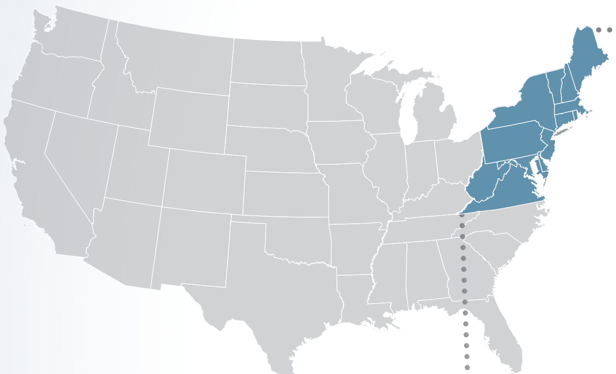
FirstNet®

Nationwide Public Safety Broadband Network

Draft Programmatic Environmental Impact Statement for the Eastern United States

VOLUME 2 - CHAPTER 4



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APRIL 2016

First Responder Network Authority

FirstNet®

Nationwide Public Safety Broadband Network

Draft Programmatic Environmental Impact Statement for the Eastern United States

VOLUME 2 - CHAPTER 4

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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
U.S. Department of Homeland Security

April 2016

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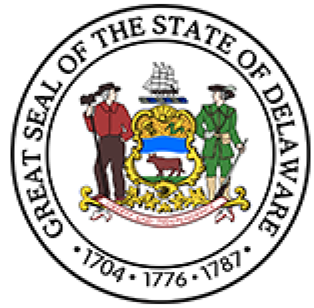
4. DELAWARE



As the first state to ratify the U.S. Constitution in 1787, Delaware was the first state to join the Union (State of Delaware, 2015a). Delaware is located on the Eastern seaboard of the United States and is bordered to the north by Pennsylvania and New Jersey, Maryland to the south and west, and the Atlantic Ocean to the east. This chapter provides details about the existing environment of Delaware as it relates to the Proposed Action.

General facts about Delaware are provided below:

State Nickname: The First State

- **Land Area:** 1,949 square miles; U.S. Rank: 49 (U.S. Census Bureau, 2015a)
- Capital: Dover
- Counties: 3 (State of Delaware, 2015a)
- Estimated Population: Over 935,000 people; U.S. Rank: 45 (U.S. Census Bureau, 2015a)
- Most Populated Cites: Wilmington, Dover, and Newark (U.S. Census Bureau, 2015b)
- Main Rivers: Christina River, Smyrna River, Leipsic River, St. Jones River, Murderkill River, Mispillion River, Nanticoke River, Delaware River, and Brandywine Creek
- Bordering Waterbodies: Atlantic Ocean and Delaware Bay
- Mountain Ranges: NA
- Highest Point: Ebright Azimuth (447.85 ft) (State of Delaware, 2015a)

4.1. AFFECTED ENVIRONMENT

4.1.1. Infrastructure

4.1.1.1. Definition of the Resource

This section provides information on key Delaware 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 4.1.1.3 provides an overview of the Delaware’s traffic and transportation infrastructure, including road and rail networks and waterway facilities. Delaware's public safety infrastructure could include any infrastructure utilized by a public safety entity[1] as defined in 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 the Delaware are presented in more detail in Section 4.1.1.4. Section 4.1.1.5 describes Delaware’s public safety communications infrastructure and commercial telecommunications infrastructure. An overview of Delaware utilities, such as power, water, and sewer, is presented in Section 4.1.1.6.

4.1.1.2. Specific Regulatory Considerations

Multiple Delaware laws and regulations pertain to the state’s public utility and transportation infrastructure and its public safety community. Table 4.1.1-1 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.

Table 4.1.1-1: Relevant Delaware Infrastructure Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Delaware Code: Title 26 Public Utilities; Title 29 State Departments; Delaware Administrative Code: Title 26 Public Utilities	Department of Natural Resources and Environmental Control; State Energy Office; Delaware Public Service Commission	Develops and maintains a comprehensive state energy plan, an energy shortage contingency plan, and a facilities energy management plan; reduces the environmental consequences of energy generation; aims to achieve effective management of energy production; collects and disseminates data and information on energy sources

[1] The term ‘public safety entity' means an entity that provides public safety services. (7 U.S.C. § 1401(26))

State Law/Regulation	Regulatory Agency	Applicability
Delaware Code: Title 7 Conservation; Delaware Administrative Code: Title 3 Agriculture; Title 7 Natural Resources and Environmental Control	Department of Natural Resources and Environmental Control; Department of Agriculture	Protects, manages, and conserves wildlife; issues licenses and permits for hunting and fishing; prevents and governs erosion, floodwater, and sediment damages; prevents, controls, reduces, and abates noise pollution; promotes the safety and welfare of state forests; manages air quality; regulates dam safety; prohibits the hunting or fishing of endangered species except when issued a permit
Delaware Code: Title 29 State Government, Title 30 State Taxes; Delaware Administrative Code: Title 1 Authorities, Boards, and Commissions	Delaware State Historic Preservation Office; Division of Historical and Cultural Affairs	Prevents further loss of national heritage and culture through the deterioration or neglect of historic buildings, sites, objects or resources; establishes the Historic Preservation Tax Credit Program which assists in preserving and rehabilitating historic buildings
Delaware Code: Title 16 Health and Safety; Title 20 Military and Civil Defense; Delaware Administrative Code: Title 2 Transportations; Title 16 Health and Safety	Department of Natural Resources and State Emergency Response Commission; Department of Safety and Homeland Security; Delaware Emergency Management Agency	Prepares and maintains a comprehensive plan for the emergency management; carries out all obligations and duties associated with state emergency or disaster response and recovery plans; directs state emergency or disaster operations; regulates travel restrictions during a state of emergency; regulates in building communications systems
Delaware Code: Title 26 Public Utilities; Delaware Administrative Code: Title 26 Public Utilities	Public Service Commission; Oil and Gas Conservation Commission	Supervises and regulates the rates, property rights, equipment, facilities, service territories, and franchises of public utilities (natural gas, electric, water, wastewater, and telecommunications); regulates cable television systems outside incorporated municipalities; certifies public utilities for public convenience and necessity; certifies and regulates electric suppliers; sets rules and regulations for energy production and distribution
Delaware Code: Title 2 Transportation; Title 17 Highways Delaware Administrative Code; Title 2 Transportation	Department of Transportation; Delaware Transportation Authority; Delaware Transit Corporation	Encourages, fosters, and assists in the development of aeronautics; encourages the establishment of airports and other air navigation facilities; licenses airports and regulates aeronautics; establishes, acquires, and operates state airports; maintains and operates turnpikes; governs public carriers (passenger rail carriers, railroads, street railways, traction railway, taxicab, limousine, motor bus or electric trackless trolley coach service); constructs, reconstructs, maintains, and improves all public roads, causeways, highways, and bridges; provide public transit services; develops plans and programs to foster efficient and economical public transportation and to serve citizens requiring specialized transportation

Source: (State of Delaware, 2015b)

4.1.1.3. Transportation

This section describes the transportation infrastructure in Delaware, including specific information related to the road networks, airport facilities, rail networks, harbors (this 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 can range from multilane road networks with asphalt surfaces to unpaved gravel or private roads. The information regarding existing transportation systems in Delaware are based on a review of maps, aerial photography, and federal and state data sources.

The Delaware Department of Transportation (DelDOT) 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 responsibilities of the DelDOT include “the planning, design, construction, and maintenance of roadways, bridges, and other multi-modal transportation facilities within the State” (DelDOT, 2004).

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

- 13,472 miles of highways and 1,599 bridges (DelDOT, 2013);
- 282 miles of rail network that includes passenger rail and freight (DelDOT, 2013);
- 41 aviation facilities, including airstrips and heliports (FAA, 2015a);
- 15 harbors (U.S. Harbors, 2015); and
- 1 major port (DelDOT, 2013).

Road Networks

As identified in Figure 4.1.1-1, the major urban center of the state are Wilmington, Newark, Glasgow, and Dover. Delaware has one major interstate to connect to other states, as well as two minor interstates to connect its major urban centers to one another; travel to local towns is via state and county routes. Table 4.1.1-2 lists the interstates and their start/end points in Delaware. 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 (USDOT, 2015).

Table 4.1.1-2: Delaware Interstates

Interstate	Southern or Western Terminus in DE	Northern or Eastern Terminus in DE
I-95	MD line near Newark	PA line near Claymont
I-295	I-95 at Newport	NJ line near Wilmington Manor
I-495	I-95 at Newport	I-95 at Claymont

In addition to the Interstate System, Delaware has both National Scenic Byways and State Scenic Byways. Both National and State Scenic Byways are roads that are recognized for one or more archaeological, cultural, historic, natural, recreational, and scenic qualities. Figure 4.1.1-1 illustrates the major transportation networks, including roadways, in Delaware. Section 4.1.8, Visual Resources, describes the National and State Scenic Byways found in Delaware from an aesthetic perspective.

National Scenic Byways are roads with nationwide interest; the byway is designated and managed by the U.S. Department of Transportation's Federal Highway Administration. Delaware has one National Scenic Byway, the Brandywine Valley National Scenic Byway (DelDOT, 2015a) (Figure 4.1.1-1). Delaware State Scenic Byways are roads with statewide interest and are designated and managed by the DelDOT. Delaware has five State Scenic Byways that crisscross the entire state (DelDOT, 2015b). For more information on National and State Scenic Byways in Delaware, see Section 4.1.8.7.

Airports

Air service to the state is provided by two major international airports, both outside Delaware: Philadelphia International Airport (PHL) and Baltimore/Washington Thurgood Marshall International Airport (BWI) (DelDOT, 2013). The largest airport in the state is New Castle Airport (ILG) in New Castle County, serving the city of Wilmington. The airport is operated by the Delaware River and Bay Authority (DelDOT, 2013). Figure 4.1.1-1 illustrates airports in the state. Section 4.1.7.5, Airspace, provides greater detail on airports and airspace in Delaware.

Rail Networks

Delaware is connected to a vast rail network of passenger rail (Amtrak), public transportation (commuter rail), and freight rail. Figure 4.1.1-1 illustrates the major rail lines in Delaware.

Amtrak runs seven lines through Delaware, including the Acela Express and Northeast Regional, which is a popular line, with routes running from Washington, D.C. to Boston in 6 hours 40 minutes and 7 hours 50 minutes, respectively. Amtrak runs on 23.3 miles of tracks through northern Delaware, serving two stations in the state: Newark and Wilmington (DelDOT, 2011a). The Wilmington station is over 100 years old and is Amtrak's 11th busiest station (DelDOT, 2013). Table 4.1.1-3 provides a complete list of Amtrak lines that run through Delaware.

Table 4.1.1-3: Amtrak Train Routes Serving Delaware

Route	Starting Point	Ending Point	Length of Trip	Cities Served in Delaware
Acela Express	Boston, MA	Washington, DC	6 hours 40 minutes	Wilmington
Cardinal	New York, NY	Chicago, IL	26 hours 30 minutes	Wilmington
Carolinian	New York, NY	Charlotte, NC	13 hours 30 minutes	Wilmington
Crescent	New York, NY	New Orleans, LA	30 hours	Wilmington
Northeast Regional	Boston, MA	Virginia Beach, VA	12 hours 30 minutes	Wilmington, Newark
Palmetto	New York, NY	Tampa/Miami, FL	28+ hours	Wilmington
Vermonter	St. Albans, VT	Washington, DC	13 hours 45 minutes	Wilmington

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

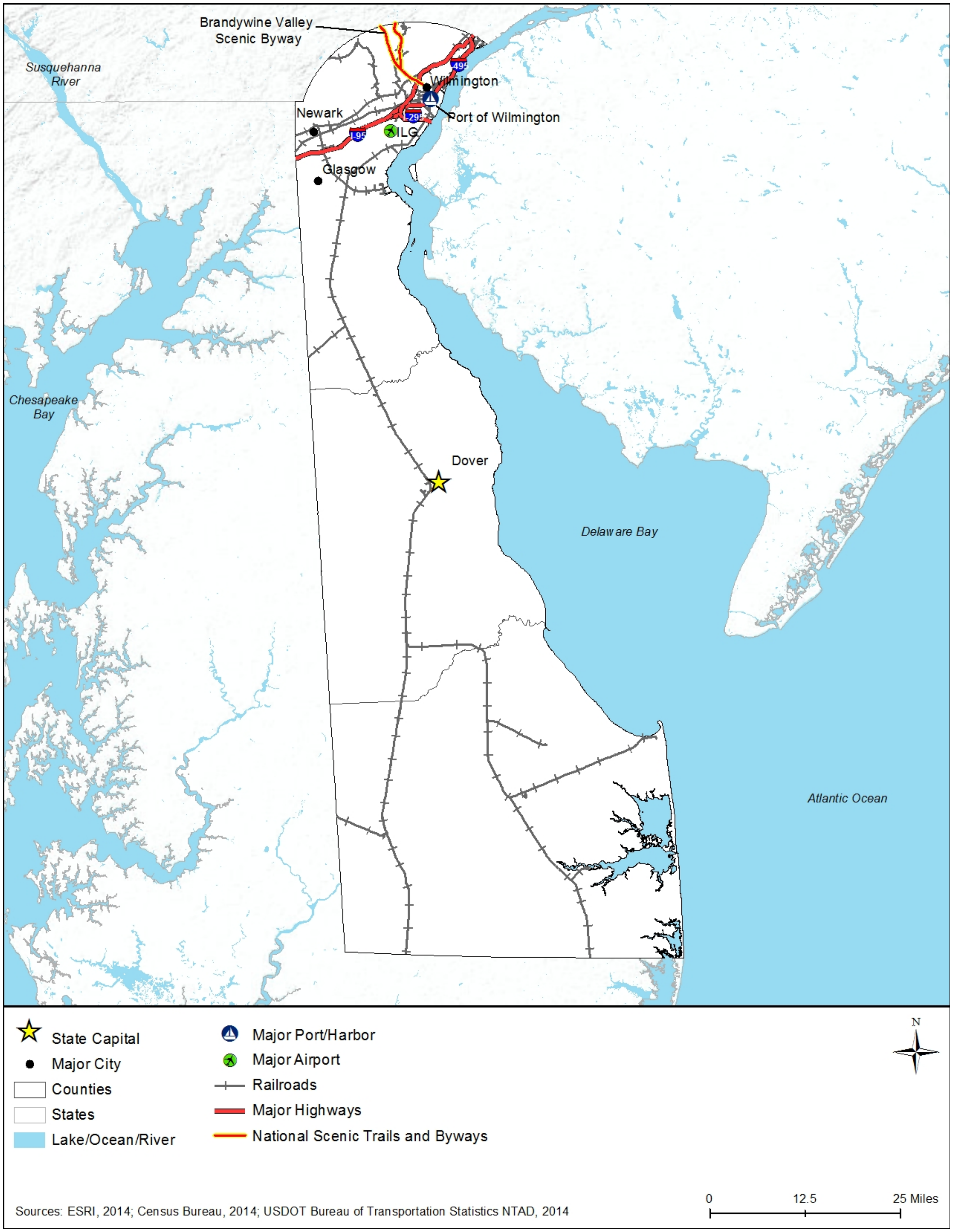


Figure 4.1.1-1: Delaware Transportation Networks

The Southeastern Pennsylvania Transportation Authority (SEPTA) operates as a commuter train service in Delaware under a contract to the Delaware Transit Corporation. SEPTA provides service between Philadelphia and four stations in Delaware: Claymont, Wilmington, Fairplay at Churchmans Crossing, and Newark. “The Wilmington-Newark line is unusual in the SEPTA regional rail system in having significant destinations at both ends; approximately one-third of ridership is Pennsylvania residents are commuting to Delaware for work, education, or other activities” (DelDOT, 2011a).

The state hosts major freight rail facilities and yards in Wilmington, Newark, Harrington, and Dover (DelDOT, 2011a). The rail traffic in Delaware is primarily pass-through, as it does not begin or end in Delaware (DelDOT, 2013).

Harbors and Ports

Although it is a coastal state, the state government of Delaware controls no major ports or harbors. The Port of Wilmington, located in Wilmington, is the only large port in the state. Owned by the Diamond State Port Corporation, it sits at the meeting point of the Christina and Delaware Rivers, just near the state line (DSPC, 2015a). As depicted in Figure 4.1.1-1, the Port of Wilmington can be reached via I-495, a branch of I-95, which runs through most of the east coast. In both 2013 and 2014, the Port of Wilmington was visited by a 367 vessels. This was a decrease from previous years, as the port saw visits from 382 and 408 vessels in 2012 and 2011 respectively (DSPC, 2015b). In 2013, the port was responsible for the import of $9,999 million worth of cargo from vessels, weighing 15,491 tons. The same year, The Port of Wilmington exported $2,511 million in waterborne cargo, weighing 1,805 tons (U.S. Census Bureau, 2015c).

4.1.1.4. Public Safety Services

Delaware 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 4.1.1-4 presents Delaware’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 4.1.9, Socioeconomics.

Table 4.1.1-4: Key Delaware Indicators

Delaware Indicators	
Estimated Population (2014)	935,614
Land Area (square miles) (2010)	1,948.54
Population Density (persons per sq. mile) (2010)	460.8
Municipal Governments (2013)	57
Cities and Towns (2007)	59

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

Table 4.1.1-5 presents Delaware’s public safety infrastructure, including fire and police stations. Table 4.1.1-6 identifies first responder personnel including dispatch, fire and rescue, law enforcement, and emergency medical personnel in the state.

Table 4.1.1-5: Public Safety Infrastructure in Delaware by Type

Infrastructure Type	Number
Fire and Rescue Stations	144
Law Enforcement Agencies	37
Fire Departments	86

Source: (National Fire Department Census, 2015)

Table 4.1.1-6: First Responder Personnel in Delaware by Type

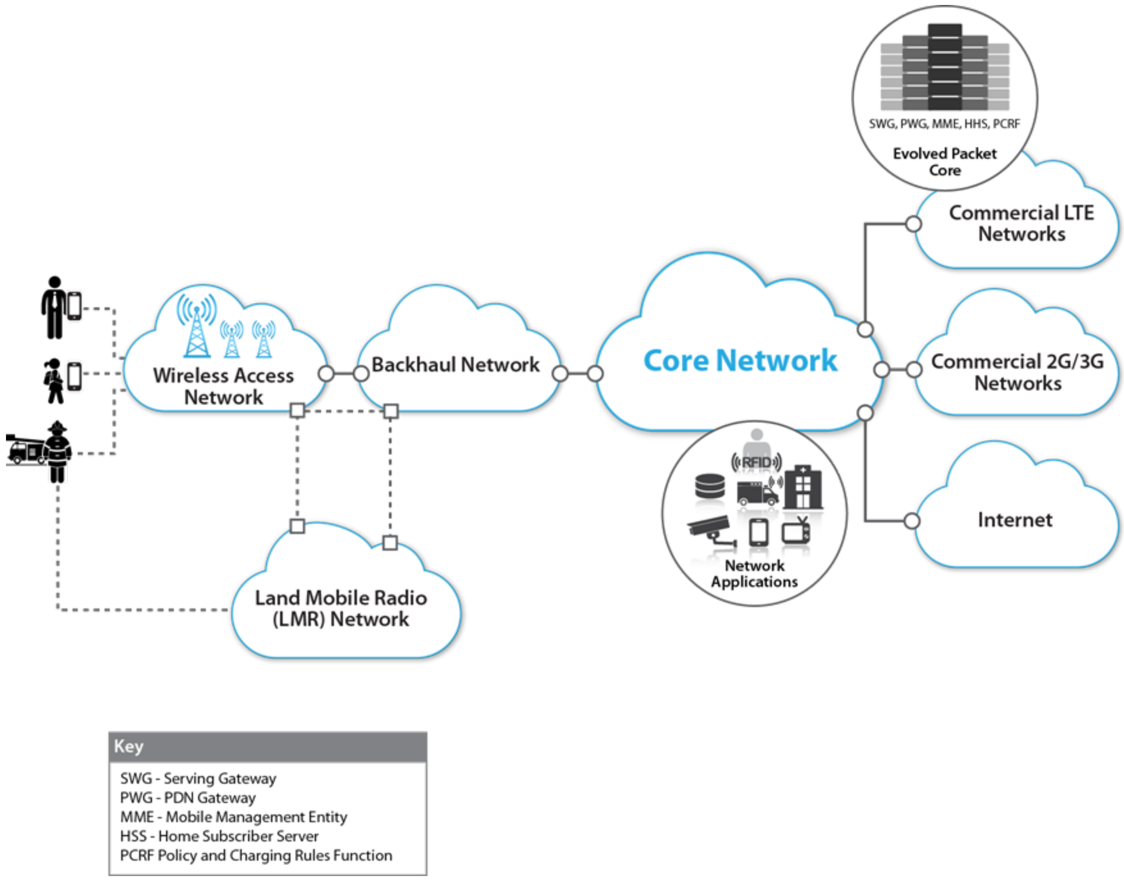
First Responder Personnel	Number
Police, Fire and Ambulance Dispatchers	220
Fire and Rescue Personnel	4,088
Law Enforcement Personnel	4,701
Emergency Medical Technicians and Paramedics	1,310

Sources: (National Fire Department Census, 2015) (BLS, 2015a)

4.1.1.5. Telecommunications Resources

Telecommunication resources in Delaware can be divided into two primary categories: specific public safety communications infrastructure and commercial telecommunications infrastructure (FCC, 2015a) (BLS, 2016). There is no central repository of information for either category; therefore, the following information and data are combined from a variety of sources, as referenced.

In general, the deployment of telecommunications resources in Delaware is widespread and similar to other states in the U.S. 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 4.1.1-2 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).



Prepared by: Booz Allen Hamilton

Figure 4.1.1-2: Wireless Network Configuration

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 2.1.1), 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 (National Institute of Standards and Technology, 2015). Historically, there have been many challenges and impediments to timely and effective sharing of information, including jurisdictional challenges, funding challenges, the pace of technology evolution, and communication interoperability. Communication interoperability has been a persistent challenge, along with issues concerning spectrum availability, embedded infrastructure, and differing standards among stakeholders (National Task Force on Interoperability, 2005). This has caused a fragmented approach to communications implementation across the U.S. and at the state level, including in Delaware.

There are five key reasons why public safety agencies often cannot connect through existing communications (National Task Force on Interoperability, 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 into 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 (USFWS, 2015g).

