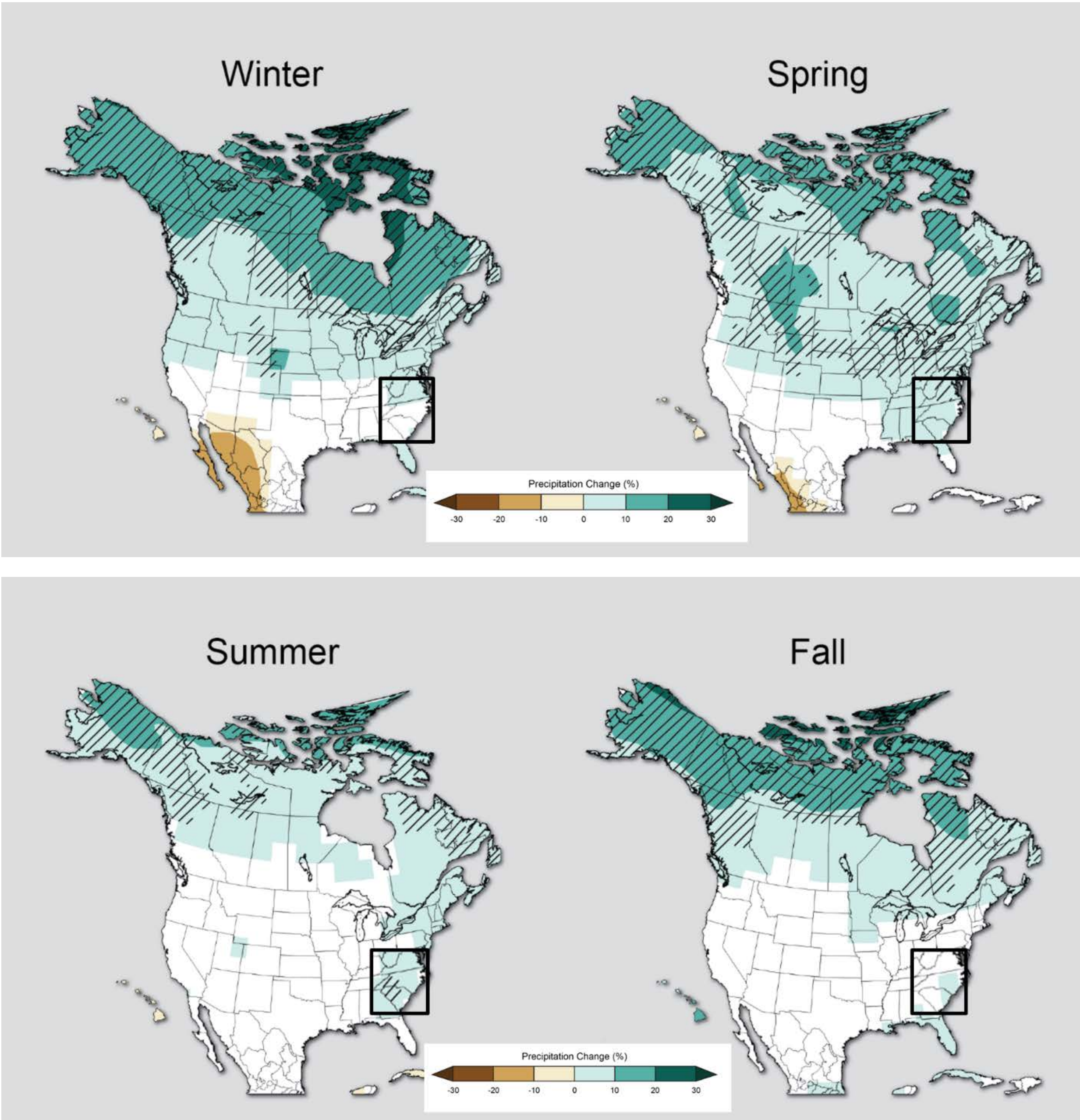

Figure 11.2.14-3: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a Low Emissions Scenario

Source: (USGCRP, 2014b)

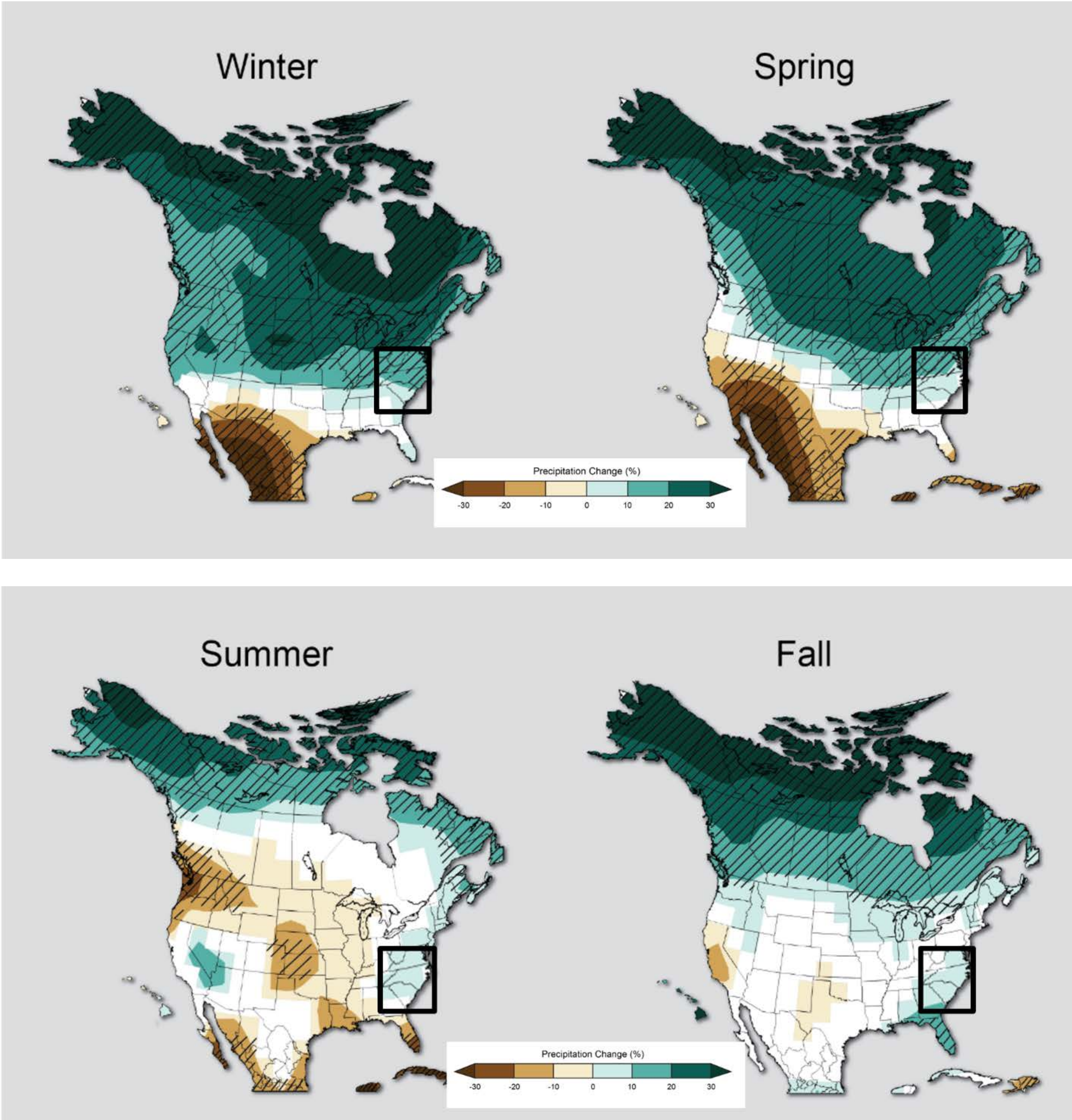

Figure 11.2.14-4: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a High Emissions Scenario

Source: (USGCRP, 2014b)

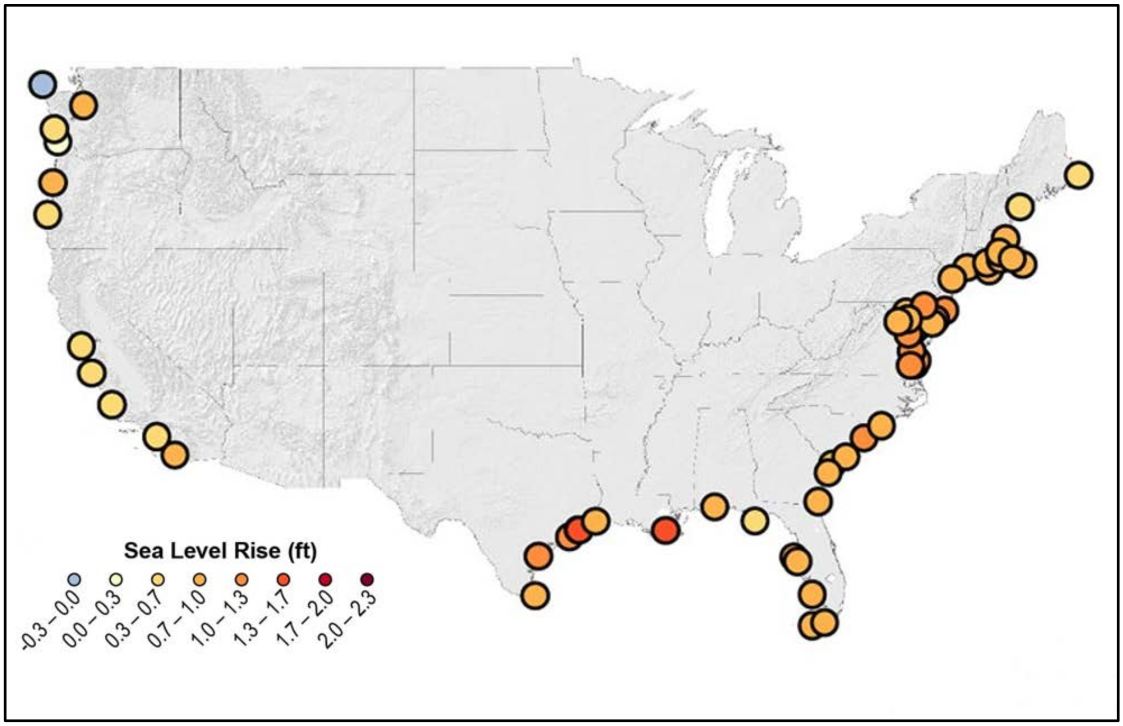

Figure 11.2.14-5: 8-inch Sea Level Rise Above 1992 Levels by 2050

Source: (USGCRP, 2014c)