Public safety communications in Delaware are similar to those in other states and consist of a mix of older analog networks across Very High Frequency (VHF),[2] Ultra High Frequency (UHF)[3] frequencies, and digital narrowband Project 25 (P-25) upgraded wireless infrastructure systems. Delaware has upgraded both of its Statewide 700 MHz and 800 MHz analog systems to P-25.

Delaware's public safety and emergency communications networks operate across a diverse set of channels and licensed wireless frequencies including: VHF, UHF, 700 MHz, and 800 MHz to serve its diverse public safety users and agencies. The Department of Safety and Homeland Security (DSHS) is the agency within the state responsible for public safety communications networks including the statewide 700 MHz and 800 MHz networks. The DSHS also has jurisdiction over the state's recurring public safety services. The DSHS Communications group has primary responsibility for public safety network operations, network maintenance, tower leases, and equipment (State of Delaware, 2015c). In addition, the Communications section of the Delaware State Police, also under DSHS, is responsible for a wide range of public communications network services including: mobile command center operations, 9-1-1 Public Safety Answering Point (PSAP) operations, and telecommunications administration, including statewide radio systems.

Statewide Networks

Delaware currently has two major statewide networks: the Delaware Interoperable Network (DELWIN), and Delaware's Public Safety Network. Both networks cover all three counties and enable police, fire, EMS, healthcare talk groups, and interagency communications.

[2] VHF band covers frequencies ranging from 30 MHz to 300 MHz (NTIA, 2005).
[3] UHF band covers frequencies ranging from 300 MHz to 3000 MHz (NTIA, 2005).

The DELWIN network is a trunked statewide P-25 700 MHz network whose primary current agency user is the Department of Corrections. In 2008, Delaware initiated a project to deploy a 700 MHz P-25 Digital Trunked Radio System to provide 95 percent in-street coverage using a portable radio. The original intent was to move DelDOT off the 800 MHz system onto the 700 MHz system to reduce loading. After the project began, a greater need for the system was expressed by the Department of Corrections, and two additional sites were added to provide better building penetration, expanding the system to 13 sites. This system uses geographically separated redundant Network Switching Servers – one located in New Castle County and the other in Sussex County. (MACINAC, 2013)

The Delaware Public Safety Network is a P-25 network operating at 800 MHz. The system currently supports approximately 14,000 users and is sub-divided into three geographic regions, which corresponds to the three counties in the state, with fourteen channels in New Castle County, and ten channels each in Kent and Sussex Counties. The system design incorporates a high capacity digital microwave (6 & 10 GHz) infrastructure, which links the three sub-systems and the intra-county system sites together. To enhance operational capabilities, the City of Wilmington's 800 MHz system was integrated into the state's system to provide seamless interoperability. There are three primary dispatch control points, one at each of the three 9-1-1 dispatch centers. The 9-1-1 dispatch center in Kent is connected to the system via fiber optics, while the others use microwave. (MACINAC, 2013)

In 2010, Delaware purchased two Site-on-Wheels (SOWs) for its 800 MHz network to provide back-up for the network as well as to provide paid response capabilities in the case of major natural disasters or threats to public safety. The SOWs are equipped with 85-foot towers and are stored in New Castle County and Kent County. (Delaware Dept. of Safety and Homeland Security, 2010)

There are nine PSAPs in Delaware located at county, police, and emergency communications facilities, one of which is at the University of Delaware (FCC, 2015b). Delaware's Public Safety talk groups use both VHF and UHF radios for dispatch and recurring operational needs. Fire, police, and EMS organizations at the county and city/town level also use the 800 MHz P-25 network. The Life-Net Statewide system uses a narrowband VHF service and the Medstar helicopter transport service in Sussex County uses a VHF dispatch and communications system. The State Police who run the Medevac helicopter service in Delaware also use the 800 MHz system to support their mission for emergency medical transport.

On March 4, 2011, the States of Delaware, Maryland, and West Virginia; the Commonwealths of Pennsylvania and Virginia; and the District of Columbia, began an initiative to facilitate the design, deployment, and operation of the nationwide public safety wireless broadband network in the mid-Atlantic region. The Mid-Atlantic Consortium for Interoperable Nationwide Advanced Communications (MACINAC) Initiative serves a coordinating function for its member states, assisting in data collection, purchasing, and improving decisions regarding the nationwide public safety wireless broadband network. Table 4.1.1-6 presents the first responder personnel within the MACINAC region that would be potential users of the NPSBN. (MACINAC, 2013)

Agencies within each of the following municipal entities are expected to be users of the network according to MACINAC:

- State of Delaware, plus three counties and local municipal agencies;
- State of Maryland, plus 23 counties, the City of Baltimore and 157 municipal agencies;
- Commonwealth of Pennsylvania, plus 67 counties and numerous local municipal agencies;
- Commonwealth of Virginia, plus 95 counties, 39 independent cites and other local municipal agencies; and
- State of West Virginia, plus 55 counties and local municipal agencies (MACINAC, 2013).

In addition to the state and local agencies listed above, the MACINAC region includes over 50 Federal agencies headquartered in the national capital area, as well as other agencies distributed throughout the state. (MACINAC, 2013)

Commercial Telecommunications Infrastructure

Delaware'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 sub-sections present information on Delaware'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

Delaware'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 as well as cable submarine systems for international connectivity. Table 4.1.1-7 presents the number of providers of switched access[4] lines, Internet access[5], and mobile wireless services including coverage.

Table 4.1.1-7: Telecommunications Access Providers and Coverage in Delaware as of December 31, 2013

Commercial Telecommunications Access Providers	Number of Service Providers	Coverage
Switched access line	92	98.1% of households
Internet access	28	73.0% of households
Mobile wireless	5	96.0% of population

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

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

Table 4.1.1-8 shows the wireless providers in Delaware along with their geographic coverage. The following four maps, Figure 4.1.1-3 to Figure 4.1.1-6, show: the combined coverage for the top two providers, Verizon Wireless and AT&T (each of which covers the entire state); Sprint's coverage; T-Mobile's coverage; and Cricket Wireless coverage, respectively.

Table 4.1.1-8: Wireless Telecommunications Coverage by Providers in Delaware

Wireless Telecommunications Providers	Coverage
Verizon Wireless	100.00%
AT&T Mobility	100.00%
Sprint	91.05%
T-Mobile	37.62%
Cricket Wireless	19.11%

Source*:* (NTIA, 2014)

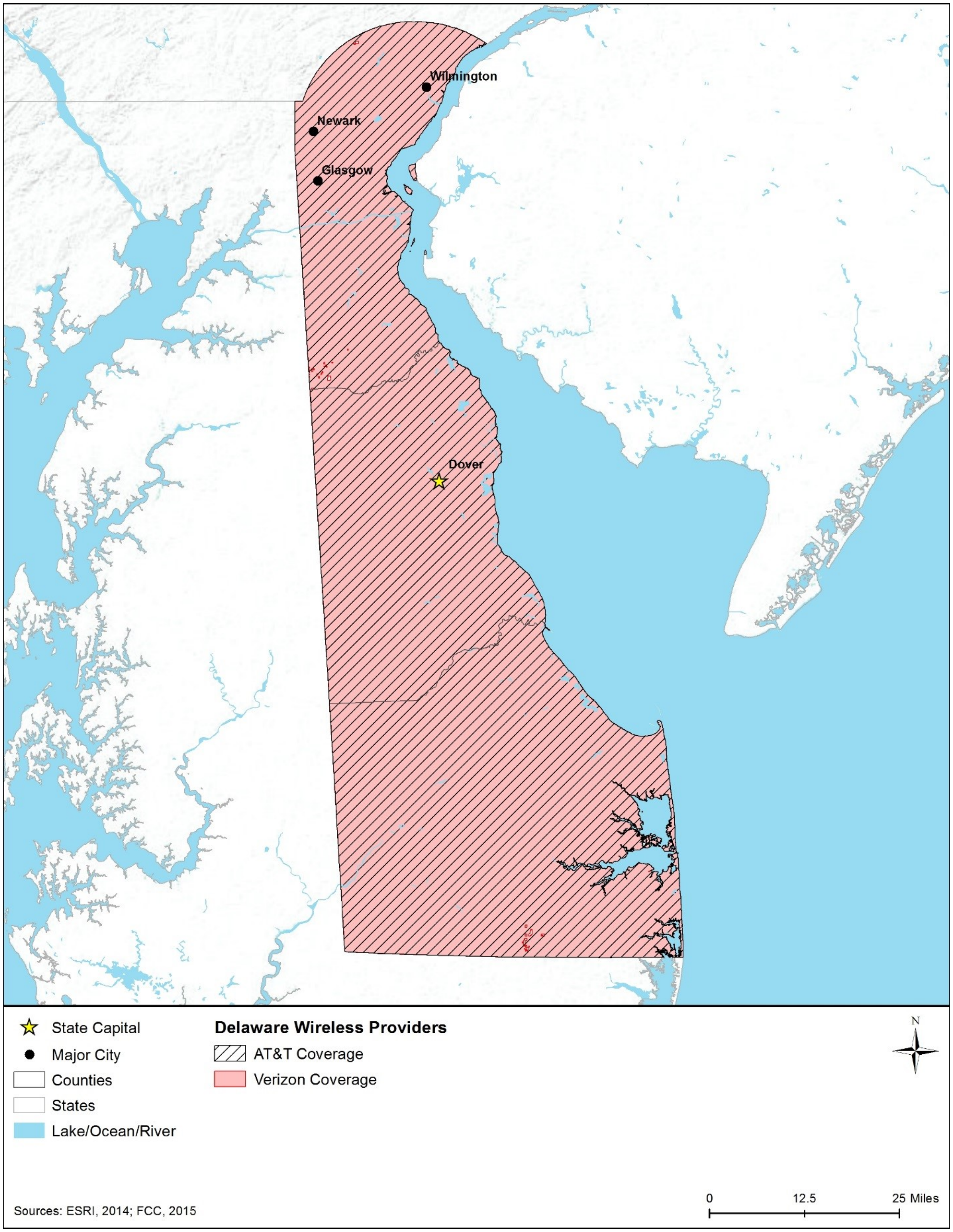


Figure 4.1.1-3: AT&T and Verizon Wireless Availability in Delaware

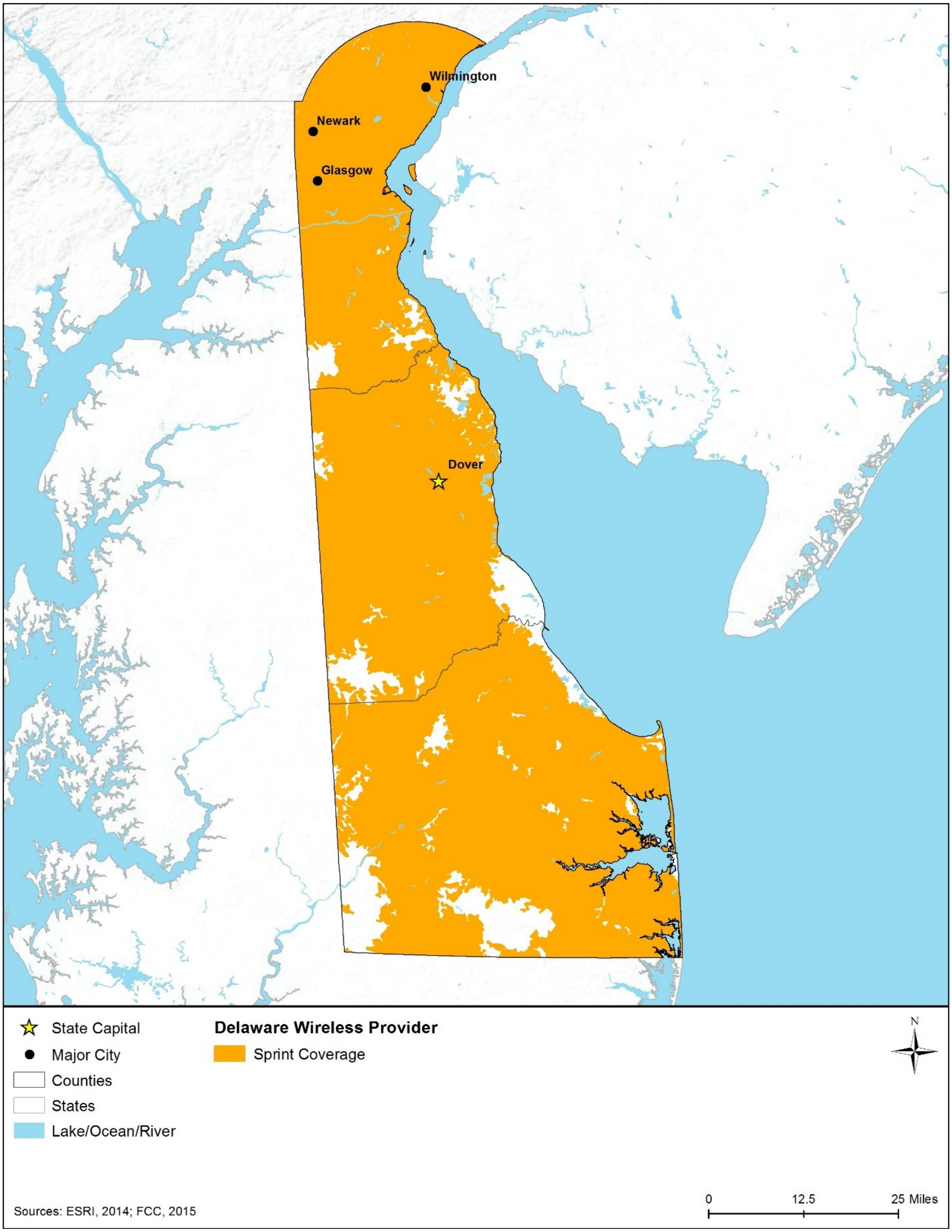


Figure 4.1.1-4: Sprint Wireless Availability in Delaware

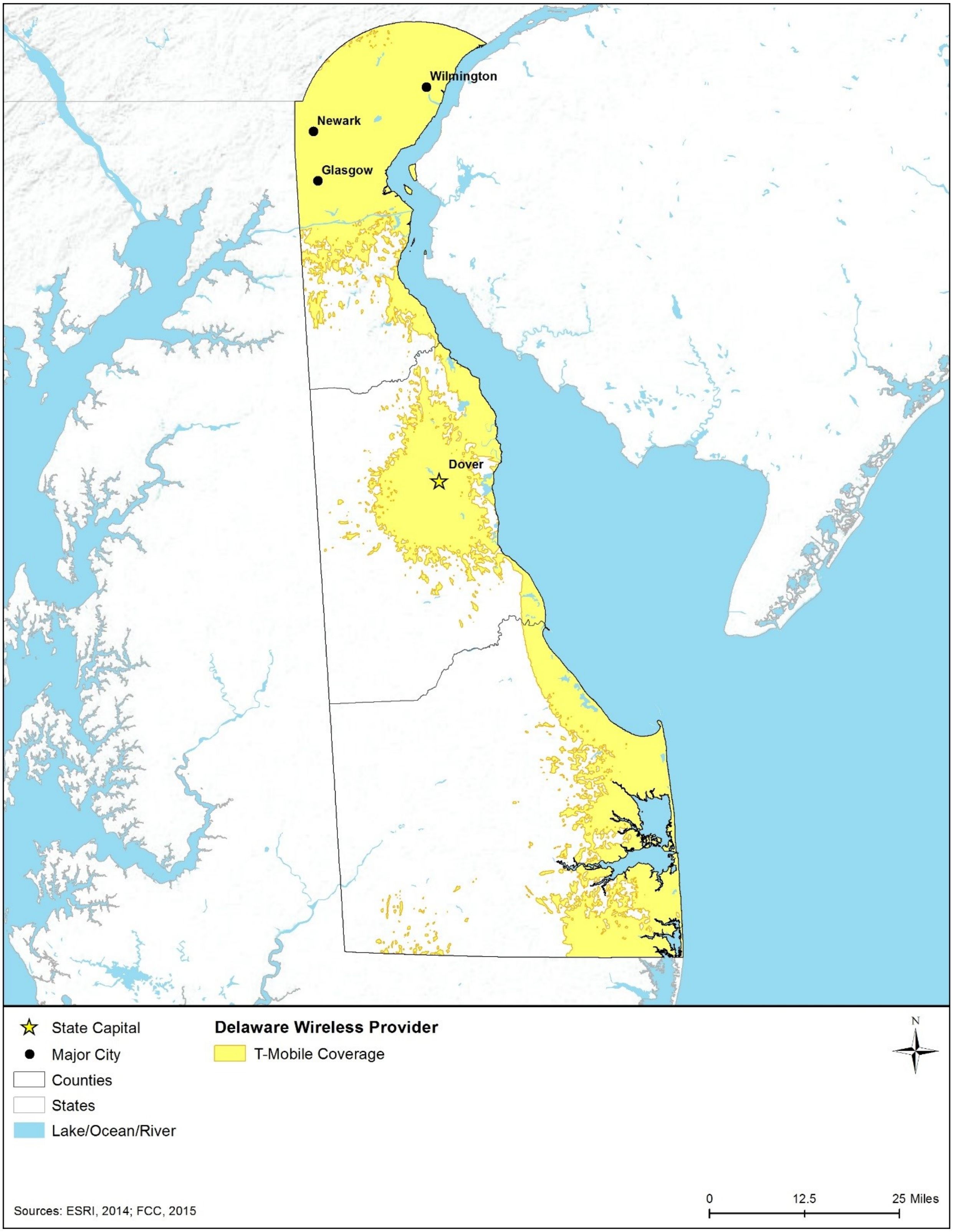


Figure 4.1.1-5: T-Mobile Wireless Availability in Delaware

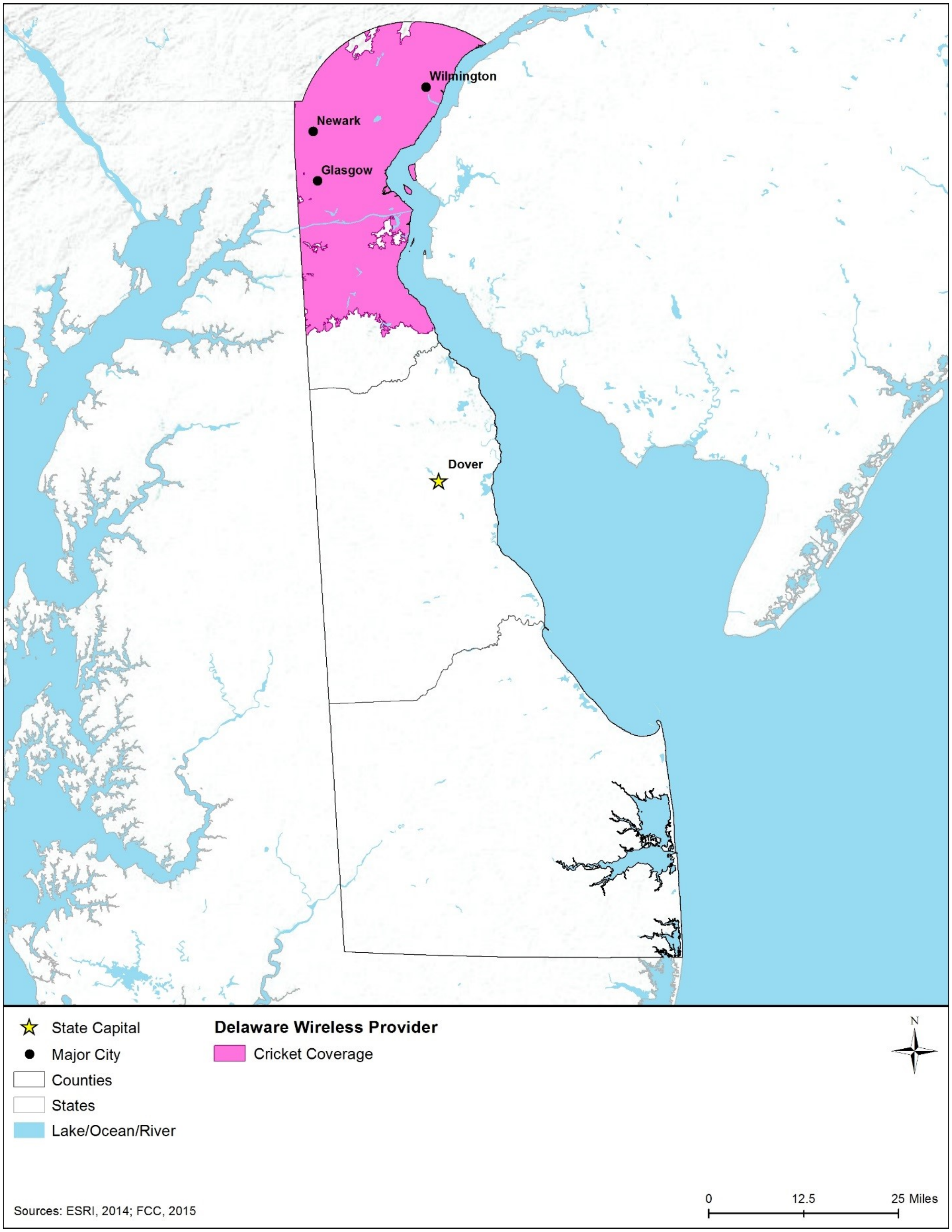


Figure 4.1.1-6: Cricket Wireless Availability in Delaware

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, Chapter 90 Communiations Site Management, 2009a). Figure 4.1.1-7 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 4.1.1-7: Types of Towers

Telecommunications tower infrastructure can be found throughout Delaware, although tower infrastructure is concentrated in the higher and more densely populated areas of Wilmington, Dover, and Newark. Owners of towers and some types of antennas are required to register those infrastructure assets with the Federal Communications Commission (FCC) (FCC, 2016b).[6] Table 4.1.1-9 presents the number of towers (including broadcast towers) registered with the FCC in Delaware. Figure 4.1.1-8: FCC Tower Structure Locations in Delaware presents the location of those 166 structures, as of June 2015.

[6] 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.