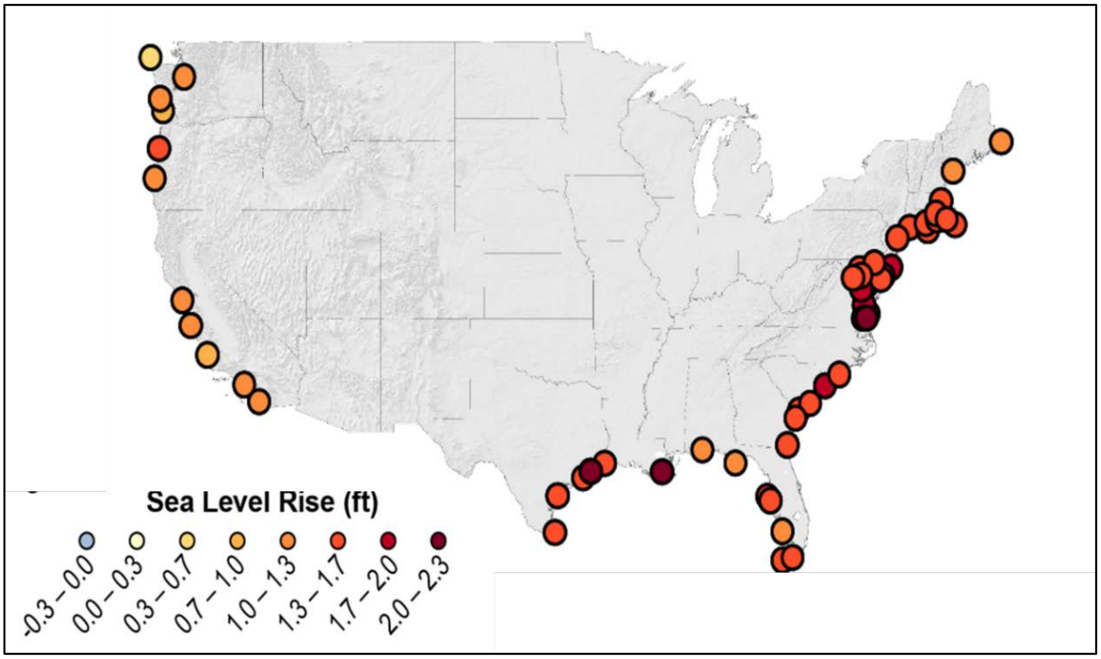

Figure 11.2.14-6: 1.24-foot Sea Level Rise Above 1992 Levels by 2050

Source: (USGCRP, 2014c)

Severe Weather Events

It is difficult to forecast the impact of climate change on severe weather events such as thunderstorms and hurricanes. Trends in thunderstorms and hurricanes are subject to greater uncertainties than trends in temperature and associated variables directly related to temperature such as sea level rise. Climate scientists are studying the influences of climate change on severe storms such as hurricanes. Recent research has yielded insights into the connections between warming and factors that cause severe storms. For example, atmospheric instability and increases in wind speed with altitude link warming with tornadoes and thunderstorms. Additionally, research has found a link between warming and conditions favorable for severe thunderstorms. However, more research is required to make definitive links between severe weather events and climate change. (USGCRP, 2014d)

United States coastal waters are expected to experience more intense hurricanes with related increases in wind, rain, and storm surges (but not necessarily an increase in the number of storms that make landfall) (USGCRP, 2014d). Changes in hurricane intensity are difficult to project because there are contradictory effects at work. Warmer oceans increase storm strength with higher winds and increased precipitation. However, changes in wind speed and direction with height are also projected to increase in some regions; this tends inhibit storm formation and growth. Current research suggests stronger, more rain-producing tropical storms and hurricanes are generally more likely, though such storms may form less frequently; ultimately, more research would provide greater certainty (USGCRP 2009).

11.2.14.4. Description of Environmental Concerns

Greenhouse Gas Emissions

Increases in GHG emissions have altered the global climate, leading to generalized temperature increases, weather disruption, increased droughts and heatwaves, and may have potentially catastrophic long-term consequences for the environment. Although GHGs are not yet regulated by the federal government, many states have set various objectives related to reducing GHG emissions, particularly CO_2 emissions from fossil fuels.

Based on the impact significance criteria presented in Table 11.2.14-1, climate change impacts as a result of GHG emissions could be significant and require a quantitative analysis if FirstNet's deployment of technology was responsible for increased emissions of 25,000 MT/year or more. The GHG emissions resulting from FirstNet activities fall into two categories: short-term and long-term. Short-term emissions could be associated with deployment activities (vehicles and other motorized construction equipment) and would have no long-term or permanent impact on GHG emissions or climate change. Long-term (both temporary and permanent) emission increases could result from operations, including the use of grid-provided electricity by FirstNet equipment such as transmitters and optical fiber, and from the temporary use of portable or onsite electric generators (a less efficient, more carbon-intensive source of electricity), during emergency situations when the electric grid was down, for example after a hurricane.

A single large cell tower would typically require 20-60kW of power to operate (Balshe, 2011). The CO_2 emissions associated with the operation of the tower would depend on whether it was supplied by a stand-alone power source, such as a generator, or from the grid, and whether it was operating at full power on a continuous basis. A standard 60kW 3-phase diesel generator consumes approximately 5.0 gallons of diesel per hour (Diesel Service & Supply, 2016). Diesel fuel combustion emits 22.38 lbs of CO_2 per gallon (EIA, 2015f). A 60kW transmitter running on a generator would therefore be responsible for 1,221 kg of CO_2/day. Running continuously, the tower would cause the emission of 446 MT of CO_2 per year.

However, grid-provided electricity would result in less CO_2 emissions than onsite provided energy. Using the average carbon intensity of grid-provided electricity of 1,136.53 lbs/MWh (USEPA, 2015s), the same transmitter would be responsible for approximately 271 MT of CO_2 per year running continuously. Actual emissions would depend on the fuel mix and efficiency of the systems from which electricity was generated. Some may even run on low/no-emissions renewable energy. Therefore, this scenario is a “worst-case” for GHG emissions. If the system deployment resulted in the operation of more than 50 60 kW towers operating at maximum power in remote locations on diesel generators on a continuous basis, the 25,000 MT/year threshold may be exceeded and a quantitative analysis required. By comparison optical fiber is considerably more energy efficient and consumes considerably less power than transmitters (Vereecken, et al., 2011), and would not impact GHG emissions in such a way as to require a quantitative analysis.

Effects of Climate Change on Project-Related Impacts

Climate change may increase project-related impacts by magnifying or otherwise altering impacts in other resources areas. Forested areas of the Southeast and Northeast may be at a higher risk of wildland fires, particularly during the periods of extended drought that are forecasted under warming scenarios (Mitchell 2014). Summer heat stress may negatively impact crop and other agricultural production, as well as natural ecosystems and their dependent species (USGCRP 2014k).

Impact of Climate Change on FirstNet Installations and Infrastructure

The entire state is at risk for stronger hurricanes as a result of climate change. Sea level rise would increase the height, areal extent, and persistence of coastal flooding during these events (USGCRP 2014i). Stronger storms may also increase the potential for damage from high winds and wind-borne debris. In inland areas of North Carolina out of the immediate path of storm surge are nevertheless at risk of flooding. Climate change is projected to increase the frequency and severity of torrential downpours, which in turn may increase the potential for flash floods with negative impacts to communities and infrastructure (USGCRP, 2014e). Extended periods of extreme heat may impede the operation of, and increase electricity demand on, the grid in the Southeastern states (DOE, 2015) and overwhelm the capacity of on-site equipment needed to keep microwave and other transmitters cool.

11.2.14.5. Potential Impacts of the Preferred Alternative

Greenhouse Gas Emissions

The following section assesses potential GHG emission impacts associated with implementation of the Preferred Alternative in North Carolina, including deployment and operation activities.

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment and operation of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to GHG emissions, climate impacts in other resource areas, and FirstNet infrastructure and operations, and others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have no impacts to climate change under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: There would be no short-term emissions associated with construction, as construction would not take place. The equipment required to blow or pull fiber through existing conduit would be used temporarily and infrequently, resulting in no perceptible generation of GHG emissions.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up dark fiber would require no construction and have no short- or long-term emissions. This would create no perceptible change in GHG emissions.
- Satellites and Other Technologies
  - Distribution of Satellite-Enabled Devices: The installation of satellite-enabled equipment on existing structures, or the use of portable satellite-enabled devices would not create any perceptible changes in GHG emissions because they would not create any new emissions sources.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. Therefore, it is anticipated that there would be no GHG emissions or any climate change effects on the project because of these activities.

Activities with the Potential to Have Impacts

The deployment and use of energy-consuming equipment as a result of the implementation of the Preferred Alternative would result in GHG emissions whose significance would vary depending on their power requirements, duration and intensity of use, and number. The types of infrastructure deployment scenarios that could be part of the Preferred Alternative and result in potential impacts to GHG emissions and climate change include the following:

- Wired Projects
  - New Build - Buried Fiber Optic Plant: This activity would include plowing (including vibratory plowing), trenching, and directional boring, and could involve construction of POPs, huts, or other facilities to house outside plant equipment or hand holes to access fiber. These activities could generate GHG emissions.
  - New Build Aerial Fiber Optic Plant: These projects would require construction equipment for installing or replacing new poles and hanging cables as well as excavation and grading for new or modified right-of-ways or easements. It could also include construction of POPs, huts, or other facilities to house outside plant equipment. These activities could generate GHG emissions.
  - Collocation on Existing Aerial Fiber Optic Plant: These projects would require equipment for replacement of existing wiring and poles. GHG emissions associated with these projects would arise from use of machinery and vehicles to complete these activities.
  - New Build – Submarine Fiber Optic Plant: The deployment of small workboats with engines similar to recreational vehicle engines may be required to transport and lay small wired cable. The emissions from these small marine sources would contribute to GHGs.
  - Installation of Optical Transmission or Centralized Transmission Equipment: The construction of small boxes or huts or other structures would require construction equipment, which could generate GHG emissions.
- Wireless Projects
  - New Wireless Tower Construction: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in short-term, temporary GHG emissions from vehicles and construction equipment. Long-term, permanent or temporary increases in GHG emissions would result from the electricity requirements of the towers (both grid-provided and backup), and would depend on their size, number, and the frequency and duration of their use.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on existing towers. There would be no short-term GHG emissions associated with construction, as it would not occur. Minor, short-term, temporary GHG emissions may result from any associated equipment used for installation, such as cranes or other equipment. Long-term, permanent or temporary increases in GHG emissions would result from the electricity requirements of the towers (both grid-provided and backup), and would depend on their size, number, and the frequency and duration of their use.