Table 4.1.1-9: Number of Commercial Towers in Delaware by Type

Constructed[a] Towers[b]		**Constructed Monopole Towers**	
100ft and over	27	100ft and over	0
75ft – 100ft	19	75ft – 100ft	0
50ft – 75ft	47	50ft – 75ft	0
25ft – 50ft	43	25ft – 50ft	7
25ft and below	2	25ft and below	2
Subtotal	**138**	**Subtotal**	**9**
Constructed Guyed Towers		**Buildings with Constructed Towers**	
100ft and over	5	100ft and over	0
75ft – 100ft	2	75ft – 100ft	0
50ft – 75ft	1	50ft – 75ft	1
25ft – 50ft	1	25ft – 50ft	0
25ft and below	1	25ft and below	1
Subtotal	**10**	**Subtotal**	**2**
Constructed Lattice Towers		**Multiple Constructed Structures[c]**	
100ft and over	2	100ft and over	0
75ft – 100ft	0	75ft – 100ft	0
50ft – 75ft	2	50ft – 75ft	0
25ft – 50ft	2	25ft – 50ft	0
25ft and below	0	25ft and below	0
Subtotal	**6**	**Subtotal**	**0**
Constructed Tanks[d]			
Tanks	1		
Subtotal	**1**		
Total All Tower Structures		**166**	

Source: (FCC, 2015c)

[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, 2013)
[b] Free standing or guyed structure used for communication purposes (FCC, 2013).
[c] Multiple constructed structures per antenna registration (FCC, 2013).
[d] Any type of tank – water, gas, etc. with a constructed antenna (FCC, 2013).

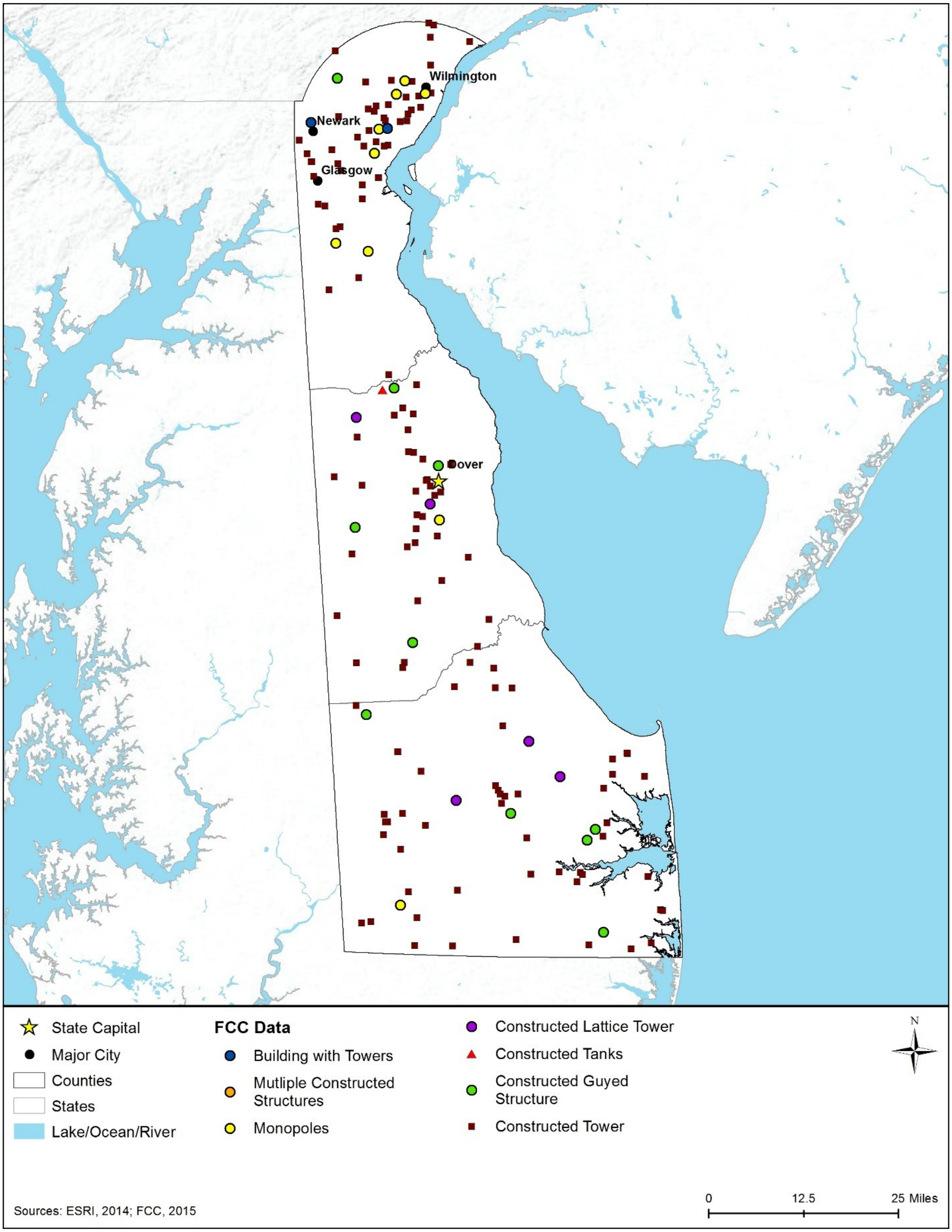
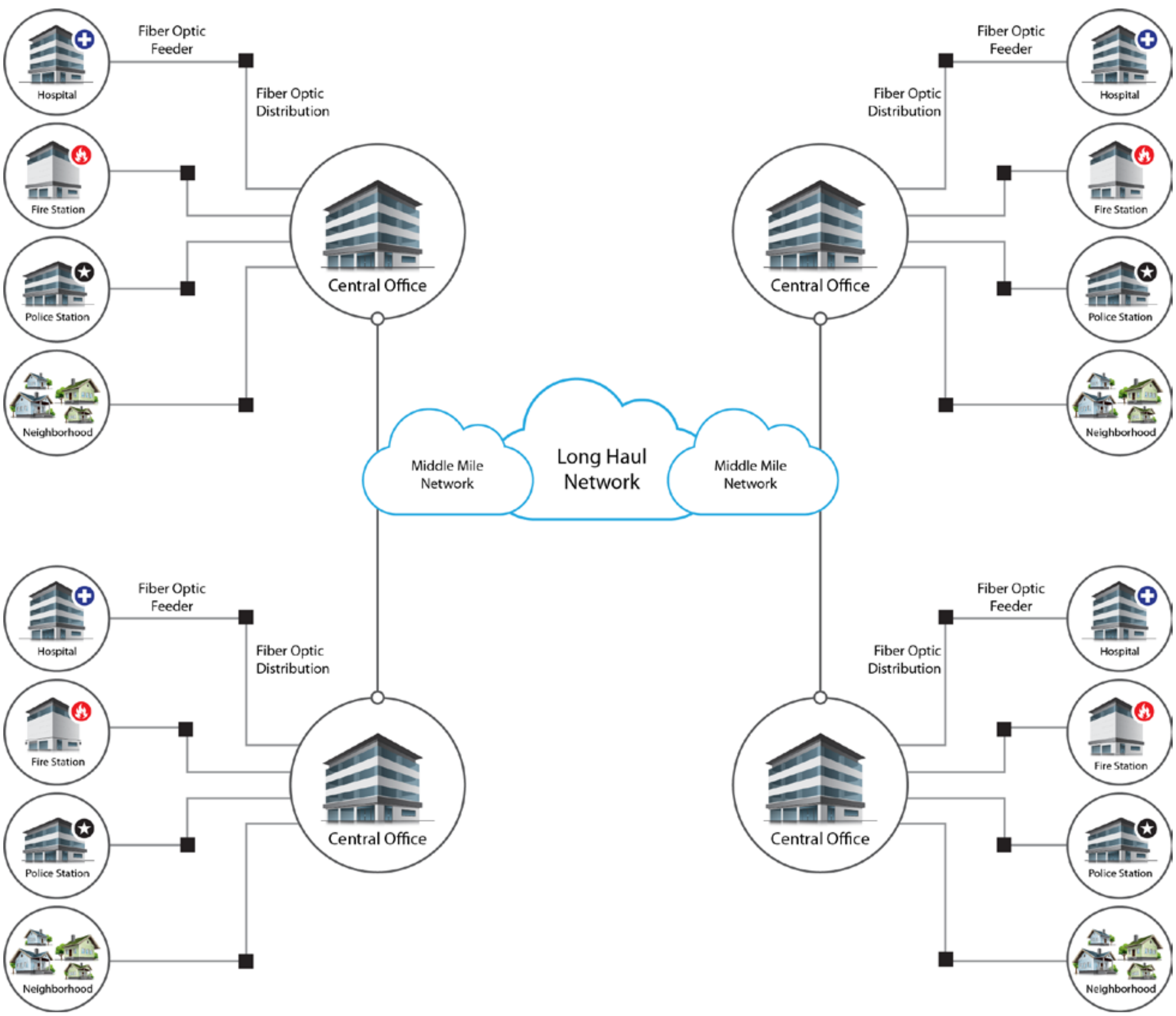


Figure 4.1.1-8: FCC Tower Structure Locations in Delaware

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 4.1.1-9. 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, Deployment of Advanced Telecommunications Capability: Second Report, 2000).



Prepared by: Booz Allen Hamilton

Figure 4.1.1-9: Typical Fiber Optic Network in Delaware

Last Mile Fiber Assets

In Delaware, fiber access networks are concentrated in the highest population centers as shown in the figures below. In Delaware, there are eight fiber providers that offer service in the state, as listed in Table 4.1.1-10. Figure 4.1.1-10 shows coverage for all providers but Verizon and Comcast, whose coverage areas are depicted in Figure 4.1.1-11 and Figure 4.1.1-12, respectively.

Table 4.1.1-10: Fiber Provider Coverage

Fiber Provider	Coverage
Verizon Communications	70.22%
Comcast	51.45%
Mediacom Delaware LLC	11.86%
Atlantic Broadband LLC	10.93%
Megapath	7.75%
Windstream	3.50%
Broadview Networks, Inc.	1.61%
Level 3 Communications, LLC	1.29%

Source*:* (NTIA, 2014)

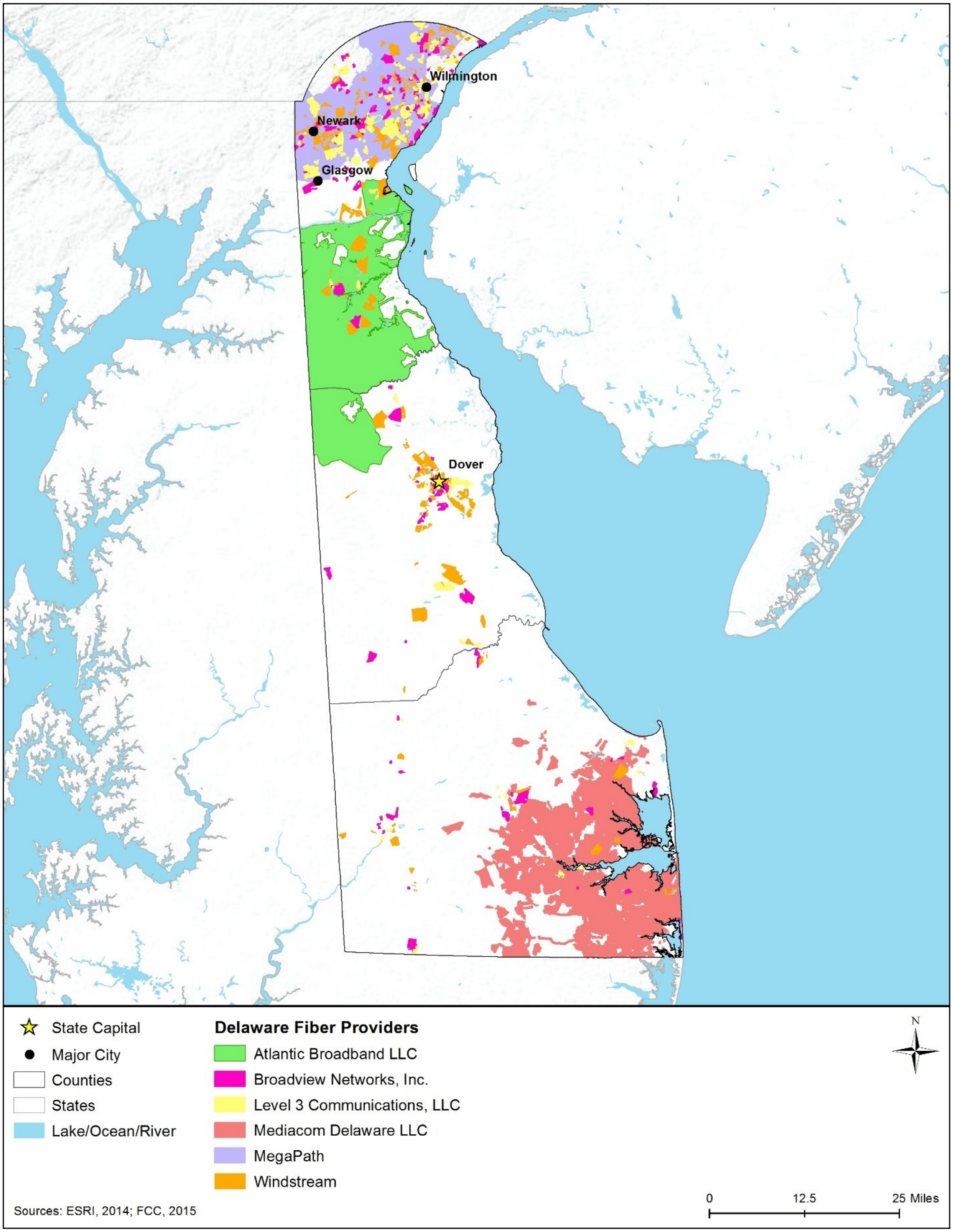


Figure 4.1.1-10: Fiber Availability in Delaware for All Providers but Verizon and Comcast

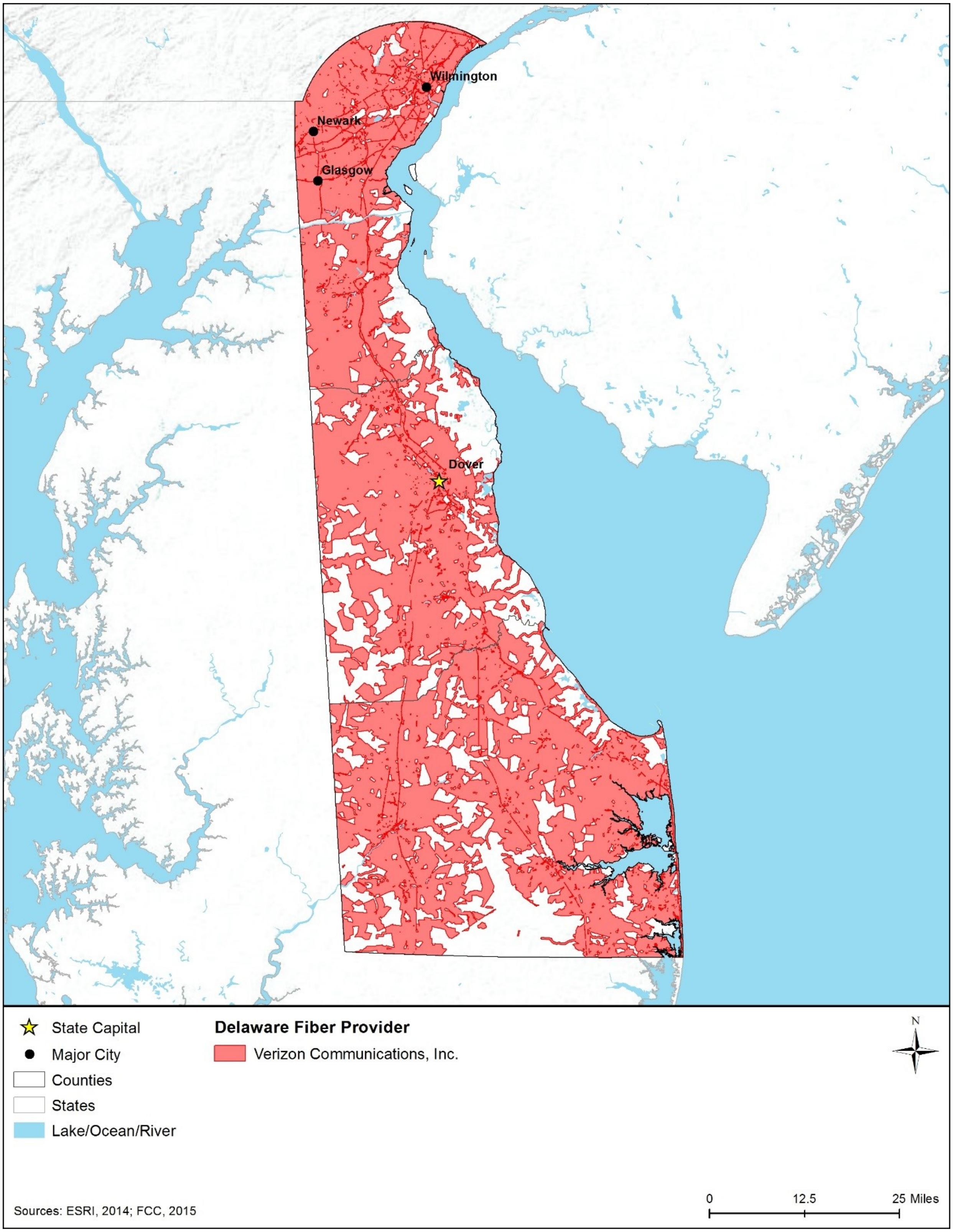


Figure 4.1.1-11: Verizon Fiber Availability in Delaware

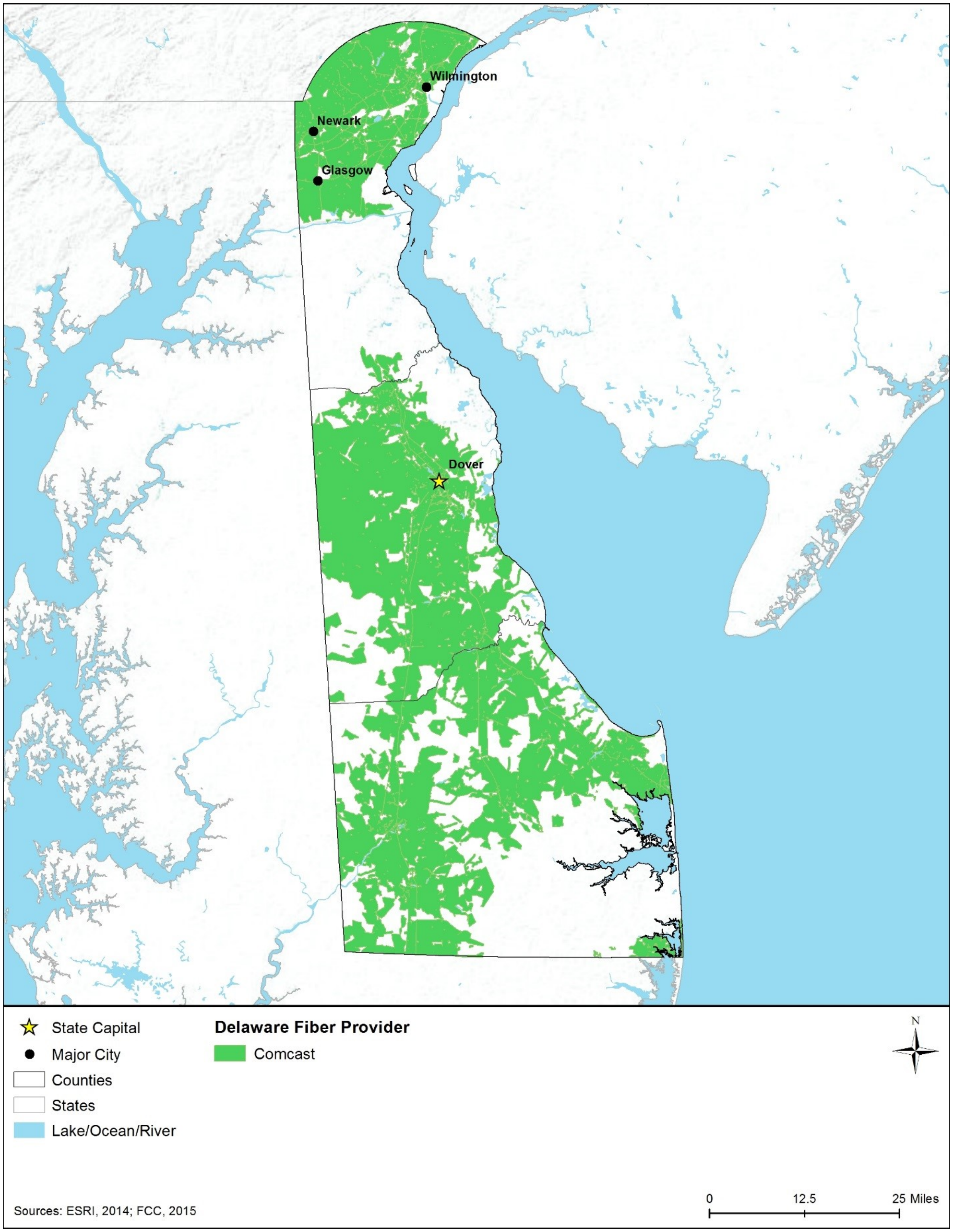


Figure 4.1.1-12: Comcast Fiber Availability in Delaware

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. These facilities also provide racks and cages for equipment, power and cooling, cabling, physical security, and 24x7 monitoring (CIO Council, 2015) (Government Accounting Office, 2013).

4.1.1.6. 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 sewage. Section 4.1.4, Water Resources, describes the potable water sources in the state.

Electricity

Electricity distribution companies in the state of Delaware are governed by the Delaware Public Service Commission (PSC), which was created in 1949. It also oversees companies that provided water, natural gas, telecommunications, and wastewater services (Delaware State Department 2015a). In 1999, legislation passed by the Delaware General Assembly restructured Delaware's electric industry. Following this, the PSC no longer regulated the generation of electricity, only the companies that distribute it (Delaware State Department, 2015b). Although electricity can be generated through a number of means, in 2014 Delaware used natural gas to produce 82 percent of its electricity. Overall, the state plans to have 25 percent of its electricity be produced by renewable resources by 2026, with at least 3.5 percent coming from photovoltaics (solar panels) (EIA, 2015a). The Public Service Commission regulates 142 companies that distribute electricity across the state (Delaware State Department, 2015c). In the first five months of 2015, Delaware tied Maryland with the 13th highest electricity prices in the nation (EIA, 2015b). In this same timeframe, Delaware produced 771,000 megawatt-hours (MWh) of electricity.[7] This was the fourth lowest amount of electricity in the nation; meaning the state made more electricity than only Vermont, Alaska, and Maine (EIA, 2015c).