- Deployable Technologies
    - COWs, COLTs, or SOWs: The long-term operations of these mobile systems have the potential to have GHG emission impacts in excess of 25,000 MT if operated in large numbers over the long-term. However, this would be highly dependent on their size, number, and the frequency and duration of their use.

      Emissions associated with the deployment and maintenance of a complete network solution of this type may be significant if large numbers of piloted or unmanned aircraft were used for a sustained period (i.e., months to years). Emissions would depend on the type of platforms used, their energy consumption, and the duration of the network's operation.

Potential climate change impacts associated with deployment activities as a result of implementation of the Preferred Alternative include increased GHG emissions. GHG emissions would arise from the combustion of fuel used by equipment during construction and changes in land use. Emissions occurring as a result of soil disturbance and loss of vegetation are expected to be less than significant due to the limited and localized nature of deployment activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Climate Change Impacts on FirstNet Infrastructure or Operations

Climate change effects on the Preferred Alternative could be potentially significant to less than significant with BMPs and mitigation measures incorporated because climate change may potentially impact FirstNet installations or infrastructure during periods of extreme heat, severe storms, and other weather events. Mitigation measures could minimize or reduce the severity or magnitude of a potential impact resulting to the project, including adaptation, which refers to anticipating adverse effects of climate change and taking appropriate action to prevent and minimize the damage climate change effects could cause.

11.2.14.6. Alternatives Impact Assessment

The following section assesses potential impacts to climate associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration.

Deployment Impacts

As explained above, implementation of deployable technologies could involve use of fossil-fuel-powered vehicles, powered generators, and/or aerial platforms. There could be some emissions and soil and vegetation loss as a result of excavation and grading for staging and/or landing areas depending on the type of technology. GHG emissions are expected to be less than significant based on the defined significance criteria, since activities would be temporary and short-term. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operations Impacts

Implementing land-based deployable technologies (COWs, COLTs, and SOWs) could result in emissions from mobile equipment on heavy trucks using internal combustion engines associated with the vehicles and onboard generators. While a single deployable vehicle may have an insignificant impact, multiple vehicles operating for longer periods, in close proximity, may have a cumulative impact, although this impact is expected to be less than significant due to the temporary nature of the operation of deployables. Some staging or landing areas (depending on the type of technology) may require excavation, site preparation, and paving. Heavy equipment used for these activities could produce emissions as a result of burning fossil fuels in internal combustion engines. The operation of aerial technology is anticipated to generate pollutants during all phases of flight, except for balloons. These activities are expected to be less than significant due the limited duration of deployment activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Additionally, routine maintenance and inspections of the deployable technologies are anticipated to be less than significant, given that these activities are of low-intensity and short duration

Climate Change Impacts on FirstNet Deployable Infrastructure or Operations

Climate change effects have the most noticeable impacts over a long period. Climate change effects such as temperature, precipitation changes, and extreme weather during operations would be expected but could have little to no impact on the deployed technology due to the temporary nature of deployment. However, if these technologies are deployed continuously (at the required location) for an extended period, climate change effects on deployables could be similar to the Proposed Action, as explained above. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure, or satellites and other technologies. As a result, there would be no impacts to GHG emissions or climate as a result of deployment and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 11.1.14, Climate Change.

11.2.15. Human Health and Safety

11.2.15.1. Introduction

This section describes potential impacts to human health and safety in North Carolina associated with deployment of the Proposed Action and Alternatives. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

11.2.15.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on human health and safety were evaluated using the significance criteria presented in Table 11.2.15-1. The categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to human health and safety addressed in this section are presented as a range of possible impacts.

Table 11.2.15-1: Impact Significance Rating Criteria for Human Health and Safety

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Exposure to Worksite Occupational Hazards as a Result of Activities at Existing or New FirstNet Sites	Magnitude or Intensity	Exposure to concentrations of chemicals above occupational regulatory limits and time-weighted averages (TWAs). A net increase in the amount of hazardous or toxic materials or wastes generated, handled, stored, used, or disposed of, resulting in unacceptable risk, exceedance of available waste disposal capacity and probable regulatory violations. Exposure to recognized workplace safety hazards (physical and chemical). Violations of various regulations including: OSHA, RCRA, CERCLA, TSCA, EPCRA.	Effect is potentially significant, but with mitigation is less than significant.	No exposure to chemicals above health-protective screening levels. Hazardous or toxic materials or wastes could be safely and adequately managed in accordance with all applicable regulations and policies, with limited exposures or risks. No exposure to unsafe working conditions or other workplace safety hazards.	No exposure to chemicals, unsafe working conditions, or other workplace safety hazards.
	Geographic Extent	Regional impacts observed ("regional" assumed to be at least a county or county-equivalent geographical extent, could extend to state/territory).		Impacts only at a local/neighborhood level.	NA
	Duration or Frequency	Occasional frequency during the life of the project.		Rare event.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with Mitigation Measures Incorporated	Less than Significant	No Impact
Exposure to Hazardous Materials, Hazardous Waste, and Mine Lands as a Result of FirstNet Site Selection and Site-Specific Land Disturbance Activities	Magnitude or Intensity	Exposure to concentrations of chemicals above regulatory limits, or USEPA chemical screening levels protective of the general public. A net increase in the amount of hazardous or toxic materials or wastes generated, handled, stored, used, or disposed of, resulting in unacceptable risk, exceedance of available waste disposal capacity and probable regulatory violations. Site contamination conditions could preclude development of sites for the proposed use. Violations of various regulations including OSHA, RCRA, CERCLA, TSCA, EPCRA. Unstable ground and seismic shifting.	Effect is potentially significant, but with mitigation is less than significant.	No exposure to chemicals above health-protective screening levels. Hazardous or toxic materials or wastes could be safely and adequately managed in accordance with all applicable regulations and policies, with limited exposures or risks. No exposure to unstable ground conditions or other workplace safety hazards.	No exposure to chemicals, unstable ground conditions, or other workplace safety hazards.
	Geographic Extent	Regional impacts observed (“regional” assumed to be at least a county or county-equivalent geographical extent, could extend to state/territory).		Impacts only at a local/neighborhood level.	NA
	Duration or Frequency	Occasional frequency during the life of the project.		Rare event.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Exposure to Hazardous Materials, Hazardous Waste, and Occupational Hazards as a Result of Natural And Man-Made Disasters	Magnitude or Intensity	Exposure to concentrations of chemicals above regulatory limits, or USEPA chemical screening levels protective of the general public. Site contamination conditions could preclude development of sites for the proposed use. Physical and biologic hazards. Loss of medical, travel, and utility infrastructure.	Effect is potentially significant, but with mitigation is less than significant.	No exposure to chemicals above health-protective screening levels. Hazardous or toxic materials or wastes could be safely and adequately managed in accordance with all applicable regulations and policies, with limited exposures or risks. No exposure to unsafe conditions. No loss of medical, travel, or utility infrastructure.	No exposure to chemicals, unsafe conditions, or other safety and exposure hazards.
	Geographic Extent	Regional impacts observed ("regional" assumed to be at least a county or county-equivalent geographical extent, could extend to state/territory).		Impacts only at a local/neighborhood level.	NA
	Duration or Frequency	Occasional frequency during the life of the project.		Rare event.	NA

NA = Not Applicable

11.2.15.3. Description of Environmental Concerns

Worksite Physical Hazards, Hazardous Materials, and Hazardous Waste

The human health and safety concern having the greatest likelihood to occur during FirstNet deployment activities is occupational injury to telecommunication workers. The nature of telecommunication work requires workers to execute job responsibilities that are inherently dangerous. Telecommunication work activities present physical and chemical hazards to workers. The physical hazards have the potential to cause acute injury, long-term disabilities, or in the most extreme incidents, death. Other occupational activities such as handling hazardous materials and hazardous waste often do not result in acute injuries, but may compound over multiple exposures, resulting in increased morbidity. Based on the impact significance criteria presented in Table 11.2.15-1, occupational injury impacts could be potentially significant if the FirstNet deployment locations require performing occupational activities that have the highest relative potential for physical injury and/or chemical exposure. Examples of activities that may present increased risk and higher potential for injury include working from heights (i.e., from towers and roof tops), ground-disturbing activities like trenching and excavating, confined space entry, operating heavy equipment, and the direct handling of hazardous materials and hazardous waste. Predominately, these hazards are limited to occupational workers, but may impact the general public if there are trespassers or if any physical of chemical hazard extends beyond the restricted access of proposed FirstNet work sites.

To protect occupational workers, OSHA mandates that employers be required to protect their employees from occupational hazards that could result in injury. Depending on the source of the hazard and the site-specific work conditions, OSHA generally recommends the following hierarchy for protecting onsite workers (OSHA, 2016c).

1.) Engineering controls;

2.) Work practice controls;

3.) Administrative controls; and

4.) Personal protective equipment (PPE).

Engineering controls are often physical barriers that prevent access to a worksite, areas of a worksite, or from idle and operating equipment. Physical barriers take many forms like perimeter fences, trench boxes[142], chain locks, bollards, storage containers (for storing equipment and chemicals), or signage and caution tape. Other forms of engineering controls could include machinery designed to manipulate the quality of the work environment, such as ventilation blowers. Whenever practical, engineering controls may result in the complete removal of the hazard from the work site, an example of which would be the transport and offsite disposal of hazardous waste or asbestos containing materials.

[142] Trench boxes are framed metal structures inserted into open trenches to support trench faces, to protect workers from cave-ins and similar incidents (OSHA, 2016).