Water

The distribution and payment rates for water utilities are also governed by the Delaware Public Service Commission (PSC). The PSC regulates 12 utility companies in the state. When necessary, any of these utility companies can petition to expand their service territory through a Certificate of Public Convenience and Necessity (CPCN) (Delaware State Department, 2015d). The quality and testing of Delaware's public drinking water is regulated by the Office of Drinking Water, which is a part of the Division of Public Health (DPH) (DPH, 2015a). Public water systems are defined as any that serve more than twenty five people (DPH, 2015b). The

[7] One Megawatt-hour is defined as "One thousand kilowatt-hours or 1 million watt-hours." One Watt-hour can be defined as "The electrical energy unit of measure equal to one watt of power supplied to, or taken from, an electric circuit steadily for one hour." (EIA, 2016)

Division oversees 213 water systems that provide service to homes, as well as those that service restaurants or stores that serve water from public sources. Any time contaminants are found in a public water system, its users are immediately notified and given instructions for taking precautions (DPH, 2015a).

Wastewater

Delaware's non-governmental wastewater utilities that serve more than 50 customers are also regulated by the PSC. The PSC grants Certificates for Public Convenience and Necessity (CPCNs), which are used to regulate utilities. CPCNs have been granted to seven wastewater utilities in Delaware (Delaware State Department, 2015e). While the PSC does not regulate onsite wastewater treatment and disposal systems (septic systems), the Ground Water Discharges Section (GWDS) of the Division of Water does. The GWDS is split into two branches. The Small Systems Branch oversees the approval and installation of systems with a flow of less than 2,500 gallons/day. The Large Systems Branch oversees systems with a flow greater than 2,500 gallons/day (Division of Water, 2015).

Solid Waste Management

The Division of Waste and Hazardous Substances has a Solid and Hazardous Waste Management Section, which gives permits for the transport of solid waste and inspects Delaware's landfills. The Division does not collect trash or run the landfills that it inspects. Collection duties are performed at a state government level, or by individuals who may transport their solid waste to a landfill, collection station or transfer station. The three landfills that receive the bulk of the state's solid waste are run by the Delaware Solid Waste Authority (DWHS, 2015a). The burning of trash, leaves, or other solid waste is illegal in Delaware, meaning most non-recyclable wastes are transported to one of these three landfills (DWHS, 2015b) Delaware's Universal Recycling Law aims to "maximize the convenience of recycling and minimize the amount of trash disposed in Delaware" (Delaware State Department, 2015f). This also mandates that all waste collection service providers have recycling options for their single family or multi-family residential complex customers (DWHS, 2015c).

4.1.2. Soils

4.1.2.1. 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. 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.
- 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, which other processes act on them.

4.1.2.2. 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. A list of applicable state laws and regulations is included in Table 4.1.2-1 below.

Table 4.1.2-1: Relevant Delaware Soil Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Delaware Code: Title 7, Chapter 40 Erosion and Sedimentation Control	Delaware Department of Natural Resources and Environmental Control (DNREC)	Provides guidelines for erosion & sediment control (including stormwater control and permitting)

Source: (State of Delaware, 2015d)

4.1.2.3. Environmental Setting

Delaware is composed of two Land Resource Regions (LRR),[8] as defined by the National Resources Conservation Service (NRCS) (NRCS, 2006):

- Atlantic and Gulf Coast Lowland Forest and Crop Region
- Northern Atlantic Slope Diversified Farming Region

Within and among Delaware's two LRRs are four Major Land Resource Areas (MLRA),[9] which are characterized by patterns of soils, climate, water resources, land uses, and type of farming (NRCS, 2006). The locations and characteristics of Delaware's MLRAs are presented in Figure 4.1.2-1 and Table 4.1.2-2, respectively.

[8] Land Resource Region: "A geographical area made up of an aggregation of Major Land Resource Areas (MLRA) with similar characteristics" (NRCS, 2006).
[9] 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).

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[10] such as bacteria, fungi, biological crusts, vegetation, animals, and climatic variables such as precipitation and temperature. For example, expansive soils[11] 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[12] (discussed further in the subsections below).

Table 4.1.2-2: Characteristics of Major Land Resource Areas in Delaware

MLRA Name	Region of State	Soil Characteristics
Mid-Atlantic Coastal Plain	Central Delaware	Ultisols[13] are the dominant soil order in this MLRA, and soils in this area are generally very deep, dominantly well drained to poorly drained, and loamy or sandy in the mineral horizons.
Northern Coastal Plain	Northeastern Delaware	Ultisols are the dominant soil order in this MLRA, and soils in this area are generally very deep, dominantly well drained to poorly drained, and loamy or sandy in the mineral horizons.
Northern Piedmont	Northwestern Delaware	Dominant soil orders are Alfisols,[14] Inceptisols,[15] and Ultisols. The soils in this area are moderately deep to very deep, moderately well-drained to somewhat excessively drained, and loamy or loamy-skeletal.
Northern Tidewater Area	Southern Delaware	Ultisols are the dominant soil order in this MLRA and soils in this area are generally very deep, dominantly well drained to poorly drained, and loamy or sandy in the mineral horizons.

Source: (NRCS, 2006)

4.1.2.4. Soil Suborders

Soil suborders are part of the soil taxonomy (a system of classification used to make and interpret soil surveys). Soil orders are the highest level in the taxonomy[16]; there are 12 soil orders in the world and they are characterized by both observed and inferred[17] properties, such as texture, color, temperature, and moisture regime. Soil suborders are the next level down, and are

[10] The flora and fauna of a region
[11] Expansive soils are characterized by "the presence of swelling clay materials" that absorb water molecules when wet and expand in size or shrink when dry leaving "voids in the soil" (Rogers, Olshansky, & Rogers, 2004).
[12] Rutting is indentations in soil from operating equipment in moist conditions or soils with lower bearing strength (USFS, Soil-Disturbance Field Guide, 2009b).
[13] 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)
[14] Alfisols: "Soils found in semiarid to moist areas that are formed from weathering processes that leach clay minerals and othe rconstituents 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)
[15] 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)
[16] Taxonomy: "A formal representation of relationships between items in a hierarchical structure" (USEPA, 2015a).
[17] "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, 2015c).

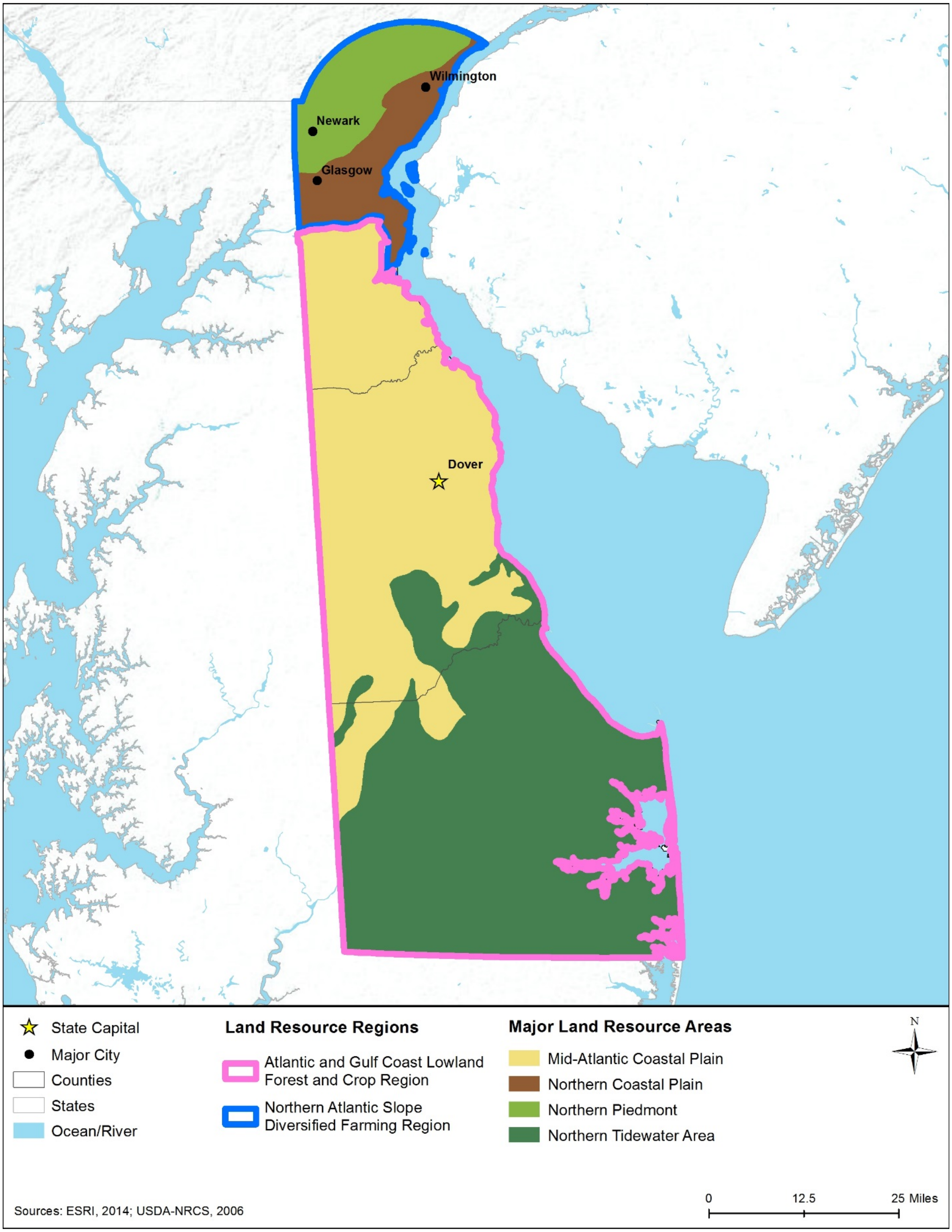


Figure 4.1.2-1: Locations of Major Land Resource Areas in Delaware

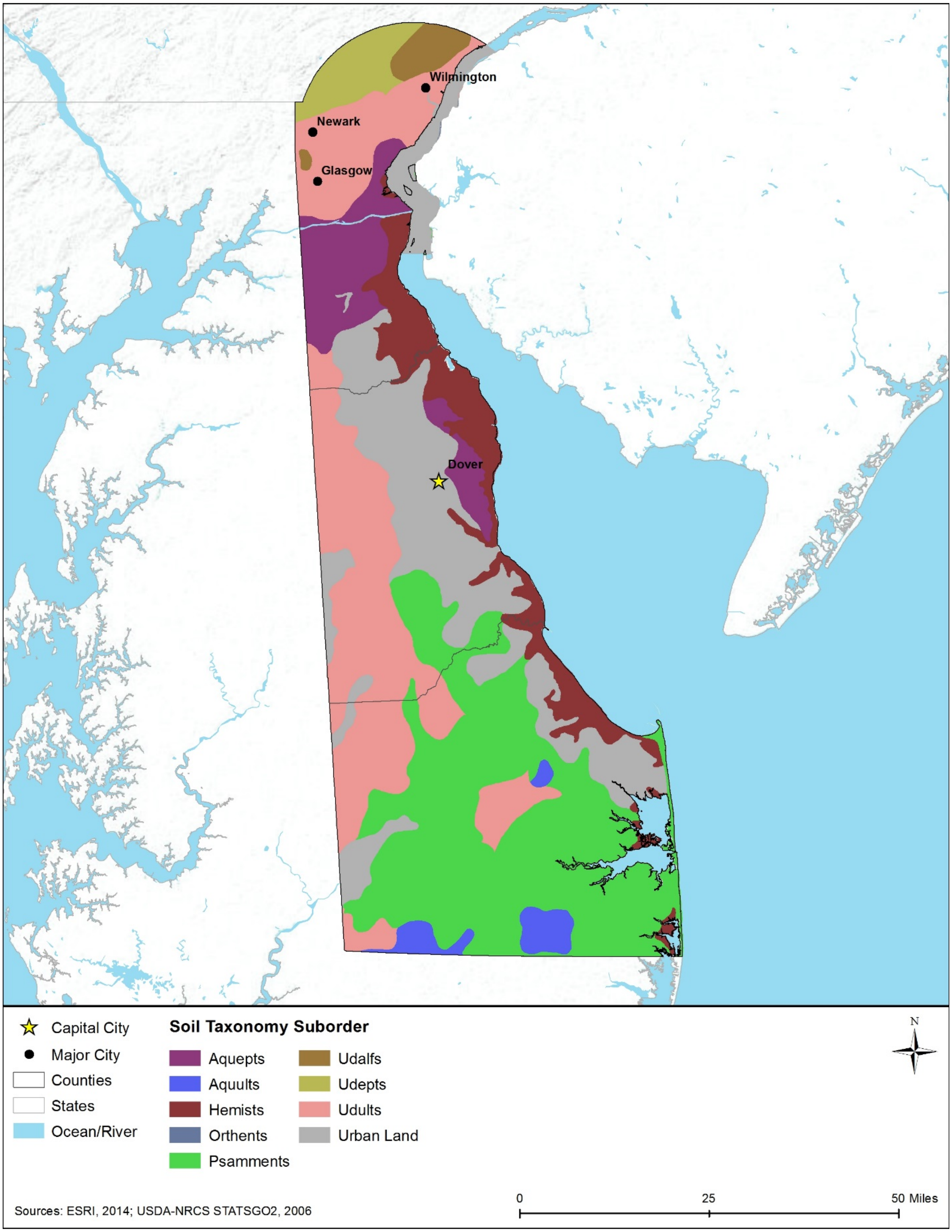


Figure 4.1.2-2: Delaware Soil Taxonomy Suborders

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Table 4.1.2-3: Major Characteristics of Soil Suborders Found in Delaware, as depicted in Figure 4.1.2-2

Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (%)	Drainage Class	Hydric Soil[18]	Hydrologic Group	Runoff Potential	Permeability[19]	Erosion Potential	Compaction and Rutting Potential
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.	Stratified sand to loamy sand	0-2	Very poorly drained	Yes	D	High	Very low	High	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.	Sandy loam, stratified sand to sandy clay loam	0-2	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
Histosols	Hemists	Hemists are usually found in broad, flat areas, such as coastal plains and outwash plains as well as closed depressions. They are typically under natural vegetation and uses for rangeland, woodlands, and/or wildlife habitat, although some large areas have been cleared and drained, and utilized for cropland.	Mucky peat	0-1	Very poorly drained	Yes	D	High	Very low	High	High, due to hydric soil and poor drainage conditions
Entisols	Orthents	Orthents are commonly found on recent erosional surfaces and are used primarily as rangeland, pasture, or wildlife habitat.	Sandy clay	0-5	Well drained	No	C	Medium	Low	Medium, 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.	Coarse sand, fine sand, loamy sand, sandy clay	0-5	Excessively drained	No	A	Low	High	Low	Low
Alfisols	Udalfs	Udalfs have a udic (humid or subhumid climate) moisture regime, and are believed to have supported forest vegetation at some time during development.	Channery silty clay loam	3-8	Moderately well drained	No	C	Medium	Low	Medium, depending on slope	Low
Inceptisols	Udepts	Udepts have a 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 silty clay loam	15-25	Somewhat excessively drained	No	A	Low	High	Low	Low
Ultisols	Udults	Udults are more or less freely drained, relatively humus poor, and have a 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).	Loam, loamy fine sand, sandy clay loam, sandy loam, silt loam, silty clay loam	0-5	Somewhat excessively drained to well drained	No	A, B, C	Low, Medium	High, Moderate, Low	Low to Medium, depending on slope	Low

Source: (NRCS, 2015b) (NRCS, 1999)

[18] 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).
[19] Based on Runoff Potential, described in Section 4.5.3.2

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differentiated within an order by soil moisture and temperature regimes, as well as dominant physical and chemical properties (NRCS, 2015f). The STATSGO2[20] soil database identifies eight different soil suborders in Delaware (NRCS, 2015b). Figure 4.1.2-2 depicts the distribution of the soil suborders, and Table 4.1.2-3 provides a summary of the major physical-chemical characteristics of the various soil suborders found.

4.1.2.5. Runoff Potential

The NRCS uses four Hydrologic Soil Groups (A, B, C, and D) that are based on a soil's runoff potential.[21] Group A generally has the smaller runoff potential, whereas Group D generally has the greatest (Purdue University, 2015). Table 4.1.2-3 (above) provides a summary of the runoff potential for each soil suborder in Delaware.

Group A. **Sand, loamy sand or sandy loam soils.** This group of soils has "low runoff potential and high infiltration rates[22] 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). Psamments, Udepts, and Udults fall into this category in Delaware.

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. Aquults and Udults fall into this category in Delaware.

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. Orthents, Udalfs, and Udults fall into this category in Delaware.

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). Aquepts, Aquults, and Hemists fall into this category in Delaware.

[20] STATSGO2 is the Digital General Soil Map of the United States developed by the National Cooperative Soil Survey and supersedes the State Soil Geographic (STATSGO) dataset; the U.S. General Soil Map is comprised of general soil association units and is maintained and distributed as a spatial and tabular dataset.
[21] 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.
[22] 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)

4.1.2.6. 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 public safety hazard (NRCS, 1996a). Table 4.1.2-3 (above) provides a summary of the erosion potential for each soil suborder in Delaware. Soils with the highest erosion potential in Delaware include those in the Aquepts, Aquults, Hemists, Orthents, Udalfs, and Udults suborders, which are found throughout most of the state, although less prevalent in the southern half (Figure 4.1.2-2).

4.1.2.7. 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 ten 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 4.1.2-3 provides a summary of the compaction and rutting potential for each soil suborder in Delaware. Soils with the highest potential for compaction and rutting in Delaware include those in the Aquepts, Aquults, and Hemists suborders, which are found across the state, and particularly along coastal areas (Figure 4.1.2-2).

4.1.3. Geology

4.1.3.1. 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 4.1.4), Human Health and Safety (Section 4.1.15), and Climate Change (Section 4.1.14).

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

- Section 4.4.3, Major Physiographic Regions and Provinces[23, 24]
- Section 4.4.4, Surface Geology
- Section 4.4.5, Bedrock Geology[25]
- Section 4.4.6, Paleontological Resources[26]
- Section 4.4.7, Fossil Fuel and Mineral Resources
- Section 4.4.8, Potential Geologic Hazards[27]

4.1.3.2. 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 Geology, such as the National Historic Preservation Act and the Clean Water Act, are detailed in Appendix C. A list of applicable state laws and regulations is included in Table 4.1.3-1.

Table 4.1.3-1: Relevant Delaware Geology Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Delaware State Parks Rules 3.1.7	Delaware State Parks	No collection, excavation, injury, or destruction of prehistoric or historic artifacts or human skeletal remains from state parks is allowed without written permission from the Director (State of Delaware, 2014b)
Building Codes	County and Municipal Governments	Guidelines for seismic design in construction
Bridge Design Manual (2015)	DelDOT	Bridges must be designed with consideration of seismic motion (DelDOT, 2015e)

4.1.3.3. 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)

[23] Physiographic regions: Areas of the United States that share commonalities based on topography, geography, and geology. (Fenneman, 1916)
[24] Physiographic provinces: Subsets within physiographic regions. (Fenneman, 1916)
[25] Bedrock: Solid rock beneath the soil and superficial rock. (USGS, 2015e)
[26] Paleontology: "Study of life in past geologic time based on fossil plants and animals." (USGS, 2015e)
[27] 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, 2013a)

Delaware has two major physiographic regions: Atlantic Plain and Appalachian Highlands (USGS, 2003a) (Figure 4.1.3-1). The locations of these regions and their provinces are shown in Figure 4.1.3-1, and their general characteristics summarized in the following subsections.

Atlantic Plain Region

The Atlantic Plain Region includes the Continental Shelf and the Gulf and Atlantic Coast plains stretching from New York to Texas. The Atlantic Plain Region formed through the repetitive rise and fall of the oceans over the last 150 million years. Sedimentary strata become thinner moving westward through the region, and thicken to several thousand feet thick along the coastline. Erosion from the nearby 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. 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)

Most of Delaware lies within the Atlantic Plain; only the extreme northwestern portion of the state has hills (EIA, 2014). Delaware's Atlantic Plain has a maximum elevation of 100 feet above sea level (ASL). The Atlantic Plain is made up of silt, sand, and gravel that have been deposited from adjacent physiographic provinces including the Piedmont and Appalachian Highlands; these sediments increase from 0 feet in depth at the western edge of the region to more than 10,000 feet at the coastline (The Delaware Geological Survey, 2015f).

Appalachian Highlands Region

The Appalachian Highlands Region extends from Canada to Alabama. This region is composed of layers of folded sedimentary rock,[28] 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,[29] the Appalachian Highlands have eroded considerably, and most peaks are now under 5,000 feet above sea level (ASL). The current Appalachian Highlands Region is characterized by prime and unique farmlands and is rich in mineral resources. (USGS, 2003a)

As reported above, the Appalachian Highlands Region within Delaware contains one physiographic province: the Piedmont Province (USGS, 2003a).

<u>Piedmont Province</u> – A small portion of northern New Castle County (in northwestern Delaware) is within the Piedmont Province. Delaware's Piedmont is characterized by low hills, which "are a part of the foothills of Appalachian Mountains." The rocks at the surface in the Piedmont formed between 543 and 250 MYA. Since that time, rivers and streams have transported sediments from the Appalachians onto the Atlantic Plain and continental shelf. (The Delaware Geological Survey, 2015f)

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[28] 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, 2014a)

[29] The Rocky Mountains exceed 14,000 feet above sea level (NPS, 2016)

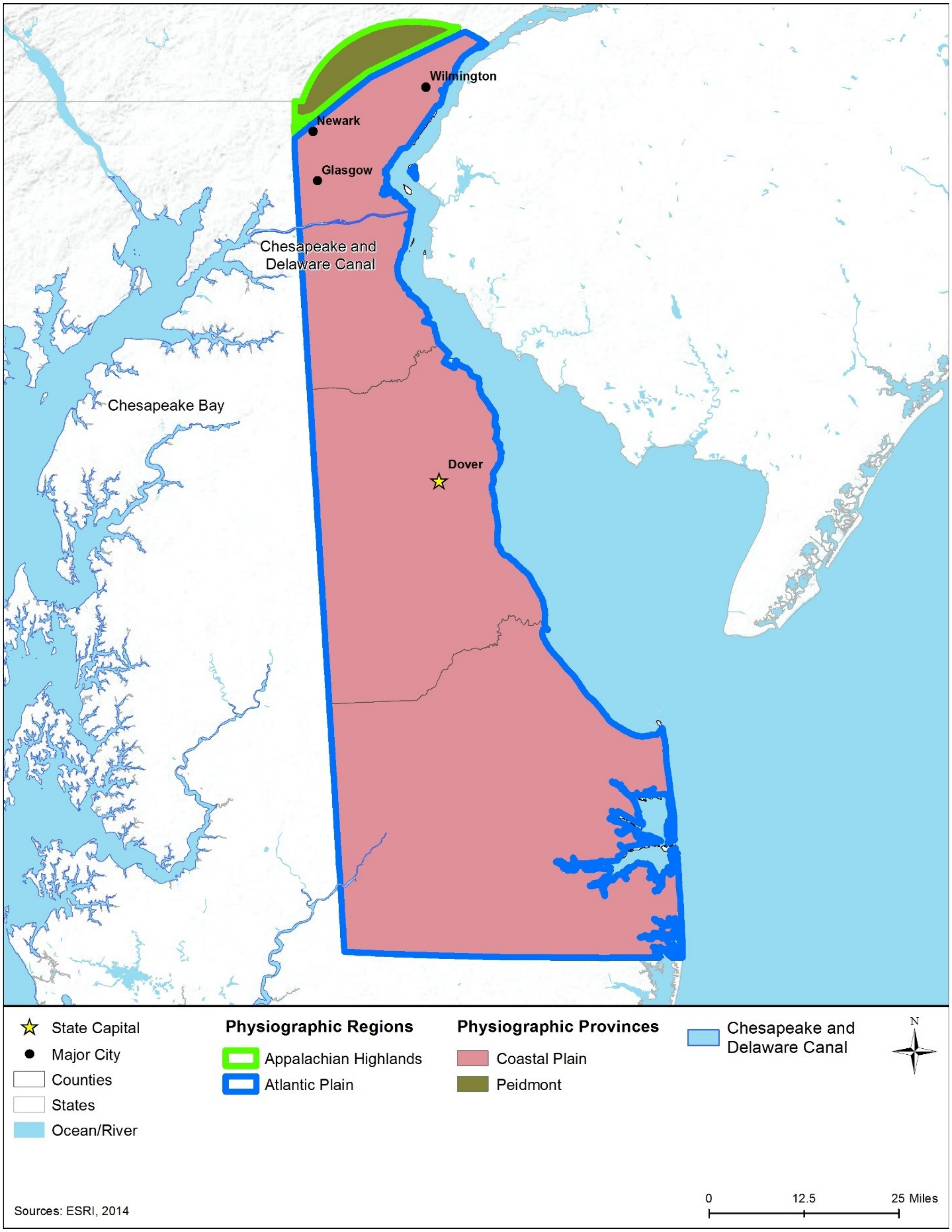


Figure 4.1.3-1: Physiographic Regions and Provinces of Delaware

Throughout the eastern United States, including within Delaware, the Fall Line[30] marks the western boundary between the Atlantic Plain Region and Piedmont Province; crystalline rocks of the Piedmont dip under the sediments of the Atlantic Plain in this area (The Delaware Geological Survey, 2015c). In Delaware, the Fall Line is near the City of Wilmington, and is characterized by an increase of stream gradients and, therefore, a rise in the number of falls and rapids (Trapp & Meisler, 1992).

4.1.3.4. Surface Geology

Surficial geology is characterized by materials such as till,[31] 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,[32] subsidence,[33] and erosion. (Thompson, 2015)

Surface deposits in Delaware originated from the Appalachian Mountains to the west, and were transported to Delaware through fluvial action. On top of the river sediments, marine sediment layers reflect the repeated rises and falls of sea level between 82 and 2 MYA. During the ice age, glacial meltwaters that originated north of the state deposited an additional layer of sediments throughout Delaware. Meltwater from glaciers to the north carried sediments into Delaware. (The Delaware Geological Survey, 2015f)

Figure 4.1.3-2 depicts a generalized illustration of the surface geology for Delaware.

[30] Fall Line: "Imaginary line marking the boundary between the ancient, resistant crystalline rocks of the Piedmont province of the Appalachian Mountains, and the younger, softer sediments of the Atlantic Coastal Plain province in the Eastern United States. Along rivers, this line commonly is reflected by waterfalls." (USGS, 2013a)
[31] 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, 2013a)
[32] Slope failure, also referred to as mass wasting, is the downslope movement of rock debris and soil in response to gravitational stresses.
[33] Subsidence: "Gradual settling or sudden sinking of the Earth's surface owing to subsurface movement of earth materials." (USGS, 2000)

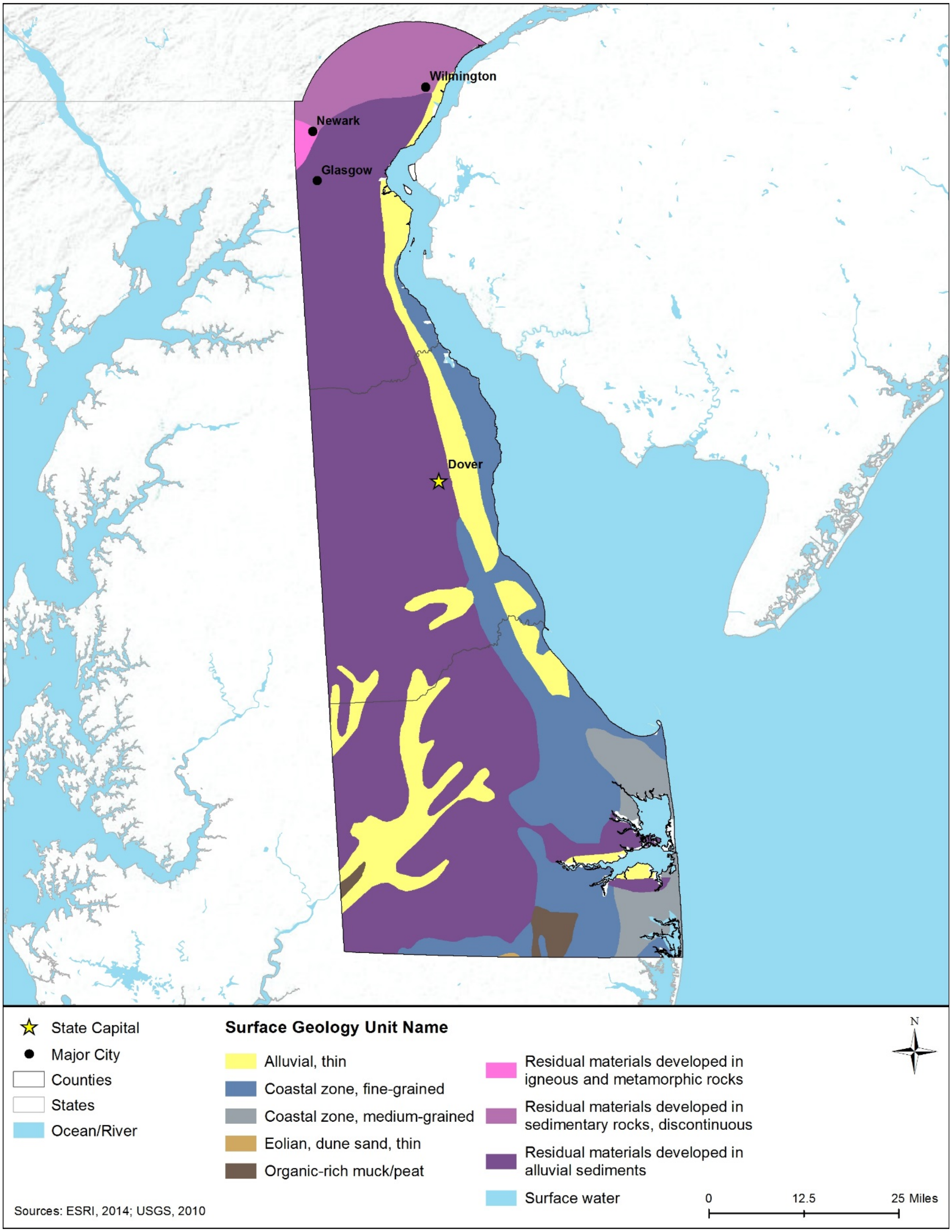


Figure 4.1.3-2: Generalized Surface Geology for Delaware

4.1.3.5. Bedrock Geology

Bedrock geology analysis, and "the study of distribution, position, shape, and internal structure of rocks" (USGS, 2015a) reveals important information about a region's surface and subsurface characteristics (i.e., 3-dimensional geometry), including dip (slope of the formation),[34] rock composition, and regional tectonism[35]. 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).

The oldest rocks in Delaware were formed during the Grenville orogeny,[36] which occurred approximately 1 Billion Years Ago (BYA). Within Delaware's Piedmont, five distinct metamorphic rock units are found:

> "(1) rocks of the volcanic arc (Wilmington Complex), (2) rocks formed from the mud and sand deposited in the deep ocean that existed between the volcanic arc and the ancient continental margin (Wissahickon Fm.), (3 & 4) rocks that were once sand and carbonates (calcite and dolomite) lying on the shallow shelf of the ancient continental margin (Setters Fm. and Cockeysville Marble), and (5) rocks of the ancient North American continent (Baltimore Gneiss)." (The Delaware Geological Survey, 2015f)

The Piedmont's metamorphic bedrock dips under the Coastal Plain at the Fall Line. The Atlantic Plain's bedrock composition contains silt, sand, and gravel that have been deposited from adjacent physiographic provinces including the Piedmont and Appalachian Highlands. These sediments form a wedge that increases from 0 feet in depth at the western edge of the region to more than 10,000 feet deep along Delaware's coast. (The Delaware Geological Survey, 2015f)

There are no active tectonic plate boundaries[37] in Delaware. Figure 4.1.3-3 shows the general bedrock geology for Delaware. Additional Delaware bedrock geology information is available from the USGS, The Delaware Geological Survey, county soil and water conservation districts, and local academic institutions.

[34] 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)
[35] Tectonicisms: “Structure forces affecting the deformation, uplift, and movement of the earth’s crust.” (USGS, 2015f)
[36] Orogeny: "The process of the formation of mountains." (USGS, 2014f)
[37] Tectonic Plate: "The large, thin, relatively rigid plates that move relative to one another on the outer surface of the Earth." (USGS, 2012e)

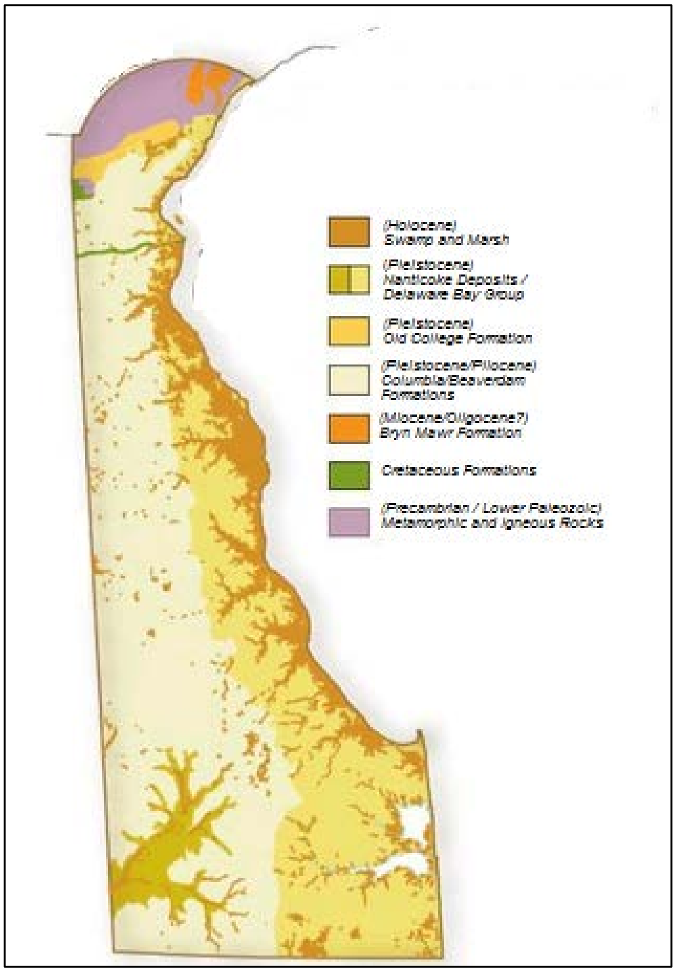


Figure 4.1.3-3: Generalized Bedrock Geology for Delaware

Source: (The Delaware Geological Survey, 2000)

4.1.3.6. Paleontological Resources

Throughout the late Cretaceous Period (146 to 66 MYA), Delaware was underwater as evidenced by marine fossils from this period. Fossil remains from Cretaceous marine life are found in the Chesapeake and Delaware Canal in northern Delaware (The Delaware Geological Survey, 2015d), which is the most prolific site in the state for fossils. When the canal was constructed, cuts exposed several formations from the Cretaceous period (The Delaware Geological Survey, 1992).

Delaware State Fossil
Belemnitella americana

Source: (The Delaware Geological Survey, 2015a)

Fossils in the Chesapeake and Delaware Canal area mostly include steinkerns, which are internal molds formed in shells. In some instances, the shell dissolves, but in other cases, the original shells are preserved. Marine invertebrate fossils, primarily bivalves and gastropods with some remains of sponges, ammonites, and belemnites have been found in this area. Fish and reptile bones are frequently encountered in the canal. *Belemnitella americana*, a squid-like organism and one of the most common fossils from the canal, and is Delaware's state fossil (The Delaware Geological Survey, 2015a). Dinosaur fossils have been found as fragmentary remains in the Chesapeake and Delaware Canal. "At least two hadrosaurid (duck-bill dinosaurs such as Maiasaura) teeth have been found. Several toe bones of ornithomimosaur (small and agile theropod predators that look something like plucked ostriches with long tails and arms) dinosaurs and a partial hadrosaurid vertebra have been recovered" (The Delaware Geological Survey, 2015b).

Pollack Farm in Kent County is the second deepest excavation in Delaware (Benson, 1998), and contains Miocene Epoch (23 to 5.3 MYA) fossils including a simple Arthropod and sharks (The Delaware Geological Survey, 2015g). Other locations in Delaware contain marine fossils and plant impressions from the Pleistocene Epoch (2.6 MYA to 11,700 years ago). Miocene fossils are found at sites in central Delaware (in addition to those found at Pollack Farm) (The Delaware Geological Survey, 2015a). Other fossils from this area include "part of a jaw and plates (scutes) of the giant crocodile *Deinosuchus*; a pleisiosaur vertebra; remains of bony fishes; and shell fragments of the turtles *Trionyx*, *Toxochelys*, and other forms. One of the most unique remains found in Delaware is that of a neck bone and a wing bone from a pterosaur" (The Delaware Geological Survey, 2015b).

4.1.3.7. Fossil Fuel and Mineral Resources

Oil and Gas

Delaware does not actively produce petroleum or natural gas, nor does it contain any petroleum reserves. There is one refining facility in Delaware City that processes approximately 182,200 barrels of crude oil daily. Delaware's Port of Wilmington is a significant terminal for importing oil and gas to the East Coast of the United States. In addition, Delaware maintains a pipeline from Pennsylvania to receive natural gas (EIA, 2014).

Minerals

As of 2014, Delaware's nonfuel mineral production was valued at $15M, ranking last in the nation. Delaware's leading nonfuel mineral commodities were crushed stone, sand and gravel (construction), magnesium compounds, and gemstones (natural) (USGS, 2016). Between 2009 and 2011, the value of construction sand and gravel produced within the state went down by more than 50 percent (USGS, 2015b). Sulfur also are produced and mined in Delaware (USGS, 2003b) (USGS, 2015b).

4.1.3.8. Geologic Hazards

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

Earthquakes

While no earthquakes have been recorded in Delaware between 1973 and March 2012, there have been several earthquakes in southwestern New Jersey have been felt in Delaware (USGS, 2014b). 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, typically occur at depths of 6 to 12 miles; these earthquakes typically do not reach magnitudes higher than 6.0 on the Richter scale.[38] 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, 2014c). 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). Delaware is located far from any convergence boundaries, but is located in the middle of a tectonic plate (Kafka, A., 2014).

Figure 4.1.3-4 depicts the seismic risk throughout Delaware. The map indicates levels of horizontal shaking (measured in Peak Ground Acceleration) 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.[39] (USGS, 2010)

Areas of greatest seismicity in Delaware are concentrated in the northern portions of the state. One of the more recent earthquakes experienced in Delaware occurred in southern New Jersey in December 1968. "Wilmington residents noted slight effects of the Richter magnitude 2.5 tremor, which caused no damage as it rumbled through New Jersey, Pennsylvania, and Delaware" (USGS, 2014d). Delaware also experienced the after-effects of the August 2011 earthquake that occurred in Central Virginia with the earthquake felt “from northernmost New Castle County to coastal and inland Sussex County” (The Delaware Geological Survey, 2015e).

Landslides

There are no areas of high landslide frequency/susceptibility in Delaware. Areas of the Delaware Piedmont, especially along the Delaware River, exhibit a moderate susceptibility/low frequency to landslides. (USGS, 2003c)

[38] 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, 2014g)

[39] Post-1985 buildings (in California) have experienced only minor damage with shaking of 60% g. (USGS, 2010)

"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, 2003c). 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, 2003c)

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, 2003c)

Figure 4.1.3-5 shows landslide incidence and susceptibility throughout Delaware.

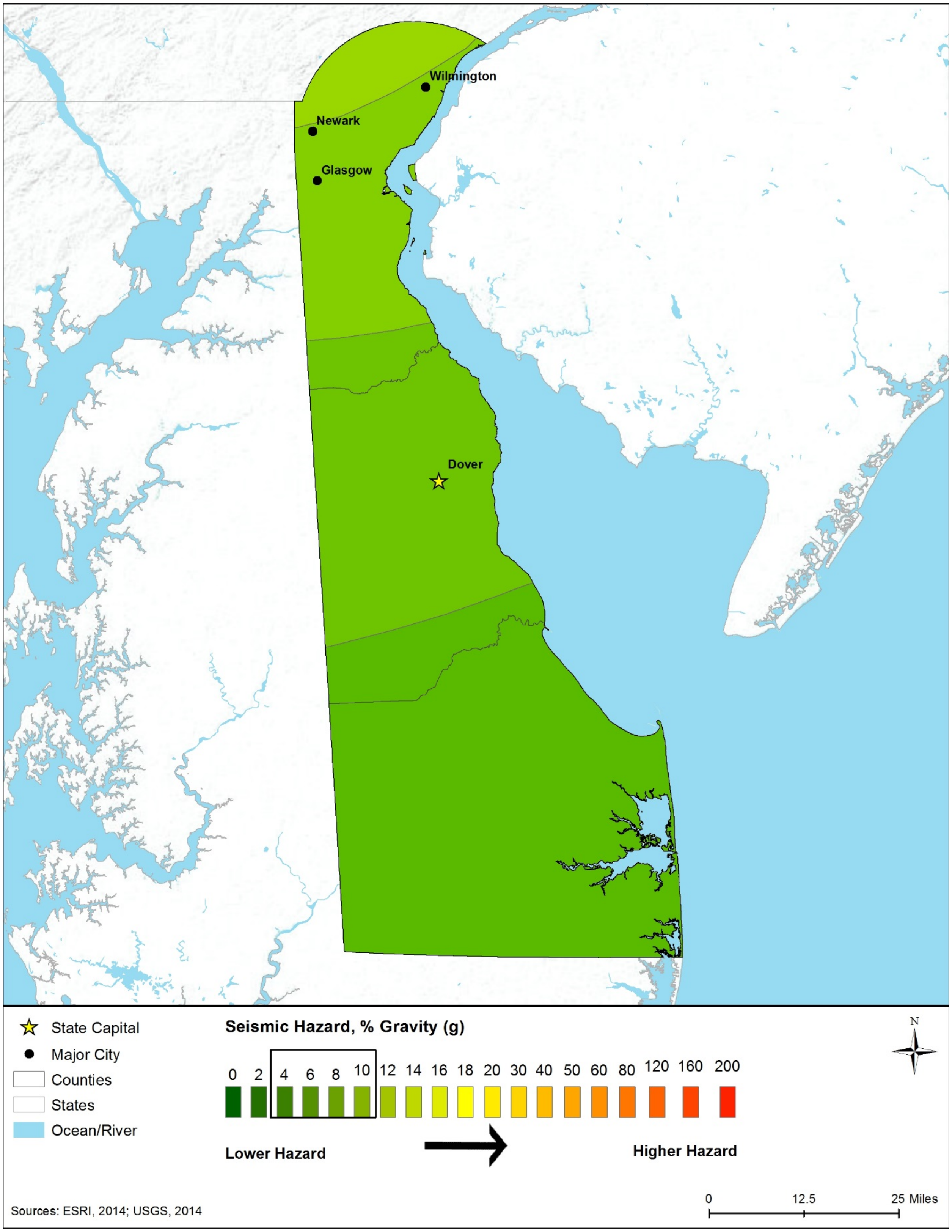


Figure 4.1.3-4: Delaware 2014 Seismic Hazard Map

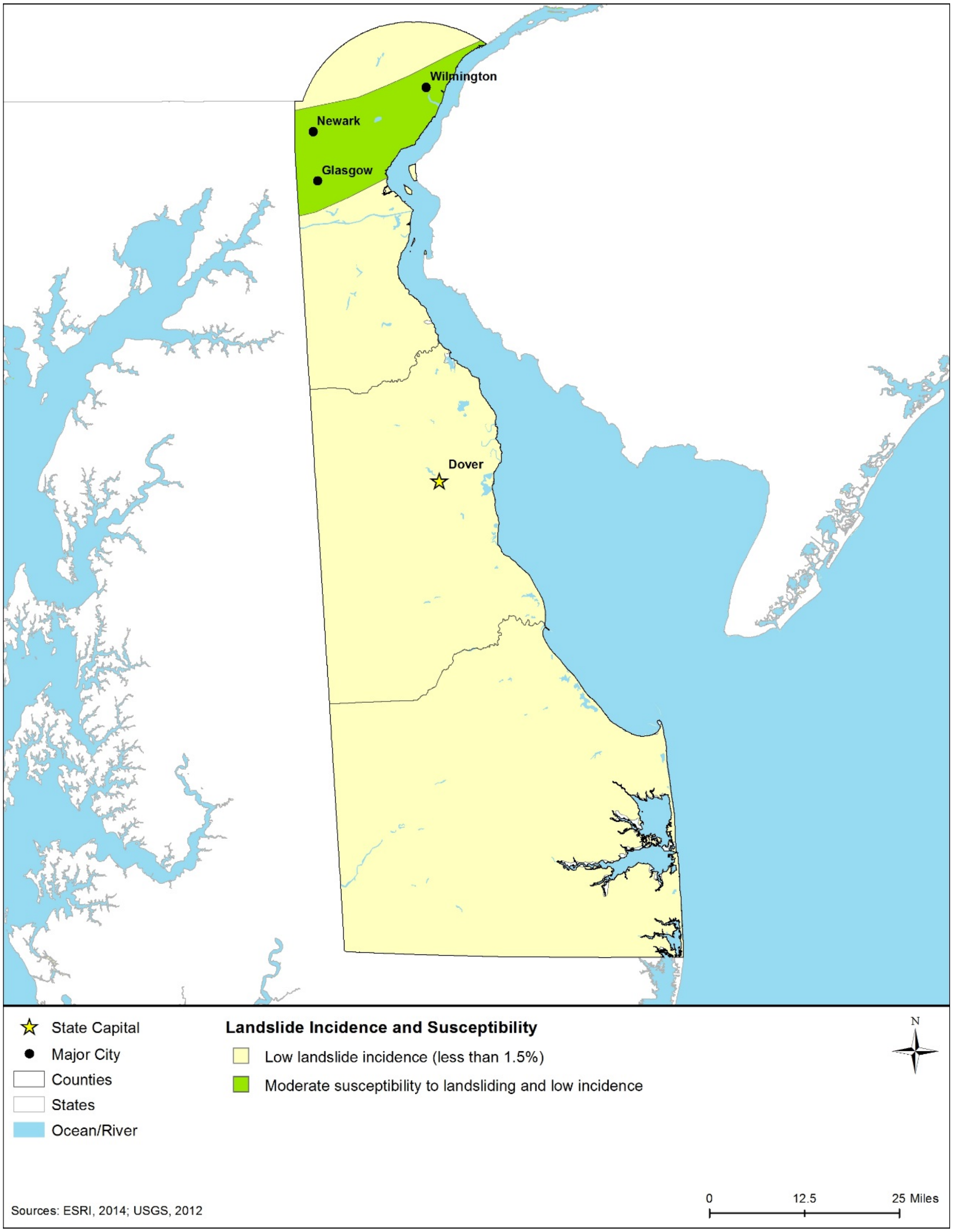


Figure 4.1.3-5: Delaware Landslide Incidence and Susceptibility Hazard Map[40]