Work practice controls could be implemented as abiding by specific OSHA industry standards, such as the Confined Space Entry standard (29 CFR 1910.146) or thru the development of employer specific workplace rules and operational practices (OSHA, 2016c). To the extent practicable, FirstNet partner(s) would likely implement and abide by work practice controls through employee safety training and by developing site-specific health and safety plans (HASP). The HASPs would identify all potential hazardous materials and hazardous wastes, potential physical hazards, and applicable mitigation steps. Other components of a HASP identifying appropriate PPE for each task and the location of nearby medical facilities. Safety Data Sheets (SDS) describing the physical and chemical properties of hazardous materials used during FirstNet deployment and maintenance activities, as well as the physical and health hazards, routes of exposure, and precautions for safe handling and use would be kept and maintained at all FirstNet Proposed Action sites. In addition to HASPs and SDSs, SOPs would be developed and implemented by FirstNet partner(s) for critical and/or repetitive tasks that require attention to detail, specialized knowledge, or clear stepwise directions to prevent worker injury and to ensure proper execution.

Administrative controls are employer-initiated methods to reduce the potential for injury and physical fatigue (OSHA, 2016c). Administrative controls may take the form of limiting the number of hours an employee is allowed to work per day, requiring daily safety meetings before starting work, utilizing the buddy system for dangerous tasks and any other similar activity or process that is designed to identify and mitigate unnecessary exposure to hazards. When engineering controls, work practice controls, and administrative controls are not feasible or do not provide sufficient protection, employers must also provide appropriate PPE to their employees and ensure its proper use. PPE is the common term used to refer to the equipment worn by employees to minimize exposure to chemical and physical hazards. Examples of PPE include gloves, protective footwear, eye protection, protective hearing devices (earplugs, muffs), hard hats, fall protection, respirators, and full body suits. PPE is the last line of defense to prevent occupational injuries and exposure.

The NCDOL is authorized by OSHA to administer the state program, which oversees employee safety in all state and local government and private sector workplaces. The FirstNet proposed action and site work will not be performed by state or local employees. The involvement of state and local employees will be limited to emergency responders (e.g., police, fire, emergency medical transporters, etc.) and local government permitting authorities.

Hazardous Materials, Hazardous Waste, and Mine Lands

The presence of environmental contamination and mine lands at FirstNet deployment sites has the potential to negatively impact health and safety of workers and the general public. Past or present contaminated media, such as soil and groundwater, may be present and become disturbed as a result of site activities. Mines may cause unstable surface and subsurface conditions because of underground shaft collapses or seismic shifting. Based on the impact significance criteria presented in Table 11.2.15-1, human health impacts could be significant if FirstNet deployment sites are near contaminated properties or abandoned mine lands. Prior to the start of any FirstNet Proposed Action, potential site locations should be screened for known environmental contamination and/or mining activities using federal resources such as the USEPA Cleanups in My Community database and U.S. Department of Interior's Abandoned Mine Lands inventory, through the NCDEQ, or through an equivalent commercial resource.

By screening sites for environmental contamination, mining activities, and reported environmental liabilities, the presence of historic contamination and unsafe ground conditions could be evaluated and may influence the site selection process. In general, the lower the density of environmental contamination or mining activities, the more favorable the site will be for FirstNet Proposed Actions. If sites containing known environmental contamination (or mine lands) are selected for proposed FirstNet deployment activities, it may be necessary to implement additional controls (e.g., engineering, work practice, administrative, and/or PPE) to ensure workers, and the general public, are not unnecessarily exposed to the associated hazards. Additionally, for any proposed FirstNet deployment site, it is possible undocumented environmental contamination is present.

During FirstNet deployment activities, if any soil or groundwater is observed to be stained or emitting an unnatural odor, it may be an indication of environmental contamination. When such instances are encountered, it may be necessary to stop work until the anomaly is further assessed through record reviews or environmental sampling. Proposed FirstNet deployment would attempt to avoid known contaminated sites. However, in the event that FirstNet is unable to avoid a contaminated site, then site analysis and remediation would be required under RCRA, CERCLA, and applicable North Carolina state laws in order to protect workers and the general public from direct exposure or fugitive contamination.

Exposure assessments identify relevant site characteristics, temporal exposure parameters, and toxicity data to determine the likelihood of adverse health effects. More formally known as a human health risk assessment (HHRA), these studies provide mathematical justification for implementing controls at the site to protect human health. If the HHRA determines the potential for adverse health effects is too great NCDEQ may require FirstNet to perform environmental clean-up actions at the site to lower the existing levels of contamination. HHRAs help determine which level of PPE (i.e., Level D, Level C, Level B, or Level A) is necessary for a work activity. HHRAs take into account all exposure pathways: absorption, ingestion, inhalation, and injection. Therefore, specific protective measures (e.g., controls and PPE) that disrupt the exposure pathways could be identified, prioritized, and implemented.

Natural and Manmade Disasters

The impacts of natural and manmade disasters are likely to present unique health and safety hazards, as well as exacerbate pre-existing hazards, such as degrading occupational work conditions and disturbing existing environmental contamination. The unique hazards presented by natural and manmade disasters may include, fire, weather incidents (e.g., floods, tornadoes, hurricanes, etc.), earthquakes, vandalism, large- or small-scale chemical releases, utility disruption, community evacuations, or any other event that abruptly and drastically denudes the availability or quality of transportation infrastructure, utility infrastructure, medical infrastructure, and sanitation infrastructure. Additionally, such natural and manmade disasters could directly impact public safety communication infrastructure assets through damage or destruction.

Based on the impact significance criteria presented in Table 11.2.15-1, human health impacts could be significant if FirstNet deployment sites are located in areas that are directly impacted by natural and manmade disasters that could lead to exposure to hazardous wastes, hazardous materials, and occupational hazards. FirstNet’s emphasis on public safety-grade communications infrastructure may result in a less than significant beneficial impact, as new infrastructure could be deployed with additional structural hardening, and existing infrastructure may also be hardened as appropriate and feasible, in an effort to reduce the possibility of infrastructure damage or destruction to some degree.

Potential mitigation measures for natural disasters is to be aware of current weather forecasts, forest fire activities, seismic activities, and other news worthy events that may indicate upcoming disaster conditions. Awareness provides time and opportunity to plan evacuation routes, to relocate critical equipment and parts, and to schedule appropriate work activities preceding and after the natural disaster. These mitigation steps reduce the presence of workers and dangerous work activities to reduce the potential for injury or death. Manmade disasters could be more difficult to anticipate due to the unexpected or accidental nature of the disaster. Though some manmade disasters are due to malicious intentions, many manmade disasters result from human error or equipment failure. The incidence of manmade disasters affecting FirstNet deployment sites would be difficult to predict and diminish because the source of such disasters is most likely to originate from sources independent of FirstNet activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

11.2.15.4. Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and maintenance activities.

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to human health and safety and others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of no impacts to less than significant with mitigation, depending on the deployment scenario or site-specific activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have no impacts to human health and safety under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: the pulling or blowing of fiber optic cable would be performed through existing conduit. Use of mechanical equipment would be limited to pulley systems and blowers. Some locations with no existing power supply may require the use of electrical generators although these materials are expected to be used infrequently and in small quantities. These activities are not likely to result in serious injury or chemical exposure, or surface disturbances since work would be limited to existing entry and exit points, would be temporary, and intermittent. It is anticipated that there would be no impacts to human health and safety.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to human health and safety because there would be no ground disturbance or heavy equipment used.
- Satellites and Other Technologies
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact human health and safety resources, it is anticipated that this activity would have no impact on those resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to human health and safety as a result of implementation of the Preferred Alternative would encompass a range of impacts that occur as a result of ground disturbance activities, construction activities, equipment upgrade activities, management of hazardous materials and/or hazardous waste, and site selection. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to human health and safety include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could require the use of heavy equipment and hazardous materials. The additional noise and activity at the site would require workers to demonstrate a high level of situational awareness. Failure to follow OSHA and industry controls could result in injuries. Excavation of soil at proposed sites known to contain environmental contamination has the potential to expose workers to harmful chemicals or releases that could impact the general public in the immediate vicinity. Additionally, some of this work would likely be performed along road ROWs, increasing the potential

for vehicle traffic to collide with site workers or equipment. If a proposed deployment activity involves the operation of heavy equipment, managing hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.

- New Build – Aerial Fiber Optic Plant: Installation of new poles and fiber optic lines could require excavation activities, working from heights, use of hazardous materials, and site locations in ROWs. Hazards associated with the site work include injury from heavy equipment, fall hazards, chemical hazards, and the potential for vehicle traffic to collide with site workers or equipment. Excavation of soil at proposed sites known to contain environmental contamination has the potential to expose workers to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.
- Collocation on Existing Aerial Fiber Optic Plant: Installation of overhead fiber optic lines would require work from height. In some instances, new poles would be installed requiring excavation activities with heavy equipment. Hazards associated with the site work include injury from heavy equipment, fall hazards, chemical hazards, and the potential for vehicle traffic to collide with site workers or equipment. Excavation of soil at proposed sites known to contain environmental contamination has the potential to expose workers to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.
- New Build – Submarine Fiber Optic Plant: The installation of fiber optic cables in or near bodies of water requires workers to operate over aquatic and/or marine environments, which presents opportunities for drowning. When working over water exposure to sun, high or low temperatures, wind, and moisture could impact worker safety. Construction of landings and/or facilities on shore to accept submarine cable would require site preparation, construction, and management of hazardous materials and hazardous waste. Excavation of soils or sediments at proposed sites known to contain environmental contamination may result in workers being exposed to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.
- Installation of Optical Transmission or Centralized Transmission Equipment: Installation of transmission equipment would require site preparation, construction activities, and management of hazardous materials and hazardous waste. Excavation of soils at proposed sites known to contain environmental contamination may result in workers being exposed to harmful chemicals or releases that could impact the general public in

the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads would require site preparation, construction activities, and management of hazardous materials and hazardous waste. Communication towers would be erected, requiring workers to perform their duties from heights sufficient to result in serious injury or death in the event of falling. Working from heights may also result in additional overhead hazards and falling objects. Excavation of soils at proposed sites known to contain environmental contamination may result in workers being exposed to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower. This would require workers to perform their duties from heights sufficient to result in serious injury or death in the event of falling not result in impacts to soils. Working from heights may also result in additional overhead hazards and falling objects. Excavation of soils at proposed sites known to contain environmental contamination may result in workers being exposed to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.
- Deployable Technologies
  - The use of deployable technologies could result in soil disturbance if land-based deployables are deployed on unpaved areas or if the implementation results in paving of previously unpaved surfaces. The use of heavy machinery presents the possibility for spills and soil and water contamination, and noise emissions could potentially impact human health; and vehicles and heavy equipment present the risk of workplace and road traffic accidents that could result in injury. Set-up of a cellular base station contained in a trailer with a large expandable antenna mast is not expected to result in impacts to human health and safety. However, due to the larger size of the deployable technology, site preparation or trailer stabilization may be required to ensure the self-contained unit is situated safely at the site. Additionally, the presence of a dedicated electrical generator

would produce fumes and noise. The possibility of site work and the operation of a dedicated electrical generator have the potential for impacts to human health and safety. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions. Use of aerial vehicles would not involve telecommunication site work. Prior to deployment and when not in use, the aerial vehicles would likely require preventive maintenance. Workers responsible for these activities may handle hazardous materials, not limited to fuel, solvents, and adhesives.

- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: The use of portable devices that utilize satellite technology would not impact human health and safety because there is no construction activities or use of hazardous materials. The installation of permanent equipment on existing structures may require workers to operate from heights or in sensitive environments. As a result, the potential for falling, overhead hazards, and falling objects is greater and there is a potential to impact human health and safety.

In general, the abovementioned FirstNet activities could potentially involve site preparation work, construction activities, work in potentially harmful environments (road ROWs, work over water, and environmental contamination, and mine lands), management of hazardous materials and hazardous waste, and weather exposure. Potential impacts to human health and safety associated with deployment of the Proposed Project could include injury from site preparation and operating heavy equipment, construction activities, falling/overhead hazards/falling objects, exposure and release of hazardous chemicals and hazardous waste, and release of historic contamination to the surrounding environment. It is anticipated that potential health impacts associated with human exposure to environmental hazardous materials in air, water, or soil, the risk of road traffic, workplace accidents and injuries, noise exposure, and risk of infectious disease transmission would be less than significant due to the small scale of likely FirstNet activities that would be temporary and of short duration. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that there would be less than significant impacts to human health and safety associated with routine inspections of the Preferred Alternative at the programmatic level. Use of PPE or other mitigation measures could be necessary to adequately protect workers. If usage of heavy equipment is part of routine maintenance, the potential for impacts to human health and safety would also increase.

It is anticipated that potential health impacts associated with human exposure to environmental hazardous materials in air, water, or soil, the risk of road traffic, workplace accidents and injuries, noise exposure, and risk of infectious disease transmission would be less than significant due to the small scale of likely FirstNet activities that would be temporary and of short duration. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

11.2.15.5. Alternatives Impact Assessment

The following section assesses potential impacts to human health and safety associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable land-based infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to human health and safety as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts to human health and safety. The largest of the land-based deployable technologies may require site preparation work or stabilization work to ensure the self-contained trailers are stable. Heavy equipment may be necessary to complete the site preparation work. However, in general, the deployable technologies are small mobile units that could be transported as needed. While in operation, the units are parked and operate off electrical generators or existing electrical power sources. Connecting deployable technology to a power supply may present increased electrocution risk during the process of connecting power. If the power source were an electrical generator, then there would also likely be a need to manage fuel onsite. These activities could result in less than significant impacts to human health and safety. It is anticipated that potential health impacts associated with human exposure to environmental hazardous materials in air, water, or soil, the risk of road traffic, workplace accidents and injuries, noise exposure, and risk of infectious disease transmission would be less than significant due to the small scale of likely FirstNet activities that would be temporary and of short duration. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be no impacts to human health and safety associated with routine inspections of the Preferred Alternative. Use of PPE or other mitigation measures may be necessary to adequately protect workers. If usage of heavy equipment is part of routine maintenance, the potential for impacts to human health and safety would also increase. These impacts would be less than significant because of the small scale of likely FirstNet activities; activities associated would routine maintenance, inspection, and deployment of deployable technologies would be temporary and often of limited duration. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to human health and safety as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 11.2.15, Human Health and Safety.

NC APPENDIX A – COMMUNITIES OF CONCERN

Table A-1: S1 Ranked Terrestrial Communities of Concern in North Carolina

Habitat Type	Ecoregion	Description	Sub Habitat	Distribution
Coastal Plain Depression Communities	Coastal Plain	Communities can contain wetland shrubs and herbs and areas where water is ponded. Species may include black gum, water oak, red maple, and sweet gum, buttonbush, blueberries, and swamp doghobble, royal ferns, sedges, sphagnum, and other mosses.	Floating Bog Small Depression Drawdown Meadow Small Depression Pond	Throughout Coastal Plain
Coastal Plain Floodplains	Coastal Plain, Sandhills	Includes levees forest, cypress gum swamps, bottomland hardwoods, and alluvial floodplains. Vegetation density, coverage, and distribution varies dependent on the water exposure.	Blackwater Bottomland Hardwoods Coastal Plain Semi permanent Impoundment Sand and Mud Bar	Throughout Coastal Plain and Sandhills
Coastal Plain Marl Outcrop	Coastal Plain	Bare or vegetated limestone that is not regularly flooded. Calciphilic vascular plants such as *Asplenium heteroresiliens*, *Cystopteris tennesseensis*, and *Aquilegia canadensis* are usually present	Coastal Plain Marl Outcrop	Vegetated outcrops of limestone in the Coastal Plain
Coastal Plain Nonalluvial Wetland Forests	Coastal Plain	Most saturated areas dominated by bald cypress, swamp black hum, and red maple. In the peatlands, loblolly and pond pine and Atlantic white cedar are more common. In the driest portion, cherrybark, laurel, and swamp chestnut oak, tulip poplar, sweetgum,	Nonriverine Swamp Forest Nonriverine Wet Hardwood Forest Peatland Atlantic White Cedar Forest Wet Marl Forest	Poorly drained areas of eastern Coastal Plain

Habitat Type	Ecoregion	Description	Sub Habitat	Distribution
		American elm, and red maple are the predominant species.		
Dry Longleaf Pine Communities	Piedmont, Sandhills, Coastal Plain	Communities dominated by long leaf pine canopies with grass/herb groundcover. One of the most endangered habitats in the country.	Mesic Pine Savanna Pine/Scrub Oak Sandhill Sand Barren	Sparsely located throughout the Piedmont, Sandhills, and Coastal Plain
Estuarine Communities	Coastal Plain	Includes salt marshes and flats, brackish marshes, sand and mud flats, and various estuarine communities. Community structure varies depend on the dynamics it is exposed to - dominated by grasses or limited sparse algal or brackish vegetation.	Brackish Marsh	Coastal North Carolina
Freshwater Tidal Wetlands	Coastal Plain	Dominated by dense herbaceous vegetation that consists of bald cypress, swamp black gum, water tupelo, giant cordgrass, sawgrass, and cattails.	Tidal Freshwater Marsh Tidal Red Cedar Forest Tidal Swamp	Primarily in northern Coastal Plain, mainly in Currituck and Albemarle
Grass and Heath Balds	Blue Ridge Mountains and Piedmont	Naturally, or apparently naturally, non-forested high mountain complexes dominated by grasses and sedges	Grassy Bald Heath Bald	Throughout Blue Ridge Mountains and Piedmont.

Habitat Type	Ecoregion	Description	Sub Habitat	Distribution
High Elevation Rock Outcrops	Blue Ridge Mountains	Sparse vegetation or moderate herbaceous vegetation cover interspersed with fractured, bare rock. Species may include S*chizachyrium scoparium, Coreopsis major, Lasallia papulosa or Umbilicaria caroliniana, Physocarpus opulifolius, Packera plattensis (= Senecio plattensis)*, and *Phlox subulata ssp. subulata*. Species typically lacking in this subtype include *Kalmia latifolia, Amelanchier arborea, Vaccinium pallidum, Danthonia spicata, Krigia montana, Carex umbellata, and Dichanthelium acuminatum.*	High Elevation Rocky Summit	Flat to vertical outcrops of fractured rock on ridge tops, upper to mid slopes, or other topographically exposed settings, at high elevations, generally above 4000 feet
Low Elevation Cliffs and Rock Outcrops	Blue Ridge Mountains, Sandhills, Piedmont	Dominated by exposed rock with occasional forest canopy, more often with patchy vegetation dependent on soil moisture and depth.	Coastal Plain Cliff	Western portions of North Carolina
			Low Elevation Rocky Summit	
			Montane Cliff	
			Piedmont Cliff	
Maritime Grasslands	Coastal Plain	Dune vegetation is mainly sea oats grass and American beach grass, while upper beach species are sea rocket, Dixie sandmat, seaside sandmat, Russian thistle, and seabeach amaranth. Vegetation is influenced by over wash, sea spray, slat, and erosion.	Dune Grass	Coastline of North Carolina
			Live Dune Barren	
			Maritime Vine Tangle	
			Stable Dune Barren	
Maritime Upland Forests	Coastal Plain	Vegetation varies due to salinity and	Calcareous Coastal Fringe Forest	Located along barrier islands and

Habitat Type	Ecoregion	Description	Sub Habitat	Distribution
		inundation, they are often disturbed communities. Community structure ranges from grassy areas, to shrubby composition, with vines, and mixed forested areas. One of the most endangered habitat in north Carolina.	Coastal Fringe Evergreen Forest	mainland North Carolina coast
			Coastal Fringe Shell Woodland	
			Maritime Deciduous Forest	
			Maritime Evergreen Forest	
Maritime Wetlands	Coastal Plain	Vegetation varies due to salinity and inundation, they are often disturbed communities. Community structure ranges from grassy areas, to shrubby composition, with vines, and mixed forested areas. One of the most endangered habitat in north Carolina.	Interdune Marsh	Barrier islands and the mainland North Carolina coast
			Interdune Pond	
			Maritime Shrub Swamp	
			Maritime Swamp Forest	
			Maritime Wet Grassland	
Mountain Bogs and Fens	Blue Ridge Mountains	Rarest communities in Southern Appalachians. Formed in poorly drained depressions, gentle slopes, or flat valleys with variable vegetation dependent on soil type, hydrology, and location. Plants species vary, but may contain Shrub rhododendron, alder, rose, poison sumac, red maple, white pine, hemlock, pitch pine, river birch, occasionally red spruce, many species of *Juncus* and sedges.	French Broad Valley Bog	Western portions of North Carolina
			Low Mountain Seepage Bog	
			Southern Appalachian Bog	
			Southern Appalachian Fen	
			Swamp Forest--Bog Complex	