[40] Susceptibility hazards not indicated in Figure 4.1.3-5 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, 2014h)

Subsidence

Land subsidence is a "gradual settling or sudden sinking of the Earth's surface owing to subsurface movement of earth materials" (USGS, 2000). In Delaware, a significant cause of land subsidence is the collapse of karst (Talley, 1981). 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, 2013b). 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 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. Changes in ground-surface elevation not only affect the integrity and operation of existing infrastructure, but also complicate vegetation and best management of land use. (USGS, 2013b)

In Delaware, karst topography is particularly present throughout the Piedmont Province. "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). By definition, karst landscape implies the existence of land subsidence, generally in the form of sinkholes brought on by sinking soils resulting from caves or simply cavities below. Karst areas in Delaware are confined to portions of the Piedmont underlain by carbonate rocks of the Cockeysville Formation (Talley, 1981). The Hockessin area is underlain by carbonate rocks that are at risk to subsidence (The Delaware Geological Survey, 2015h). Six sinkholes were discovered in the Hockessin Valley between 1978 and 1981 (Talley, 1981). A photo of a 1980 sinkhole in the Hockessin area is included at right.

Hockessin Sinkhole (1980)

Source: (The Delaware Geological Survey, 2015h)

4.1.4. Water Resources

4.1.4.1. Definition of the Resource

Water resources are defined as all surface water bodies and groundwater systems including streams, rivers, lakes, canals, ditches, estuarine waters, floodplains, aquifers, and other aquatic habitats (wetlands are discussed separately in Section 4.1.5). 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, 2014e)

4.1.4.2. Specific Regulatory Considerations

Federal laws relevant to protecting the quality and use of water resources are summarized in Appendix C. Table 4.1.4-1 summarizes the major Delaware laws and permitting requirements relevant to the state's water resources.

Table 4.1.4-1: Relevant Delaware Water Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Subaqueous Lands Act	DNREC	Permits are "required for dredging, filling, or the placement of any structure in, on, over or under privately owned" submerged lands or tidelands in Delaware. (DNREC, 2015a)
Delaware Coastal Zone Act	DNREC, Delaware Coastal Programs	An application is required for certain activities in Delaware's coastal zone. (DNREC, 2015b)
Beach Preservation Act	DNREC Division of Watershed Stewardship	Permit and application required to for construction activities within defined beach areas and seaward of the DNREC building line. (DNREC, 2015c)
Clean Water Act (CWA) Section 401 permit	DNREC Division of Water, Wetlands and Subaqueous Lands Section	Section 401 certification required for all activities that require a federally issued permit. (DNREC, 2015a)
Sediment & Stormwater Law/ National Pollutant Discharge Elimination System (NPDES) program	DNREC, Division of Water, Surface Water Discharges Section	Construction projects that disturb areas greater than 5,000 square feet (0.1 acres) require a permit. (DNREC, 2015d)

4.1.4.3. Environmental Setting: Surface Water

Surface water resources are lakes, ponds, rivers, and streams, as well as estuarine[41] and coastal waters. According to the DNREC, Delaware has about 2,500 miles of rivers and streams, about

[41] 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, 2015b)

3,000 acres of lakes, reservoirs, and ponds, more than 840 square miles of estuaries, and about 25 miles of Atlantic Ocean coastline. These surface waters are used for "such purposes as drinking water supply, recreation, and the propagation of fish, aquatic life and wildlife." (DNREC, 2013a)

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). Delaware's waters (lakes, rivers and streams) are divided into four major drainage basins (Figure 4.1.4-1). Delaware Appendix A, Table A-1, provides detailed information on the state's major basins, as defined by DNREC. DNREC divides the state's four major basins into 45 smaller watersheds. To describe water at a state-level, this PEIS uses the basin level. For more information on the 45 watersheds, including location, size, and water quality, visit www.dnrec.delaware.gov/swc/wa/Pages/WatershedAssessment.aspx (DNREC, 2015e).

The Piedmont basin is located in the northern tip of Delaware and drains into the Delaware River. Extending down the eastern portion of the state, the Delaware Bay basin stretches from the Wilmington area, which includes the Delaware Bay, in the north to Cape Henlopen in the south. The Chesapeake Bay basin extends across multiple states, including Delaware, Maryland, Virginia, West Virginia, Pennsylvania, New York, and D.C. In Delaware, the watershed is located along the western border of the state, stretching from the Chesapeake and Delaware Canal in the north, to the southern border with Maryland, where it drains to the Chesapeake Bay. Within the southeastern corner, the Inland Bays/Atlantic Ocean basin drains to the Atlantic Ocean or the Inland Bays (Rehoboth Bay, Indian River Bay, Little Assawoman Bay, and Assawoman Bay). (DNREC, 2015e)

Freshwater

Freshwater streams and rivers are dynamic interconnected systems of moving water that join, ultimately flowing into lakes, bays, or estuaries. As shown in Figure 4.1.4-1 there are nine major rivers in Delaware: Christina, Smyrna, Leipsic, St. Jones, Murderkill, Mispillion, Nanticoke, Delaware, and Brandywine Creek. The Delaware River forms the border between Delaware and New Jersey before flowing into the Delaware Bay. At more than 330 miles long, the Delaware River is the longest river in the state, although only about 30 of those miles are within Delaware (NPS, 2015b) (Delaware River Basin Commission, 2015). Delaware contains 2,954 acres of lakes and ponds including Lums Pond, which is located within Lums Pond state park and is the largest freshwater pond in the state (DNREC, 2013a) (Division of Parks and Recreation, 2015). The Hoopes Reservoir, with a capacity of over 2 billion gallons, and Newark Reservoir, with a capacity of over 300 million gallons, are the two primary reservoirs in the state and are both found in New Castle County (City of Wilmington Water Works, 2006) (DNREC, 2015f).

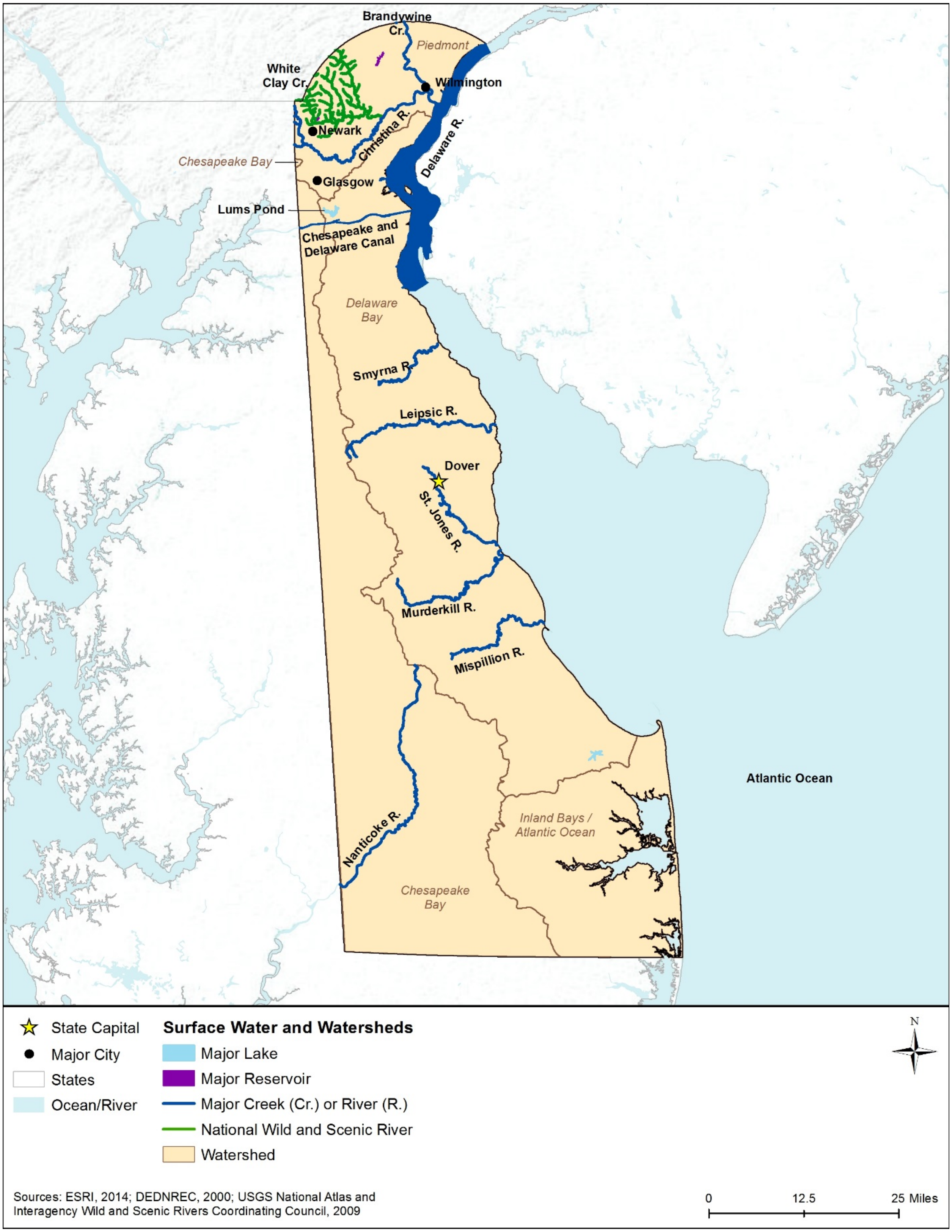


Figure 4.1.4-1: Major Delaware Watersheds, Defined by DNREC, and Surface Waterbodies

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 Delaware, from ocean waves and storms (USEPA, 2012a). Delaware's estuarine environments support a variety of habitats, including tidal wetlands, mudflats, oyster reefs, freshwater wetlands, sandy beaches, and eelgrass beds, and are a critical part of the life cycle of many different plant and animal species. For instance, Delaware's estuaries and shoreline provide habitat for more than 400 species of birds and wildlife (DNREC, 2012a). Delaware's 381 miles of shoreline, with 24 miles of coastline along the Atlantic Ocean, provide recreational areas for boating, swimming, hiking, bird watching, and other activities (DNREC, 2015g). Figure 4.1.4-2 shows Delaware's two major estuaries, the Delaware Inland Bays and Delaware Bay Estuary; descriptions of each are provided below.

- The **Delaware Inland Bays Estuaries** make up a 32 square mile estuary system comprised of three interconnected bays: Rehoboth Bay, Indian River Bay, and Little Assawoman Bay (Figure 4.1.4-2). This system is located in the southeastern portion of the state, stretching from Cape Henlopen to the north at the mouth of the Delaware Bay, to Fenwick Island at the Maryland state line to the south (USEPA, 2014a). In 1988, the U.S. Environmental Protection Agency's (USEPA) National Estuary Program (NEP) recognized the Delaware Inland Bays as an Estuary of National Significance (USEPA, 2014a). The USEPA and state and county agencies developed the Comprehensive Conservation and Management Plan (CCMP) for the Delaware Inland Bays, which was completed in 1995 (USEPA, 2014a). The CCMP identified five action plans to protect and restore the estuaries: education and outreach; agricultural sources; industrial, municipal, and septic systems; land use; and habitat protection (USEPA, 2014a). The USEPA's NEP website (http://water.epa.gov/type/oceb/nep/index.cfm#tabs-2) provides more information on the Delaware Inland Bays estuaries.

- The **Delaware Bay Estuary** stretches approximately 135 miles from Trenton, NJ and Morrisville, PA, south to Cape May, NJ and Cape Henlopen, DE. The Delaware Estuary includes all of the Delaware Bay and the tidal reaches of the Delaware River (Figure 4.1.4-2). While the northwestern portion of the bay near the mouth of the Delaware River is in close proximity to the urban centers of Wilmington, DE and Philadelphia, PA, the remainder of the bay is mostly bordered by agricultural and undeveloped land. In 1988, the USEPA's NEP recognized the Delaware Bay as an Estuary of National Significance (USEPA, 2014a). The estuary's 1996 CCMP identified seven areas of concern and management actions: land management, water use management, habitat and living resources, toxics, education and involvement, monitoring, and regional information management (USEPA, 2014a). The USEPA's NEP website (http://water.epa.gov/type/oceb/nep/index.cfm#tabs-2) provides more information on the Delaware Estuary.

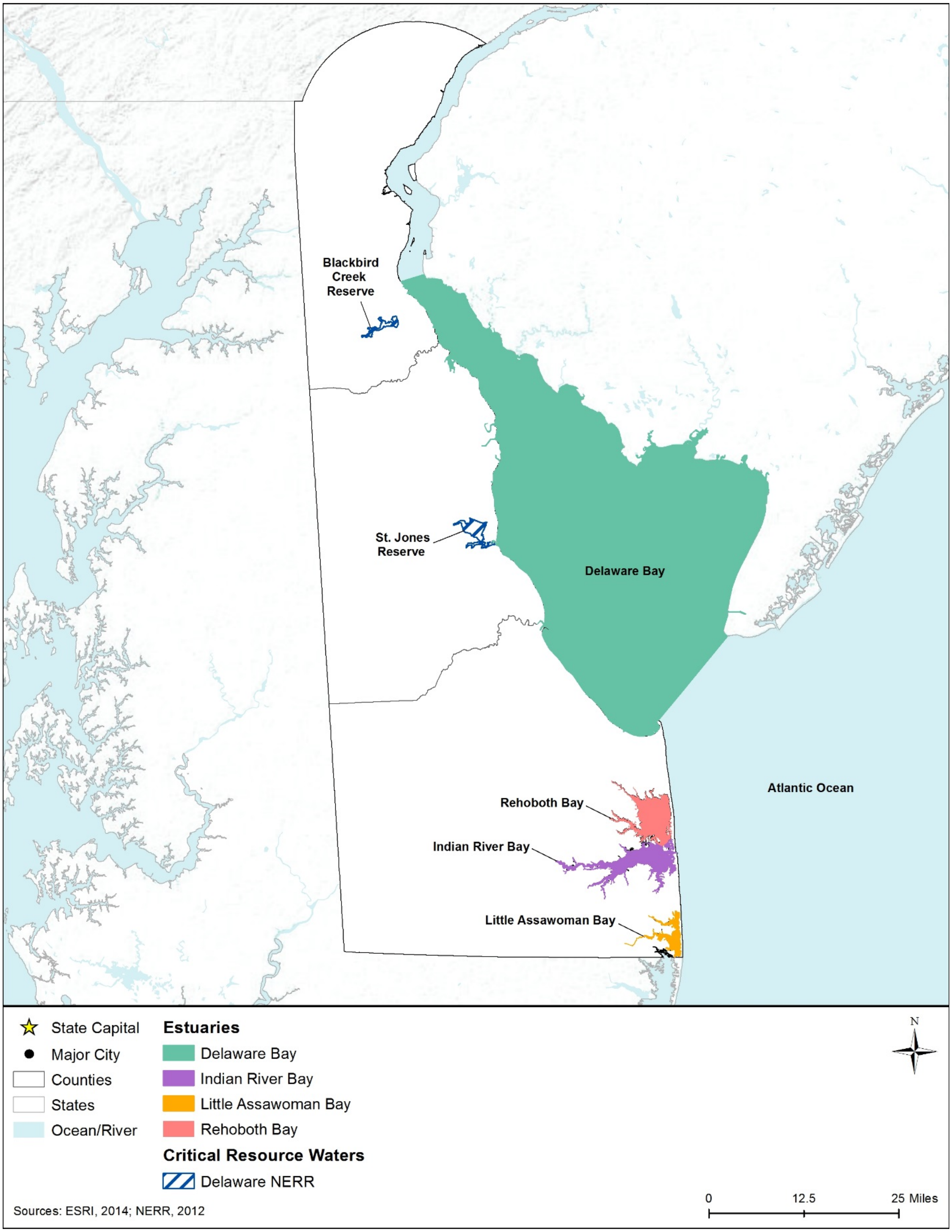


Figure 4.1.4-2: Delaware's Estuaries and Critical Resource Waters

Due to Delaware's small size and narrow shape, no part of the state is more than 12 miles from tidally influenced waters; therefore, the entire state is a designated coastal zone. The coastal zone is divided into two tiers: the "coastal strip" and the remainder of the state. The coastal strip is approximately four miles wide and follows the ocean shoreline. Under the Delaware Coastal Zone Act of 1971, this area requires special zoning permission prior to industrial development (DNREC, 2014a). Visit the Delaware DNREC Coastal Programs at www.dnrec.delaware.gov/coastal/Pages/CoastalMgt.aspx for more information on the state's coastal management program.

4.1.4.4. Sensitive or Protected Waterbodies

Wild and Scenic Rivers

The only federally designated National Wild and Scenic River in Delaware is White Clay Creek, which flows from Pennsylvania to northern Delaware (Figure 4.1.4-1). Of the 199 miles designated, approximately 31.5 miles are scenic and 167.5 miles are designated as recreational. White Clay Creek was the first National Wild and Scenic River protected as a watershed rather than as a river corridor due to its important environmental resources, such as its scenery, bird watching, and trout fishing opportunities, and historic features. The area includes Delaware's most extensive tract of mature-growth Piedmont forest and is home to the federally endangered bog turtle. Additionally, the 107 square mile watershed is an important source of drinking water with the Cockeysville Marble Formation aquifer. White Clay Creek's proximity to major metropolitan areas (Philadelphia, PA and Newark, DE) place the watershed at risk to environmental impacts, such as impaired water quality, noise, light pollution, and sensitive habitat destruction (NPS, 2006a) (Pennsylvania 16th Congressional District, 2010) (National Wild and Scenic Rivers System, 2015).

State Designated Critical Resource Waters[42]

The Delaware National Estuarine Research Reserve (NERR) System, administered by the National Ocean and Atmospheric Administration (NOAA), is one of 28 NERRs "whose goal is to establish, protect, and manage natural estuarine habitats for research, education, and coastal stewardship" (DNREC, 2015h). The Delaware NERR is comprised of "1,087 acres of freshwater wetlands, ponds, and forest lands" in Blackbird Creek Reserve in Townsend, DE and "5,119 acres of salt marsh and open

Figure 4.1.4-3: Delaware National Estuarine Research Reserve

Source: (NOAA, 2015k)

[42] Critical Resource Waters include NOAA-designated marine sanctuaries, National Estuarine Research Reserves, National Wild and Scenic Rivers, critical habitat for Federally listed threatened and endangered species, coral reefs, State natural heritage sites, and outstanding national resource waters or other waters officially designated by a State as having particular environmental or ecological significance and identified by the District Engineer after notice and opportunity for public comment. (ILDNR, 2015)

water habitats on the St. Jones River in the Delaware Bay" (NOAA, 2015a). These sites are considered Critical Resource Waters in Delaware and support "major spawning areas for horseshoe crabs each spring, and the resulting eggs provide fuel for migratory shorebirds" (see Figure 4.1.4-3) (NOAA, 2015a). More information on Delaware's NERR management plan as available at their website (www.dnrec.delaware.gov/coastal/DNERR/Pages/DelawareNationalEstuarineResearchReserve.aspx).

4.1.4.5. 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 Clean Water Act, states are required to report a listing of impaired waters, [43] the causes of impairment, and probable sources. Table 4.1.4-2 summarizes the water quality of Delaware's assessed major waterbodies by category, percent impaired, designated use, [44] cause, and probable sources in 2006. Figure 4.1.4-4 shows the Section 303(d) waters in Delaware as of 2012.