Habitat Type	Ecoregion	Description	Sub Habitat	Distribution
Mountain Cove Forests	Blue Ridge Mountains	Occurring in low to mid-elevation that are stable, climax forests with dense tree canopy. Common trees found may include yellow poplar, sugar maple, yellow buckeye, basswood, beech, black cherry, white ash, red maple, hemlock, black birch, umbrella tree, fraser magnolia, and northern red oaks.	Canada Hemlock Forest	Mountains of western North Carolina
Mountain Dry Coniferous Woodlands	Blue Ridge Mountains, Sandhills, Piedmont	Located along ridgetops, spur ridges, and steep slopes in low to middle elevations with shallow acidic soils. Usually dominated by Virginia pine changing to mountain pine at high elevations. Species may include table mountain pine, pitch pine, Virginia pine, chestnut oak, Carolina hemlock, or white pine	Carolina Hemlock Forest	Southern Appalachians, common in ridge and valley and Cumberland Plateau
			Southern Mountain Pine--Oak Forest	
Mountain Oak Forests	Blue Ridge Mountains	Mix of community types with range of moisture and topography requirements. Species and community structures may include high elevation red oak, montane white oak, chestnut oak, montane oak-hickory, dry oak-hickory, dry-mesic oak-hickory, basic oak hickory, pine-oak heath, and mesic mixed hardwood.	Calcareous Oak-Walnut Forest	Throughout western North Carolina
			High Elevation White Oak Forest	

Habitat Type	Ecoregion	Description	Sub Habitat	Distribution
Natural Lake Communities	Coastal Plain	Tree dominated wetlands on shores of lakes. Vegetation varies dependent on size of lake. Most lakes are acidic; therefore have low productivity, which also influences vegetation.	Natural Lake Shoreline Marsh	Throughout southeastern Coastal Plain
			Natural Lake Shoreline Swamp	
Northern Hardwood Forests	Blue Ridge Mountains	High elevation forests with boulderfield forest and beech gaps in moist cool climates. Other species can include yellow birch, American beech, yellow buckeye, and sugar maple. More wide spread than spruce fire forests.	Northern Hardwood Forest	High elevation sites throughout western North Carolina
Peatland Pocosins	Sandhills, Coastal Plain	Acidic, poor nutrient habitats that are constantly submerged. Species may include low shrubs and stunted pond pine, with beds of sphagnum, pitcher plants, and cranberry.	Peatland Canebrake	Throughout outer Coastal Plain, mainly in Sandhill region or Carolina Bays of inner Coastal Plain
			Pocosin Opening	
			Pond Pine Woodland	
Piedmont and Coastal Plain Mesic Forests	Piedmont, Coastal Plain	Shrubby forests with unusual mixed composition of wetland and upland species and of Piedmont and Coastal Plain species, occurring in moist upland habitat. Species include American beech, tulip poplar and red oak, and in the western Piedmont, eastern hemlock	Cape Fear Valley Mixed Bluff Forest	Throughout Piedmont, in Umstead State Park, Duke Forest, Hill Demonstration Forest, Raven Rock State Park, Eno River State Park, and Uwharrie National Forest and Coastal Plain in North Carolina
Piedmont and Coastal Plain Oak Forests	Piedmont, Mid-Atlantic	Occur on ridge tops, upper slopes, south facing slopes, and other dry upland areas with acidic soils. Dominated by	Dry-Mesic Basic Oak--Hickory Forest	Throughout Piedmont and Coastal Plain

Habitat Type	Ecoregion	Description	Sub Habitat	Distribution
		mix of oak and hickory, with occasional pines.		
Piedmont and Mountain Floodplains	Blue Ridge Mountains, Piedmont	Ecologically rich and diverse communities without levees, sloughs, and ridges that are exposed to infrequent high intensity flooding event. Species may include eastern hemlock, yellow poplar, yellow birch, red maple, sycamore, river birch, box elder, rhododendron, dog-hobble and alder.	Montane Alluvial Forest Montane Floodplain Slough Forest Piedmont Bottomland Forest Piedmont/Mountain Canebrake Rocky Bar and Shore	Across the Blue Ridge Mountains, Piedmont regions of North Carolina
Piedmont and Mountain Glades and Barrens	Blue Ridge Mountains, Piedmont	Consists of forest woodlands on steep slopes, shallow soils, and rocky outcrops, patchy vegetation on rocky outcrops, and vegetation on sloping low elevations with in alkaline soils.	Acidic Shale Slope Woodland Calcareous Shale Slope Woodland Diabase Glade High Elevation Mafic Glade Low Elevation Basic Glade Piedmont Basic Glade Ultramafic Outcrop Barren Xeric Hardpan Forest Xeric Piedmont Slope Woodland	Across the Blue Ridge Mountains, Piedmont regions of North Carolina
Piedmont and Mountain Upland Pools and Depressions	Blue Ridge Mountains, Piedmont	Dominated by wetland shrubs and herbs, often small in size without permanent saturation. Species may include black gum, water oak, red maple, sweet gum, buttonbrush, blueberries, royal ferns, sedges, and sphagnum.	Upland Pool	Across the Blue Ridge Mountains, Piedmont regions of North Carolina
Spruce-Fir Forests	Blue Ridge Mountains	Mix of northern hardwoods and northern red oaks	Fraser Fir Forest Red Spruce--Fraser Fir Forest	High mountain peaks in western North Carolina,

Habitat Type	Ecoregion	Description	Sub Habitat	Distribution
		with a red spruce mix, becoming more dominate in higher elevations. Dominated by Fraser firs above 6,000 feet.		generally above 4,500 feet.
Streamhead Pocosins	Sandhills, Coastal Plain	Located ravines in permanently saturated Sandhill seeps and are characterized by an open canopy of pond pine. Species may include red maple, sourwood, swamp black gum, and tulip poplar.	Stream head Canebrake	Throughout outer Coastal Plain and Sandhill, mainly in Sandhill region or Carolina Bays of inner Coastal Plain
Upland Seepages and Spray Cliffs	Blue Ridge Mountains, Piedmont, Sandhill, and Coastal Plain	Dominated by exposed rock with occasional forest canopy, more often with patchy vegetation dependent on soil moisture and depth.	Hillside Seepage Bog	Across the Blue Ridge Mountains, Piedmont regions of North Carolina
			Low Elevation Seep	
Wet Pine Savannas	Coastal Plain, Sandhills	Found in mineral wetlands with an open canopy of longleaf or pond pine and understory of wiregrass, cane, herbs, and pocosin shrubs. Vegetation species are dependent on soil moisture and fire frequency.	Northern Wet Pine Savanna	Lower Coastal Plain and Sandhills on wet, flat areas and low islands in peatlands or swamps
			Sandy Pine Savanna	
			Very Wet Loamy Pine Savanna	
			Wet Loamy Pine Savanna	
			Wet Piedmont Longleaf Pine Forest	
			Wet Pine Flatwoods	

Table A-2: Essential Fish Habitat (EFH) in North Carolina

Mid-Atlantic Species				
Common Name	**Eggs**	**Larvae/YOY**[143]	**Juveniles**	**Adults**
Albacore tuna	No EFH has been designated for this life stage.	No EFH has been designated for this life stage.	Concentrations offshore with a southern boundary of Cape Hatteras.	Concentrations offshore of North Carolina.
Atlantic butterfish	Pelagic habitats over bottom depths of less than 50,000 feet, with a southern boundary of Cape Hatteras.	Pelagic habitats over depths between 134 and 1,148 feet, with a southern boundary of Cape Hatteras.	Pelagic habitats over depths between 33 and 918 feet, inshore estuaries and embayments with a southern boundary of Pamlico Sound and inshore waters from southern New England to South Carolina.	Pelagic habitats over depths between 33 and 820 feet, inshore estuaries and embayments with a southern boundary of Pamlico Sound and inshore waters from southern New England to South Carolina.
Atlantic herring	No EFH in North Carolina.	No EFH in North Carolina.	Pelagic and bottom habitats with depths between 49 and 443 feet, with a southern boundary of Cape Hatteras.	Pelagic and bottom habitats with depths between 65 and 427 feet, with a southern boundary of Cape Hatteras.
Atlantic mackerel	Pelagic habitats over bottom depths of less than 330 feet, with a southern boundary of Cape Hatteras.	Pelagic habitats over bottom depths between 68 and 328 feet, with a southern boundary of Cape Hatteras.	Pelagic habitats over bottom depths between 30 and 360 feet, with a southern boundary of Cape Hatteras.	Pelagic habitats over bottom depths of less than 557 feet, with a southern boundary of Cape Hatteras.
Atlantic Surfclam	NA	NA	Substrate habitat from the beach zone to a depth of 656 feet, with a southern boundary of Cape Hatteras.	Substrate habitat from the beach zone to a depth of 656 feet, with a southern boundary of Cape Hatteras.
Atlantic Sharpnose Shark (highly migratory)	NA	Concentrations offshore with a northern boundary of Cape Hatteras.	Concentrations offshore with a northern boundary of Cape Hatteras.	Concentrations offshore of North Carolina.
Basking shark	NA	NA	Concentrations offshore north of Cape Hatteras.	Concentrations offshore north of Cape Hatteras.
Bigeye Thresher Shark (highly migratory)	NA	Concentrations offshore of North Carolina.	Concentrations offshore of North Carolina.	Concentrations offshore of North Carolina.
Bigeye Tuna (highly migratory)	No EFH has been designated for this life stage.	No EFH has been designated for this life stage.	Concentrations offshore of North Carolina.	Offshore north of Cape Hatteras.

[143] YOY (Young of the year): “All of the fish of a species that were born in the past year, from transformation to juvenile until January 1.” (EPA 2015p)

Mid-Atlantic Species				
Common Name	**Eggs**	**Larvae/YOY**[143]	**Juveniles**	**Adults**
Bignose Shark (highly migratory)	NA	No EFH has been designated for this life stage.	Bottom habitats of the deeper waters of the Continental Shelf offshore of North Carolina.	Bottom habitats of the deeper waters of the Continental Shelf offshore of North Carolina.
Black sea bass	On the Continental Shelf with a southern boundary of North Carolina.	Pelagic habitat over the Continental Shelf, with a southern boundary of Cape Hatteras.	Demersal waters over the Continental Shelf, with a southern boundary of Cape Hatteras.	Demersal waters over the Continental Shelf, with a southern boundary of Cape Hatteras and offshore with a southern boundary of North Carolina.
Blacknose Shark (highly migratory)	NA	Concentrations offshore of North Carolina.	Concentrations offshore of North Carolina.	Concentrations offshore of North Carolina.
Blue Marlin (highly migratory)	No EFH in North Carolina.	No EFH in North Carolina.	Concentrations offshore of North Carolina.	Concentrations offshore of North Carolina.
Blue Shark (highly migratory)	NA	No EFH in North Carolina.	Concentrations offshore north of Cape Hatteras.	Concentrations offshore of North Carolina.
Bluefin tuna (highly migratory)	No EFH in North Carolina.	No EFH in North Carolina.	Concentrations offshore of North Carolina.	Concentrations offshore of North Carolina.
Bluefish	Offshore, the pelagic waters over the Continental Shelf (from the coast out to the eastern wall of the Gulf Stream), at mid-shelf depths.	Offshore, the pelagic waters greater than 45 feet over the Continental Shelf, and the "slope sea" and Gulf Stream between latitudes 29^{o} 00 N and 40^{o} 00 N.	Offshore, the pelagic waters over the Continental Shelf (from the coast out to the eastern wall of the Gulf Stream), and the "slope sea" and Gulf Stream between latitudes 29 00 N and 40 00 N. Inshore, EFH includes all major estuaries.	Offshore, the pelagic waters over the Continental Shelf (from the coast out to the eastern wall of the Gulf Stream). Inshore, EFH includes all major estuaries.
Bonnethead Shark (highly migratory)	NA	No EFH in North Carolina.	Concentrations offshore with a northern boundary of Cape Lookout.	Concentrations offshore with a northern boundary of Cape Lookout.
Clearnose skate	No information on this life stage is available.	NA	Rocky or gravel substrate habitat from the shore to a depth of 1,640 feet, with a southern boundary of Cape Hatteras.	Rocky or gravel substrate habitat from the shore to a depth of 1,312 feet, with a southern boundary of Cape Hatteras.
Common Thresher Shark (highly migratory)	NA	Concentrations offshore of North Carolina.	Concentrations offshore of North Carolina.	Concentrations offshore of North Carolina.

Mid-Atlantic Species				
Common Name	**Eggs**	**Larvae/YOY**[143]	**Juveniles**	**Adults**
Dusky Shark (highly migratory)	NA	Concentrations offshore of North Carolina.	Concentrations offshore of North Carolina.	Concentrations offshore of North Carolina.
Finetooth Shark (highly migratory)	NA	No EFH designated in North Carolina.	Concentrations offshore with a northern boundary of Cape Hatteras.	Concentrations offshore with a northern boundary of Cape Hatteras.
Golden tilefish	Pelagic habitat of temperatures between 45.5° and 63.5°F of the Continental Shelf south to the boundary of Virginia and North Carolina.	Pelagic habitat of temperatures between 45.5° and 63.5°F of the Continental Shelf south to the boundary of Virginia and North Carolina.	Semi-lithified clay substrate habitat of the outer Continental Shelf at depths of 328 to 984 feet south to the boundary of Virginia and North Carolina.	Semi-lithified clay substrate habitat of the outer Continental Shelf at depths of 328 to 984 feet south to the boundary of Virginia and North Carolina.
Great Hammerhead Shark (highly migratory)	NA	Concentrations offshore of North Carolina.	Concentrations offshore of North Carolina.	Concentrations offshore of North Carolina.
Little skate	Sand substrate habitat at a depth of less than 89 feet, south to the Middle Atlantic Bight	NA	Sand or gravel substrate habitat from the shore to a depth of 450 feet, with a southern boundary of Cape Hatteras.	Sand, gravel, or mud substrate habitat from the shore to a depth of 450 feet, with a southern boundary of Cape Hatteras.
Longbill Spearfish (highly migratory).	No EFH designated for this life stage.	No EFH designated for this life stage.	Concentrations offshore of North Carolina.	Concentrations offshore of North Carolina.
Longfin Inshore Squid	Inshore and offshore hard bottom, submerged aquatic vegetation, sand, or mud habitat at depths less than 154 feet, with a southern boundary of Cape Hatteras.	NA	Pelagic habitats in inshore and offshore continental shelf waters over depths between 19.5 and 525 feet and in embayments, with a southern boundary of Cape Hatteras.	Pelagic habitats in inshore and offshore continental shelf waters over depth between 19.5 and 656 feet and in embayments, with a southern boundary of Cape Hatteras.
Longfin Mako Shark (highly migratory)	NA	Concentrations offshore of North Carolina.	Concentrations offshore of North Carolina.	Concentrations offshore of North Carolina.
Monkfish	Surface water over depths of 49 to 3,281 feet, with a southern boundary of Cape Hatteras.	Pelagic habitat over depths of 82 to 3,281 feet, with a southern boundary of Cape Hatteras.	Sand-shell mix, algae covered rocks, sand, gravel, or mud substrate habitat at depths between 82 and 656 feet, with a southern boundary of Cape Lookout.	Sand-shell mix, algae covered rocks, sand, gravel, or mud substrate habitat at depths between 82 and 656 feet, with a southern boundary of Cape Lookout.

Mid-Atlantic Species				
Common Name	Eggs	Larvae/YOY[143]	Juveniles	Adults
Night Shark (highly migratory)	NA	Concentrations offshore of North Carolina.	Concentrations offshore of North Carolina.	Concentrations offshore of North Carolina.
Northern Shortfin Squid	Pelagic habitats along the outer continental shelf and slope within the latitudinal range of 40°N to 35°50 N.	NA	Pelagic habitats along the outer continental shelf and slope, with a southern boundary of South Carolina.	Pelagic habitats on the continental shelf and slope with a southern boundary of South Carolina.
Oceanic Whitetip Shark (highly migratory)	NA	Concentrations offshore of North Carolina.	Concentrations offshore of North Carolina.	Concentrations offshore of North Carolina.
Offshore hake	Pelagic habitat along the outer Continental Shelf at depths of less than 4101 feet, with a southern boundary of Cape Hatteras.	No EFH in North Carolina.	No EFH in North Carolina.	Bottom habitat at depths of 492 to 1247 feet, with a southern boundary of Cape Hatteras.
Porbeagle shark	NA	Concentrations offshore north of Pamlico Sound.	Concentrations offshore north of Pamlico Sound.	No EFH in North Carolina.
Red crab	Egg-bearing females are found on shallow continental slope at depths between 656 and 1,312 feet, with a southern boundary of Cape Hatteras.	Water column from the surface to the seafloor over depths of 656 to 5,906 feet, with a southern boundary of Cape Hatteras.	Silt, clay, and all composite substrate habitat at depths between 2,296 and 5,906 feet, with a southern boundary of Cape Hatteras.	Silt, clay, and all composite substrate habitat at depths between 656 and 4,265 feet, with a southern boundary of Cape Hatteras.
Red hake	Surface waters of the continental shelf, with a southern boundary of Cape Hatteras.	Surface waters of the continental shelf, with a southern boundary of Cape Hatteras.	Substrate habitats with shell fragments of the continental shelf, with a southern boundary of Cape Hatteras.	Sand and mud substrate habitats with depressions at a depth of less than 328 feet of the continental shelf, with a southern boundary of Cape Hatteras.
Roundscale Spearfish (highly migratory, similar to white marlin)	No EFH designated.	No EFH designated.	Concentrations offshore of North Carolina.	Concentrations offshore of North Carolina.
Sailfish (highly migratory)	No EFH defined for North Carolina.	No EFH defined for North Carolina.	Epipelagic and coastal concentrations offshore at the Outer Banks.	Concentrations offshore of North Carolina.
Sand Tiger Shark (highly migratory)	NA	Concentrations offshore of North Carolina.	Concentrations offshore of North Carolina.	Concentrations offshore of North Carolina.
Sandbar Shark (highly migratory)	NA	Concentrations offshore north of Cape Hatteras.	Concentrations offshore of North Carolina.	Concentrations offshore of North Carolina.

Mid-Atlantic Species				
Common Name	**Eggs**	**Larvae/YOY[143]**	**Juveniles**	**Adults**
Scalloped Hammerhead Shark (highly migratory)	NA	Concentrations offshore with a northern boundary of Frying Pan Shoals.	Concentrations offshore of North Carolina.	Concentrations offshore of North Carolina.
Scup	No EFH in North Carolina.	No EFH in North Carolina.	Demersal habitat over the Continental Shelf, with a southern boundary of Cape Hatteras.	Demersal habitat over the Continental Shelf, with a southern boundary of Cape Hatteras.
Shortfin Mako Shark (highly migratory)	NA	Concentrations offshore north of Lookout Point.	Concentrations offshore north of Lookout Point.	Concentrations offshore north of Lookout Point.
Silky Shark (highly migratory)	NA	Concentrations offshore of North Carolina.	Concentrations offshore of North Carolina.	Concentrations offshore of North Carolina.
Silver hake	Surface waters of the Continental Shelf above depths between 164 and 328 feet, with a southern boundary of Cape Hatteras.	Surface waters of the continental shelf with depths between 164 and 467 feet, with a southern boundary of Cape Hatteras.	Substrate habitats of all types at depths between 66 and 886 feet, with a southern boundary of Cape Hatteras.	Substrate habitats of all types at depths between 98 and 1,066 feet, with a southern boundary of Cape Hatteras.
Skipjack Tuna (highly migratory)	No EFH in North Carolina.	No EFH in North Carolina.	Concentrations offshore north of Cape Hatteras.	Concentrations offshore north of Cape Hatteras.
Smooth dogfish (highly migratory)	NA	Concentrations offshore of North Carolina.	Concentrations offshore of North Carolina.	Concentrations offshore of North Carolina.
Spinner shark (highly migratory)	NA	Coastal pelagic habitat with a northern boundary of Cape Hatteras.	Concentrations offshore of North Carolina.	Concentrations offshore of northern and central North Carolina, mainly concentrated around Cape Hatteras and Lookout Point.
Summer flounder	Pelagic habitat over the Continental Shelf to depths of 360 feet, with a southern boundary of Cape Hatteras.	Pelagic habitat over the Continental Shelf with a southern boundary of Cape Hatteras, nearshore waters of the Continental Shelf from Cape Hatteras south to Florida, and inshore estuaries.	Demersal habitat over the Continental Shelf with a southern boundary of Cape Hatteras, waters over the Continental Shelf to depths of 500 feet from Cape Hatteras south to Florida, and inshore estuaries.	Demersal habitat over the Continental Shelf with a southern boundary of Cape Hatteras, waters over the Continental Shelf to depths of 500 feet from Cape Hatteras south to Florida, and inshore estuaries.
Swordfish (highly migratory)	Offshore from off Cape Hatteras, North Carolina extending southward.	Offshore from off Cape Hatteras, North Carolina extending southward.	Offshore from off Cape Hatteras, North Carolina extending southward.	Offshore from off Cape Hatteras, North Carolina extending southward.
Tiger Shark (highly migratory)	NA	Concentrations offshore of North Carolina.	Concentrations offshore of North Carolina.	Concentrations offshore of North Carolina.