According to DNREC's 2012 statewide waters assessment, most of Delaware's rivers and streams (86 percent) and almost half of the state's freshwater ponds and lakes (44 percent) do not fully support swimming or fishing due to nonpoint source pollution[45] impacts and "bacteria concentrations above the levels considered acceptable for primary contact recreation (swimming, bathing, and water skiing)" (DNREC, 2013a). High bacteria levels (above levels considered safe for shellfish harvesting and consumption) have affected many of Delaware's estuarine and tidal waters, including the Delaware Bay's tidal tributaries and portions of Delaware's Inland Bays. (DNREC, 2013a)

[43] 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, 2015b)

[44] Designated Use: an appropriate intended use by humans and/or aquatic life for a waterbody. Designated uses may include recreation, shellfishing, or drinking water supply. (USEPA, 2015b).

[45] Nonpoint source pollution: a source of pollution that does not have an identifiable, specific physical location or a defined discharge point. Non-point source pollution includes nutrients that run off croplands, lawns, parking lots, streets and other land uses. It also includes nutrients that enter waterways via air pollution groundwater, or septic systems (USEPA, 2015b).

Table 4.1.4-2: Section 303(d) Impaired Waters of Delaware, 2006

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%	agricultural water supply, coldwater fish, aquatic life, and harvestable shellfish waters	nutrients, such as total phosphorus and nitrogen, pathogens[c]	agriculture, natural sources (wildlife), onsite treatment systems (septic systems), and municipal point source discharges
Lakes, Reservoirs, and Ponds	100%	97%	agricultural water supply, aquatic life, fishing, industrial water supply, and primary and secondary contact recreation	nutrients such as phosphorus and nitrogen, pathogens, and chemicals such as polychlorinated biphenyls	agriculture, natural sources (wildlife), and industrial discharge
Estuaries and Bays	7%	100%	aquatic life, harvestable shellfish waters, industrial water supply, and recreation	nutrients such as nitrogen and phosphorus, pathogens, and sediment	municipal point source discharges, on-site treatment systems (septic systems), agriculture, and natural sources (wildlife)
Delaware coastal shoreline	100%	0%	aquatic life, industrial water supply, and primary and secondary contact recreation	NA	NA

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

Eutrophication[46] caused by excess nutrients (nitrogen and phosphorus) is another leading cause of water quality impairment in Delaware, most likely from domestic waste disposal (on-site septic systems), soil erosion, and runoff. Other causes of water quality impairment include toxic chemicals such as polychlorinated biphenyls (PCBs), metals, and pesticides, which persist in the environment and accumulate in the flesh of fish. These impairments cause the DNREC to issue fish consumption advisories over the years. The DNREC Division of Watershed Stewardship, Watershed Assessment Section: 305(b) and 303(d) Reports (www.dnrec.delaware.gov/swc/wa/Pages/WatershedAssessment30 5band303dReports.aspx) for more information on Delaware’s water quality (DNREC, 2013a).

[46] Eutrophication: the process where a body of water acquires a high concentration of nutrients, especially phosphates and nitrates, which can lead to excessive growth of algae (USGS, 2014i).

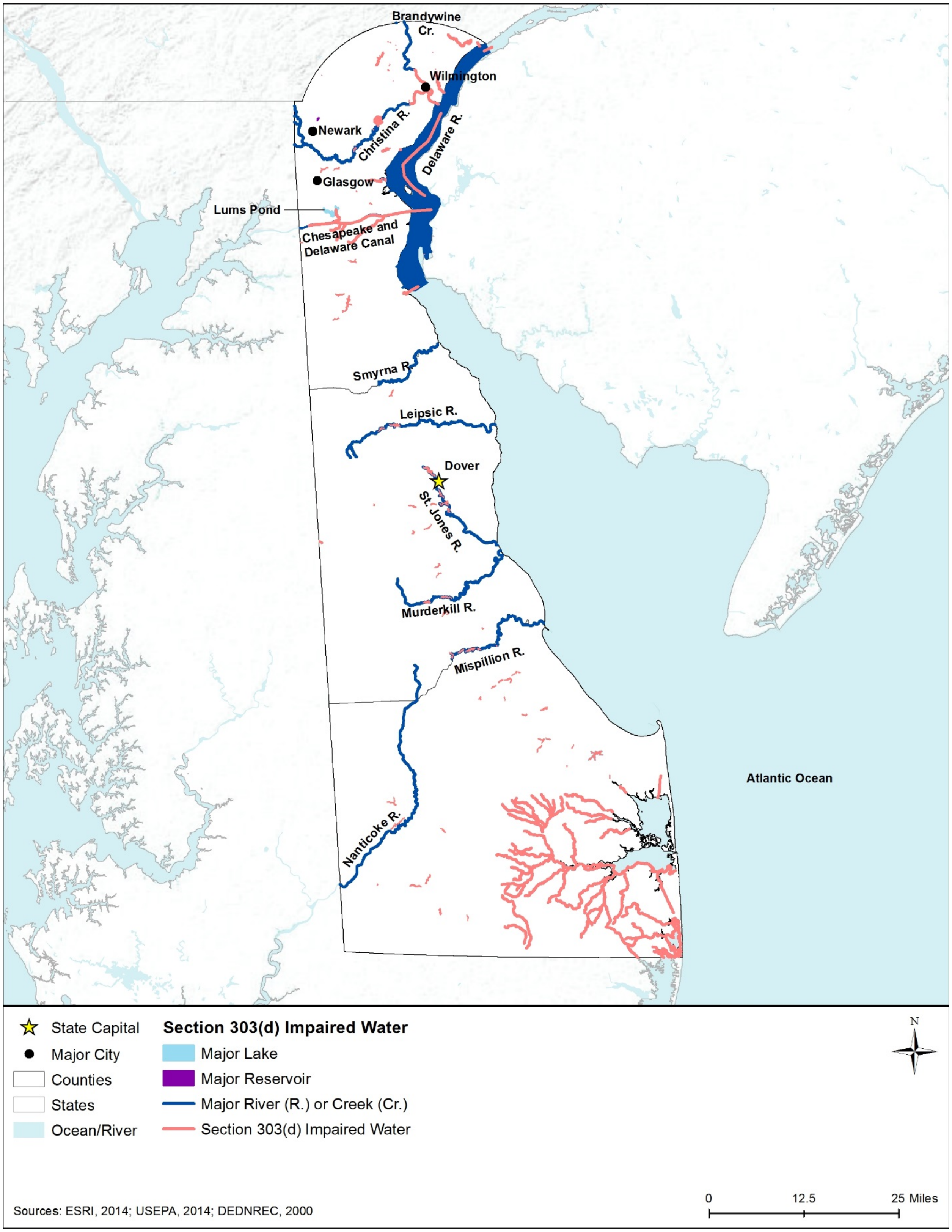


Figure 4.1.4-4: Section 303(d) Impaired Waters of Delaware, 2012

4.1.4.6. Floodplains

Floodplains are lowlands along inland or coastal waters, including flood-prone areas of offshore islands. 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). 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 provide shading, 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)

There are two primary types of floodplains in Delaware:

- **Riverine floodplains** occur along rivers or streams where overbank flooding may occur, inundating adjacent land areas. Delaware is relatively flat with a mean elevation of only 60 feet above sea level with the lowest elevation of any state in the nation (Kauffman, 2011). As a result, these floodplains can remain flooded with shallow, slow-moving floodwaters for days (FEMA, 2014b).

- **Coastal floodplains** in Delaware border the Atlantic Ocean, Delaware Bay, and the Inland Bays. In fact, nearly the entire eastern border of the state lies on a coastal floodplain. Coastal flooding can occur when strong wind and storms, usually nor’easters and hurricanes, create storm surges that increase water levels along shorelines (FEMA, 2013). A large proportion of Delaware is at risk of coastal flooding because the state occupies a relatively narrow strip of land along an ocean coastline. The barrier beaches in the southern portion of the state are particularly susceptible to coastal flooding as storm surges can easily inundate the low, flat, narrow strips of sand and sediment that can face rising waters both from the open ocean to the east and from inland bays to the west. Coastal flooding is often accompanied by inland, riverine flooding because storms typically also result in heavy inland precipitation. (DNREC, 2015i)

Flooding is the leading cause for disaster declaration by the President in the U.S. (NOAA, 2015b). Delaware’s 100-year floodplains encompass over 331 square miles (17 percent of the state’s landmass), with over 620 miles of roads and more than 18,000 buildings and homes

(Kauffman, 2011). Located entirely within the coastal zone, Delaware experiences millions of dollars of property and infrastructure damage annually because of flooding from major storms (DNREC, 2013b). The main causes of flooding in Delaware include heavy rainfall and storm surge from coastal storms (DNREC, 2015i).

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 48 communities in Delaware 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, Delaware had 10 communities participating in the CRS (FEMA, 2014d)[47].

4.1.4.7. Groundwater

Groundwater systems are sources of water that result from precipitation infiltrating the ground surface, and include underground water that occupies pore spaces between sand, clay, or rock particles. An aquifer is a permeable geological formation that stores or transmits water, such as 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. Table 4.1.4-3 provides details on aquifer characteristics in the state; Figure 4.1.4-5 shows Delaware's principal and sole source aquifers.

Delaware's principal aquifers consist of unconsolidated sedimentary deposits[48] that underlie the Coastal Plain physiographic province and crystalline bedrock[49] that underlies the Piedmont physiographic province in the northernmost portion of the state (USGS, 2003d). In New Castle County, 75 percent of the drinking water comes from streams in the Delaware River basin, with the remaining drinking water provided by groundwater. Kent and Sussex Counties rely solely on groundwater for drinking water. Threats to groundwater quality in Delaware include leaking

[47] A list of these 10 CRS communities can be found in the most recent FEMA CRS report dated June 1, 2014 (www.fema.gov/media-library-data/1398878892102-cbcaa727a635327277d834491210fec/CRS_Communites_May_1_2014.pdf) and additional program information is available from FEMA's NFIP CRS website (www.fema.gov/national-flood-insurance-program-community-rating-system) (DelDOT, 2011b)

[48] Unconsolidated sedimentary deposits: "loosely bound sediments such as sand, gravel, and silt, which tend to accumulate in low areas or valleys" (USGS, 2015g).

[49] Crystalline bedrock: rock formed from molten material such as magma, or rock that has been changed over time due to chemical changes or pressure (USGS, 2015h).

domestic and large on-site septic systems, hazardous waste generators, underground storage tanks, Superfund sites, and animal operations. (DNREC and Delaware SWPC and TAC, 2007)

Table 4.1.4-3: Description of Delaware's Principal Aquifers

Aquifer Type and Name	Location in State	Groundwater Quality
Piedmont and Blue Ridge crystalline rock These aquifers consist mainly of coarse-grained gneisses and schists of various mineral composition.	Occurs in the northern-most tip of the state in New Castle County.	Water is generally suitable for drinking and other uses, and is soft and slightly acidic. Contains dissolved solids concentrations of about 120 milligrams per Liter (mg/L) and is slightly acidic, and average iron concentration is 0.1 gram per milliliter (g/mL). (USGS, 1995)
Northern Atlantic Coastal Plain system Unconsolidated sediments primarily of clay, silt, and sand. Atlantic Coastal Plain aquifer system includes The Chesapeake Group of Aquifers, Piney Point, Rancocas, Magothy, and Potomac Aquifers.	Occurs beneath the portion of the state within the Coastal Plain physiographic province, which is the majority of the state	Water is generally suitable for drinking, but contaminants include nitrate and naturally occurring radium (USGS, 2015d).

Source: (Moody, Carr, Chase, & Paulson, 1986), (Trapp J. H., 1997), (USGS, 1995)

Sole Source Aquifers

The USEPA defines a sole source aquifer (SSA) as one that "supplies at least 50 percent of the drinking water consumed in the area overlying the aquifer" (USEPA, 2015d). Delaware has only one designated SSA, the New Jersey Coastal Plain Aquifer (Figure 4.1.4-5), which underlies much of New Jersey, and is slightly within the boundaries of Delaware along the banks of the Delaware River (USEPA, 2007a). Designating a groundwater resource as an SSA helps to protect the drinking water supply in that area and requires reviews for all federally funded proposed projects to ensure that the water source is not jeopardized (USEPA, 2015d).

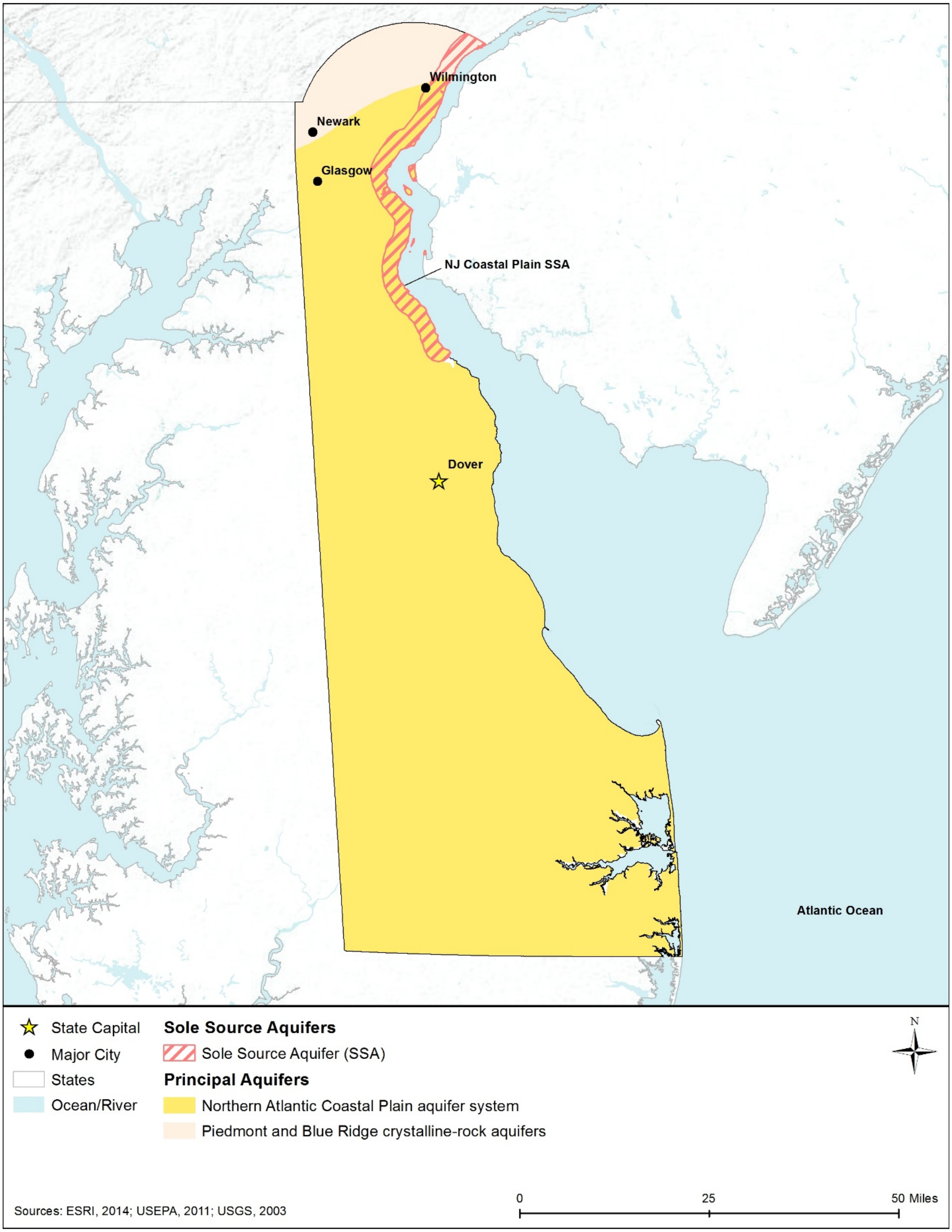


Figure 4.1.4-5: Principal and Sole Source Aquifers of Delaware

4.1.5. Wetlands

4.1.5.1. Definition of the Resource

The Clean Water Act (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).

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.

4.1.5.2. Specific Regulatory Considerations

Appendix C explains the pertinent federal laws to protecting wetlands in detail. Table 4.1.5-1 summarizes major Delaware state laws and permitting requirements relevant to the state's wetlands.

Table 4.1.5-1: Relevant Delaware Wetlands Laws and Regulations

State Law/Regulation	Regulatory Authority	Applicability
CWA Section 404 permit, DE regional requirements	U.S. Army Corps of Engineers (USACE), Philadelphia District	The NWP program does not authorize certain activities in Critical Resource Waters, which includes all wetlands in the Delaware National Estuarine Research Reserves: Blackbird Creek Reserve and St. Jones Reserve. (USACE, 2012b)
CWA Section 401 Certification	DNREC, Division of Water, Wetlands and Subaqueous Lands Section (WSLS)	In accordance with CWA Section 401, activities that may result in a discharge to waters, as well as tidal and nontidal wetlands, of the U.S. require a Water Quality Certification from DNREC indicating that the proposed activity will not violate water quality standards. (DNREC, 2013c)(DNREC, 2015a)
Wetlands Act	DNREC, Division of Water, WSLS	Regulated activities that occur within tidal and large non-tidal wetlands (>400 contiguous acres) require authorization from DNREC. A Type I permit is required for select maintenance activities, and when there is no new construction that will disturb one acre or less of wetlands. Projects disturbing wetlands exceeding one acre and when there is new construction require a Type II permit. (DNREC, 2013c) (DNREC, 2015a)

4.1.5.3. 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, Carter, Golet, & LaRoe, 1979). The WCS includes five major wetland systems: Marine, Estuarine, Riverine, Lacustrine, and Palustrine (as detailed Table 4.1.5-2). 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 open ocean, continental shelf, including beaches, rocky shores, lagoons, and shallow coral reefs. Normal marine salinity (saltiness) to hypersaline (more than 35% salty) water chemistry; minimal influence from rivers or 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 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 of 0.5 ppt or greater.
- Lacustrine System includes inland water bodies that are situated in topographic depressions, lack emergent trees and shrubs, have less than 30% vegetation cover, and occupy at least 20 acres. Includes lakes, larger ponds, sloughs, lochs, bayous, etc.
- Palustrine includes all nontidal wetlands dominated by trees, shrubs, persistent emergent plants, or emergent mosses or lichens, and all wetlands that occur in tidal areas where the salinity is below 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) (Federal Geographic Data Committee, 2013)

In Delaware, the two main types of wetlands are palustrine (freshwater) wetlands found on river and lake floodplains across the state, and estuarine (tidal) wetlands around large coastal rivers, such as the Indian and Leipsic Rivers, Delaware Bay, and the inland bays of Rehoboth Bay, Indian River Bay, and Little Assawoman Bay. In 2011, wetlands covered an estimated 25 percent of Delaware (Tiner, Biddle, Jacobs, & Rogers, 2011). Lacustrine and riverine wetlands comprise less than 1 percent of total wetlands in the state, therefore they are not discussed separately.

Table 4.1.5-2 uses 2014 NWI data to characterize and map Delaware's wetlands on a broad-scale. The data is 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. As shown in Figure 4.1.5-1, western and northern Delaware are predominately palustrine wetlands, while estuarine/marine wetlands are in the eastern portion of the state along the coast. The map codes and colorings in Table 4.1.5-2 correspond to the wetland types in the figures.

Palustrine Wetlands

In Delaware, palustrine wetlands include the majority of vegetated freshwater wetlands (freshwater marshes, swamps, and ponds). Across the state of Delaware, palustrine forested wetlands (PFO) are the predominant and most extensive type of wetlands (Tiner, Biddle, Jacobs, & Rogers, 2011) (DNREC, 2013c). Tidal palustrine forested wetlands may be dominated by trees such as green ash, red maple, and black gum (Tiner, R., 2001). Evergreen and deciduous forested wetlands are common nontidal palustrine forested wetlands with abundant species including loblolly pine, pond pine, Atlantic white cedar (not as common), red maple, sweet gum, various oaks, sweet bay, and river birch (Tiner, Biddle, Jacobs, & Rogers, 2011) (DNREC, 2015j) (DNREC, 2013c). Red maple swamps are the most prevalent type of wetland found in Delaware (Tiner, 1985).

Common species of nontidal scrub-shrub wetlands (PSS) include buttonbush, sweet pepperbush, black willow, smooth alder, marsh elder, highbush blueberry, winterberry, inkberry, fetterbush, wax myrtle, and silky dogwood (Tiner, R., 2001; DNREC, 2015j). PFO and PSS are the most common type of palustrine wetlands within Delaware. Palustrine emergent wetlands (PEM), tidal or nontidal freshwater marshes, in Delaware support diverse plant and animal populations (Tiner, 1985). Common PEM marsh plants in Delaware include cattails (*Typha latifolia*), spatterdock (*Nuphar advena*), pickerelweed (*Pontederia cordata*), wild rice, water-willow (Decodon verticillatus), buttonbush (*Cephalanthus occidentalis*), bulrushes, and arrowheads (*Sagittaria sp*.) (Tiner, 1985; DNREC, 2015j). Palustrine wetlands also include the shallow waters of lakes, rivers, ponds, and aquatic beds formed by water lilies and other floating-leaved or free-floating plants. These are the easiest wetlands to recognize and occur throughout the state.

As of 2007, approximately 75 percent of Delaware’s total wetlands were palustrine wetlands (Tiner, Biddle, Jacobs, & Rogers, 2011). The most common freshwater wetland type was PFO (approximately 85 percent); followed by PSS (7 percent), PEM (5 percent), PUB/PAB (ponds) and other palustrine wetlands comprise the last 3 percent (Tiner, Biddle, Jacobs, & Rogers, 2011). Based on the NWI 2014 analysis, approximately 70 percent of Delaware’s total wetlands are palustrine wetlands. The most common freshwater wetland type was PFO (approximately 85.7 percent); followed by PSS (6.9 percent), PEM (3.6 percent), PUB/PAB (ponds) (3.7 percent) and other palustrine wetlands (less than 1 percent) (USFWS, 2014a). There are currently about 180,000 acres of palustrine (freshwater) wetlands in the state (USFWS, 2014a). In Delaware, the main threats to palustrine wetlands are from agricultural conversion and residential development and urbanization (DNREC, 2013c) (DNREC, 2015k).