Mid-Atlantic Species				
Common Name	**Eggs**	**Larvae/YOY**[143]	**Juveniles**	**Adults**
White Marlin (highly migratory)	No EFH designated.	No EFH designated.	Concentrations offshore of North Carolina.	Concentrations offshore of North Carolina.
White Shark (highly migratory)	NA	Concentrations offshore of North Carolina.	Concentrations offshore of North Carolina.	Concentrations offshore of North Carolina.
Witch flounder	Surface waters of the Continental Shelf, with a southern boundary of Cape Hatteras.	Surface waters to a depth of 820 feet of the Continental Shelf, with a southern boundary of Cape Hatteras.	Fine-grained substrate habitat along the outer continental shelf with a southern boundary of Cape Hatteras.	No EFH in North Carolina.
Winter skate	No information on this life stage is available.	No larval stage exists for this species.	Sand and gravel or mud substrate from the shoreline to a depth of 1,312 feet, with a southern boundary off the coast of northern North Carolina.	Sand and gravel or mud substrate from the shoreline to a depth of 1,217 feet, with a southern boundary off the coast of northern North Carolina.
Yellowfin Tuna (highly migratory)	No EFH in North Carolina.	No EFH in North Carolina.	Concentrations offshore of North Carolina.	Concentrations offshore of North Carolina.

ACRONYMS

Acronym	Definition
AAF	Army Airfield
AARC	Average Annual Rate of Change
ACHP	Advisory Council on Historic Preservation
ACS	American Community Survey
AEC	Area of Environmental Concern
AGL	Above Ground Level
AIRFA	American Indian Religious Freedom Act
AML	Abandoned Mine Lands
APC	Air Pollution Control
AQCR	Air Quality Control Region
ARPA	Archaeological Resources Protection Act of 1979
ASL	Above Sea Level
ASPM	Aviation System Performance Metrics
ATC	Air Traffic Control
ATO	Air Traffic Organization
BGEPA	Bald and Golden Eagle Protection Act
BLM	Bureau of Land Management
BLS	Bureau of Labor Statistics
CAA	Clean Air Act
CAMA	Coastal Area Management Act
CCMP	Comprehensive Conservation and Management Plan
CDC	Centers for Disease Control and Prevention
CEQ	Council On Environmental Quality
CFR	Code of Federal Regulations
CGP	Construction General Permit
CH_4	Dioxide (CO_2), Methane
CHPP	Coastal Habitat Protection Plan
CIMC	Cleanups In My Community
CLT	Charlotte/Douglas International Airport Code
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COLT	Cell On Light Trucks
COW	Cell On Wheels
CRS	Community Rating System
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
DOE	Department of Energy
DPS	Distinct Population Segments

Acronym	Definition
DMV	Department of Motor Vehicles
DWM	Division of Waste Management
NCDWR	Division of Water Resources
EAP	Office of Environmental Assistance and Protection
EDACS	Enhanced Digital Access Communications System
EFH	Essential Fish Habitats
EIA	Energy Information Agency
EMS	Emergency Medical Services
EPCRA	Emergency Planning and Community Right To Know Act
FAA	Federal Aviation Administration
FAQ	Frequently Asked Questions
FCAQTC	Forsyth County Air Quality Technical Code
FCC	Federal Communications Commission
FEMA	Federal Emergency Management Agency
FGDC	Federal Geographic Data Committee
FHWA	Federal Highway Administration
FLM	Federal Land Manager
FMP	Fishery Management Plan
FSDO	Flight Standards District Offices
FSS	Flight Service Station
GAP	Gap Analysis Program
GHG	Greenhouse Gas
GNIS	Geographic Names Information System
GSO	Piedmont Triad International Airport Code
HAP	Hazardous Air Pollutant
HAPC	Habitat Areas of Particular Concern
HASP	Health and Safety Plans
HHRA	Human Health Risk Assessment
IBA	Important Bird Areas
IFR	Instrument Flight Rules
IPCC	Intergovernmental Panel On Climate Change
LBS	Locations-Based Services
LCCS	Land Cover Classification System
LMR	Land Mobile Radio
LPG	Liquefied Petroleum Gas
LRR	Land Resource Regions
LTE	Long Term Evolution
MBTA	Migratory Bird Treaty Act
MCAPCO	Mecklenburg County Air Pollution Control Ordinance
MCAQC	Mecklenburg County Air Quality Commission

Acronym	Definition
MCAS	Marine Corps Air Station
MHI	Median Household Income
MLRA	Major Land Resource Areas
MMPA	Marine Mammal Protection Act
MMT	(MMT) Source
MSFCMA	Magnuson Stevens Fishery Conservation and Management Act
MSL	Mean Sea Level
MYA	Million Years Ago
N_2O	Nitrous Oxide
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NAICS	North American Industry Classification System
NAS	National Airspace System
NCAAQS	North Carolina Ambient Air Quality Standards
NCAC	North Carolina Administrative Code
NCDACS	North Carolina Department of Agriculture and Consumer Services
NCDEQ	North Carolina Department of Environmental Quality
NCDHHS	North Carolina Department of Health and Human Services
NCDMF	North Carolina Division of Marine Fisheries
NCDOA	North Carolina Department of Administration
NCDOL	North Carolina Department of Labor
NCDOT	North Carolina Department of Transportation
NCOSH	North Carolina Occupational Safety and Health Division
NCREN	North Carolina Research and Education Network
NCUC	North Carolina Utilities Commission
NCWRC	North Carolina Wildlife Resources Commission
NEP	National Estuary Program
NEPA	National Environmental Policy Act
NERRS	National Estuarine Research Reserve System
NFIP	National Flood Insurance Program
NHA	National Heritage Areas
NHL	National Historic Landmarks
NHP	Natural Heritage Program
NHPA	National Historic Preservation Act of 1966, As Amended
NIH	National Institutes of Health
NIST	National Institute of Standards and Technology
NM	Nautical Miles
NOAA	National Ocean and Atmospheric Administration
NOTAM	Notices To Airmen
NO_2	Oxides of Nitrogen

Acronym	Definition
NPDES	National Pollutant Discharge Elimination System
NPSBN	Nationwide Public Safety Broadband Network
NPL	National Priorities List
NPS	National Park Service
NRC	National Response Center
NRCS	National Resources Conservation Service
NRHP	National Register of Historic Places
NSA	National Security Areas
NST	National Scenic Trails
NTFI	National Task Force on Interoperability
NTIA	National Information Telecommunications Administration
NWI	National Wetlands Inventory
NWP	Nationwide Permit
OE/AAA	Obstruction Evaluation/Airport Airspace Analysis
OEAP	Office of Environmental Assistance and Protection
OSHA	Occupational Safety and Health Administration
OTR	Ozone Transport Region
PAB	Palustrine Aquatic Bed
PADUS	Protected Areas Database of the United States
PEIS	Programmatic Environmental Impact Statement
PEM	Palustrine Emergent Wetlands
PFO	Palustrine Forested Wetlands
PGA	Peak Ground Acceleration
POP	Points of Presence
PPE	Personal Protective Equipment
PSAP	Public Safety Answering Point
PSCR	Public Safety Communications Research
PSD	Prevention of Significant Deterioration
PSS	Palustrine Scrub-Shrub Wetlands
PUB	Palustrine Unconsolidated Bottom
RCRA	Resource Conservation and Recovery Act
RF	Radio Frequency
SAA	Sense and Avoid
SAIPE	Small Area Income and Poverty Estimates
SASP	State Aviation System Plan
SDS	Safety Data Sheets
SF_6	Sulfur Hexaflouride
SGCN	Species of Greatest Conservation Need
SHPO	State Historic Preservation Office
SIP	State Implementation Plan

Acronym	Definition
SO_2	Sulfur Dioxide
SOC	Standard Occupational Classification
SOP	Standard Operating Procedures
SOW	System On Wheels
SO_x	Oxides of Sulfur
SPL	Sound Pressure Level
SUA	Special Use Airspace
SWDA	Safe Drinking Water Act
SWPPP	Storm water Pollution Prevention Plan
THPO	Tribal Historic Preservation Office
TMDL	Total Maximum Daily Load
TRI	Toxics Release Inventory
TVA	Tennessee Valley Authority
TWA	Time Weighted Average
UA	Unmanned Aircraft
UAS	Unmanned Aircraft Systems
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VFR	Visual Flight Rules
VHF	Very High Frequency
VIPER	Voice Interoperable Plan for Emergency Responders
VOC	Ozone
WAP	Wildlife Action Plan
WCS	Wetlands Classification Standard
WNC	Western North Carolina
WNCRAQA	Western North Carolina Regional Air Quality Agency
WWI	World War I
WWII	World War II

REFERENCES

The citations in this Draft PEIS reflect the most recent information on the referenced site at the time the document was being written. If the site was updated after that point, the more recent information will be incorporated, as feasible, into the final document.

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