Table 4.1.5-2: Delaware 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, hardwood swamps, and silver maple-ash swamps are examples of PFO wetlands.	Throughout the state, forested lowlands within the state	167,654
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	Palustrine emergent wetlands have erect, rooted, green-stemmed, annual, water-loving plants, excluding mosses and lichens present for most of the growing season in most years. PEM wetlands include freshwater marshes, wet meadows, fens[50], prairie potholes, and sloughs.	Throughout the state	6,555
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	6,714
Palustrine aquatic bed	PAB	PAB wetlands include wetlands vegetated by plants growing mainly on or below the water surface line.		
Other Palustrine wetland	Misc. Types	Farmed wetland, saline seep[51], and other miscellaneous wetlands are included in this group.	Throughout the state	1
Riverine wetland	R	Riverine systems include rivers, creeks, and streams. They are contained in natural or artificial channels periodically or continuously containing flowing water.	Throughout the state	13
Lacustrine wetland	L2	Lacustrine systems are lakes or shallow reservoir basins generally consisting of ponded waters in depressions or dammed river channels, with sparse or lacking persistent emergent vegetation, including any areas with abundant submerged or floating-leaved aquatic vegetation. These wetlands are generally less than 8.2 feet deep.	Throughout the state	429

[50] Fens are nutrient-rich, grass- and sedge-dominated emergent wetlands that are recharged from groundwater and have continuous running water. (Edinger, et al., 2014)
[51] Saline seep is an area where saline groundwater discharges at the soil surface. Saline soils and salt tolerant plants characterize these wetland types. (City of Lincoln, 2015)

Wetland Type	Map Code and Color	Description[a]	Occurrence	Amount (acres)[b]
Estuarine intertidal 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.	Around Delaware Bay, south to the Inland Bays, and along the Atlantic shoreline	75,295

[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 minimum guidelines for wetlands mapping efforts. (Federal Geographic Data Committee, 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, 2015b) Source: (Cowardin, Carter, Golet, & LaRoe, 1979), (USFWS, 2015a), (Federal Geographic Data Committee, 2013)

In 1973, the Delaware State Legislature passed the Wetlands Act to "preserve and protect the productive public and private wetlands and to prevent their despoliation and destruction consistent with the historic right of private ownership of lands" (Del. Code Ann. Title 7, § 6601, 2015). Tidal and large nontidal wetlands, exceeding 400 contiguous acres, are mapped and regulated under the Act (DNREC, 2013c) (DNREC, 2015a).

Estuarine and Marine Wetlands

Estuarine and marine wetlands account for approximately 25 percent of Delaware's wetlands (Tiner, Biddle, Jacobs, & Rogers, 2011). Estuarine, or tidal fringe wetlands, can be vegetated (marshes) or unvegetated (mud and sand flats), and are found between the open saltwater of the bays or Atlantic Ocean and the uplands of the coastal plain. Estuarine wetlands include vegetated mudflats exposed at low tide and salt marshes (tidally flooded grasslands). They are found along Delaware's coast, from the mouth of the Delaware Bay south to the Inland Bays. Delaware's estuarine wetlands also extend upstream in large tidal rivers such as the Smyrna, Indian, Leipsic, St. Jones, Murderkill, Mispillion and Broadkill Rivers. In Delaware, salt marshes are most extensive along the Delaware Bay, south of the Chesapeake and Delaware Canal to Lewes. (Tiner, 1985; DNREC, 2015j)

The Wetlands Act established regulations on Delaware's estuarine wetlands to help reduce loss from development. From 1992 to 2007, Delaware experienced a net loss of more than 230 acres in estuarine vegetated wetlands (Tiner, Biddle, Jacobs, & Rogers, 2011). Land subsidence and sea level rise were the primary causes, in addition to construction and development (Tiner, Biddle, Jacobs, & Rogers, 2011) (DNREC, 2013c).

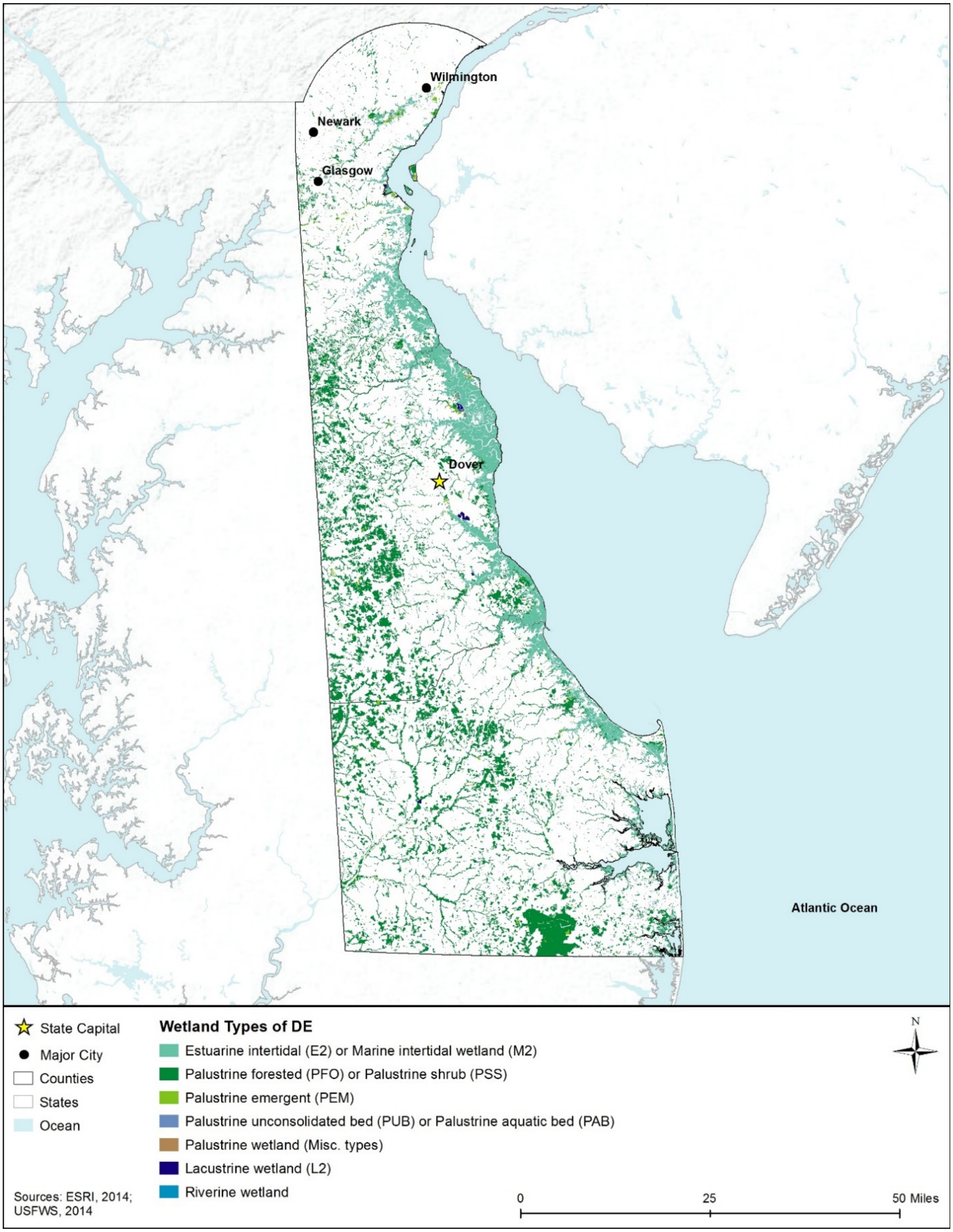


Figure 4.1.5-1: Wetlands by Type, in Delaware, 2014 Estuarine and Marine Wetlands

4.1.5.4. Wetlands of Special Concern or Value

In addition to protections under the state's Wetlands Act and national CWA, Delaware considers certain wetland communities as areas of special value due to their global or regional scarcity, local importance, or habitat they support. These include palustrine tidal marshes, Atlantic white cedar swamps, coastal plain ponds, and interdunal swales,[52] as well the Delaware Bay Estuary, Inland Bays Estuary, and wetlands associated with critical resource waters.

Palustrine Tidal Marshes

Palustrine tidal marshes are becoming increasingly scarce in the state due to sea-level rise. These wetlands provide habitat for a number of threatened plant species and are found primarily along the Christina River in northern Delaware and near the Nanticoke River in Southern Delaware (see Figure 4.1.4-1, Major Delaware Watersheds, defined by DNREC, and Surface Waterbodies, in Section 4.1.4, Water Resources). (Tiner, R., 2001; DNREC, 2015j)

Atlantic White Cedar Swamps

Atlantic white cedar swamps are a type of PFO wetland characterized by acidic, highly organic, and poorly drained soils near floodplains. These swamps support unique species such as sundews and pitcher plants that are not as common elsewhere in the state. Historically these swamps were extensive across the state. Due to drainage and the timber industry in the 1800s and 1900s, they are now limited to small stands in Sussex County along the floodplains of Cedar Creek and the Mispillion and Nanticoke Rivers (see Figure 4.1.4-1, Major Delaware Watersheds, defined by DNREC, and Surface Waterbodies, in Section 4.1.4, Water Resources). (Tiner, R., 2001; DNREC, 2015j)

Coastal Plain Ponds

Source: (McAvoy, 2014)

Figure 4.1.5-2: Bald Cypress Swamp, Delaware

Coastal plain ponds, also known as Delmarva bays or potholes, are small, shallow, isolated, seasonally inundated, freshwater depressional wetlands located primarily in the inland region of the state in New Castle and Kent Counties. These wetlands are typically fed by groundwater, rainfall, and snowmelt during the winter, spring months, and may be dry during the summer months. There are more than a thousand coastal plain ponds in Delaware, which provide critical habitat to numerous threatened and rare species of plants and animals and offer essential breeding areas for many amphibians. Currently, coastal plain ponds are threatened and vulnerable to development. An estimated 25

[52] See below for a description of interdunal swales.

percent of these wetlands are designated as isolated and are not protected under federal or Delaware wetland regulations. (DNREC, 2013c) (Tiner, R., 2001) (DNREC, 2015j)

Bald Cypress Swamps

Bald cypress swamps are forested, permanently flooded wetlands (Figure 4.1.5-2). Dominated by bald cypress, Delaware is the northernmost reach for this type of wetland in the United States. Other plants such as red maple, black gum (*Nyssa sylvatica*), spatterdock (*Nuphar advena*), picklerweed (*Pontederia cordata*), bur reed (*Sparganium erectum*), pondweeds (*Stuckenia pectinata*), and white water lily (*Nymphaea alba*), typically found in these wetlands.

Bald cypress swamps occur primarily in southern Delaware within forested floodplains of creeks, rivers, and ponds such as Trussum Pond and Trap Pond in Sussex County. Bald Cypress Swamps are extremely rare in Delaware. (Tiner, 1985; DNREC, 2015j)

Interdunal Swales

Interdunal swales are wetlands that occur in the low-lying areas between and behind dunes along the coastline. Delaware interdunal swales are found in Sussex County near the Delaware Bay and the Inland Bays. Groundwater feeds these nontidal wetlands, which change due to seasonal groundwater fluctuations. Interdunal swales vary in shape and size, but they typically consist of less than 1 acre of wetland habitat. Interdunal swales feature plant communities including grasses, sedges, rushes, and asters. These wetlands provide habitat for many rare species and are important freshwater sources for organisms within the coastal dune systems. (McAvoy, W., 1994)

Delaware Bay Estuary

The Delaware Bay Estuary contains more than 400,000 acres of tidal and nontidal wetlands (USEPA, 2012b). The estuary features a variety of wetland types such as “tidal salt marshes, tidal freshwater marshes, intertidal mudflats, oyster reefs, beaches, inland wetlands, and upland meadows and forests” (USEPA, 2007b). In addition, in 1992 the Delaware Bay Estuary was designated a Wetlands of International Significance by the Ramsar Convention on Wetlands,[53] because it provides critical resting and feeding areas for migratory shore and wading birds (USFWS, 2015c). See Section 4.1.4, Water Resources, for more information about the Delaware Bay Estuary.

Inland Bays Estuary

The Inland Bays Estuary feature tidal wetlands as well as some of Delaware’s most rare nontidal wetlands, such as Atlantic white cedar swamps, sea-level fens, and interdunal swales. Currently, there are approximately 25,000 acres of nontidal wetlands and 9,000 acres of tidal wetlands in the Inland Bays Estuary. The Inland Bays Estuary provides important habitats for many plants and animals. (Jacobs, Rogerson, Fillis, & Bason, 2009; Rogerson, Howard, & Jacobs, 2009)

[53] The Ramsar Convention is the “oldest of the modern global intergovernmental environmental agreements. The treaty was negotiated through the 1960s by countries and non-governmental organizations concerned about the increasing loss and degradation of wetland habitat for migratory waterbirds.” (Ramsar Convention, 2014)

See Section 4.1.4, Water Resources, for more information about the Delaware Inland Bays Estuary.

Wetlands Associated with Critical Resource Waters

Under the USACE Nationwide Permit General Condition #22, Delaware provides additional protection for wetlands associated with critical resources waters, which includes the Delaware National Estuarine Research Reserve (NERR) (USACE, 2012a; NOAA, 2015c). The Delaware NERR consists of palustrine and estuarine wetlands and uplands at two sites, the Blackbird Creek Reserve and the St. Jones Reserve. The Blackbird Creek Reserve, in a rural region of southern New Castle County, features approximately 1,100 acres of palustrine tidal and nontidal wetlands. The St. Jones Reserve, in Kent County south of the City of Dover, contains approximately 5,100 acres of estuarine vegetated and nonvegetated wetlands and deepwater habitat. (NOAA, 2015c)

Other important wetland sites in Delaware include:

- Wetland Nature Centers are open to the public and all are state-protected because of their ecological importance (DNREC, 2015l). More information on the centers is available at www.dnrec.delaware.gov/Admin/DelawareWetlands/Pages/EnjoyWetlands.aspx.
- Wildlife Management Areas and state parks are designated for outdoor recreation (DNREC, 2015l). To learn more about Wild Life Management Areas and State Parks in Delaware, visit www.destateparks.com/park/.
- National Wildlife Refuges (NWRs) are open to the public and are federally protected areas because of their ecological importance (DNREC, 2015l). The Prime Hook NWR is one of the largest in Delaware and is designated a Wetlands of International Significance by the Ramsar Convention on Wetlands. The USFWS' National Wildlife Refuges website (www.fws.gov/refuges/refugeLocatorMaps/Delaware.html) provides additional information about Delaware's NWRs.
- Other wetlands protected under easements or agreements through voluntary government programs and resource conservation groups found across the state, including Natural Resources Conservation Service (NRCS) Agricultural Conservation Easement Program, Farm Service Agency Conservation Reserve Program, Delaware DNREC Division of Parks and Recreation, and easements managed by natural resource conservation groups such as state land trusts, and The Nature Conservancy (DNREC, 2015m). The Delaware DNREC manages more than 55,000 acres of conservation easements across the state (DNREC Open Space Council, 2015). 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 7,500 acres in conservation easements in Delaware (National Conservation Easement Database, 2015).

For more information on Delaware's wildlife management areas, National Natural Landmarks, conservation programs, and easements, see Section 4.1.3, Visual Resources, and Section 4.1.7, Land Use, Recreation, and Airspace.

4.1.6. Biological Resources

4.1.6.1. Definition of the Resource

This chapter describes the biological resources of Delaware. Biological resources include terrestrial[54] vegetation, wildlife, fisheries, aquatic[55] habitats, and threatened[56] and endangered[57] species as well as species of conservation concern. Wildlife habitat and associated biological ecosystems are also important components of biological resources. There is little topographic relief within the state, which is located within the Atlantic Coastal Plain, except for the northernmost portion of the state which is part of the Delmarva Peninsula. However, due to Delaware's geographic location between northern and southern climate ranges, coupled with its varied coastal and marsh habitats, Delaware supports a wide variety of biological resources. Delaware is composed of three counties and the location of these counties is helpful in facilitating an understanding of the biological resources of the state; from north to south, these three counties are New Castle, Kent, and Sussex. Each of these topics is discussed in more detail below.

4.1.6.2. Specific Regulatory Considerations

The proposed project must meet the requirements of NEPA and other applicable laws and regulations. Pertinent federal laws relevant to the protection and management of biological resources in Delaware are summarized in Appendix C. Table 4.1.6-1 summarizes the major state laws relevant to the state's biological resources.

Table 4.1.6-1: Relevant Delaware Biological Resources Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Delaware Code 7, Chapter 25, Delaware Land Protection Act	DNREC Division of Parks and Recreation	Open Space Program that coordinates various state lands such as parks, fish and wildlife areas, forests, nature preserves and cultural sites. Authorizes the development of State Resource Areas.
Delaware Code 7, Chapter 73, Natural Areas Preservation System	State of Delaware	Establishing an inventory of natural areas statewide and a system for nature preserves.

Source: (State of Delaware, 2015b)

[54] Terrestrial: "Pertaining to land." (USEPA, 2015a)
[55] Aquatic: "Pertaining to water." (USEPA, 2015a)
[56] Threatened species are "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." (16 U.S.C. §1532(20))
[57] Endangered species are "any species which is in danger of extinction throughout all or a significant portion of its range." (16 U.S.C. §1532(6))

4.1.6.3. Terrestrial Vegetation

The distribution of flora within a state is a function of the characteristic geology[58], soils, climate[59], and water of a given geographic area and correlates with distinct areas identified as ecoregions[60]. Ecoregions are broadly defined areas that share similar characteristics, such as climate, 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 Wide Fund, 2015).

Ecoregion boundaries often coincide with the physiographic regions of a state. Two physiographic provinces occur in Delaware. The majority of the state is in the Atlantic Coastal Plain physiographic province, and the northernmost tip of the state is located in the Piedmont physiographic province. The ecoregions mapped by the USEPA are the most commonly referenced, although individual states and organizations have also developed ecoregions that may differ slightly from those designated by the USEPA. The USEPA Level I ecoregion is the coarsest level, dividing North America into 15 ecological regions. Level II further divides the continent into 50 regions. The continental U.S. contains 104 Level III ecoregions and the conterminous U.S. has 84 ecoregions. This section provides an overview of the terrestrial vegetation resources for Delaware at USEPA Level III (Woods, Omernik, & Brown, 1999).

As shown in Figure 4.1.6-1, the USEPA divides Delaware into three Level III ecoregions. These ecoregions support a variety of different plant communities, all based on their general location within the state. The Northern Piedmont ecoregion occurs in the northernmost tip of the state. Along with a small occurrence of the Southeastern Plains – both of these are only found in New Castle County. The Middle Atlantic Coastal Plain occurs throughout the entire state including all three counties (i.e., New Castle, Kent, and Sussex). Table 4.1.6-2 provides a summary of the general abiotic characteristics, vegetative communities, and the typical vegetation found within the three Delaware ecoregions.

[58] 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.

[59] 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, 2015a)

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

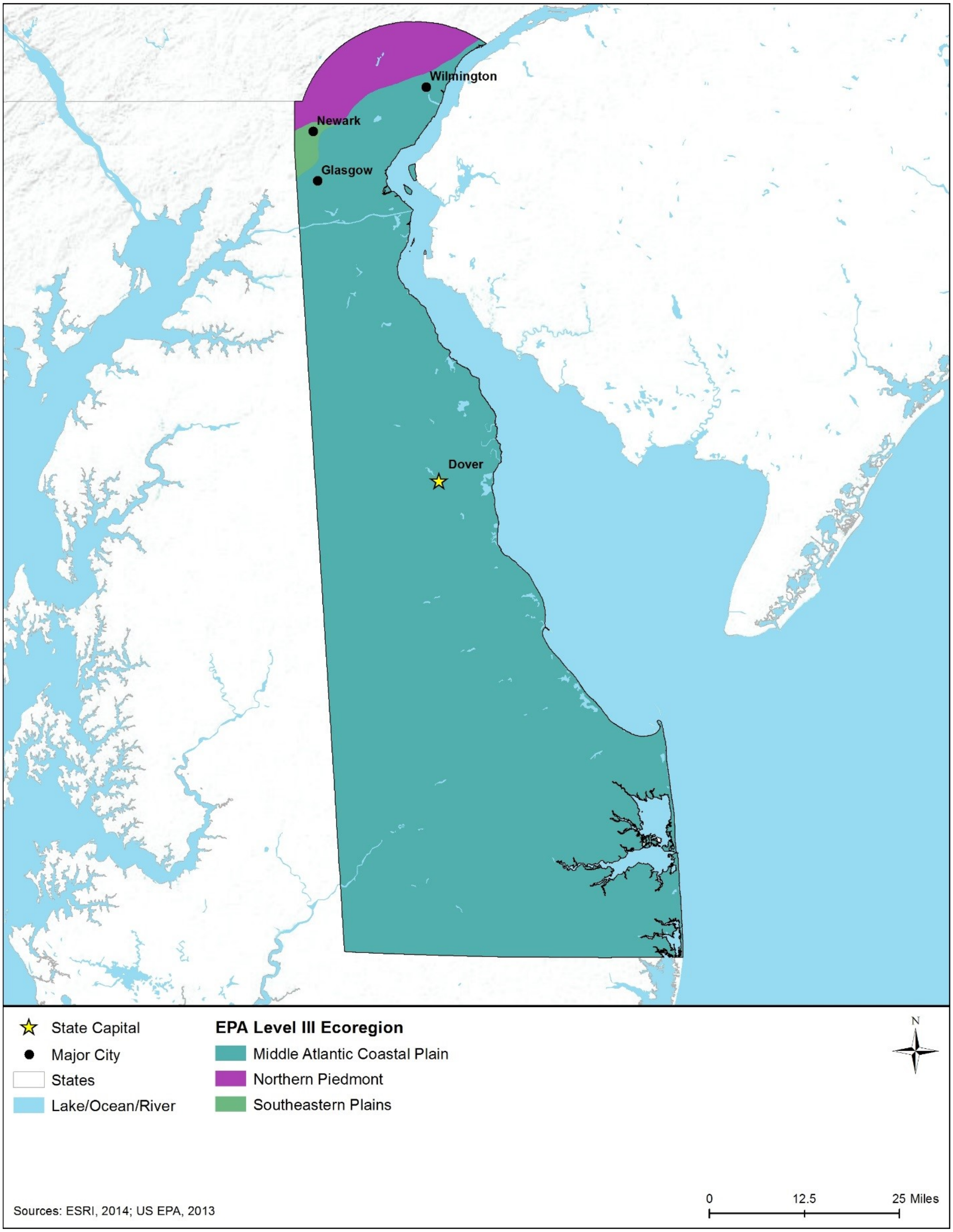


Figure 4.1.6-1: USEPA Level III Ecoregions in Delaware

Table 4.1.6-2: USEPA Level III Ecoregions of Delaware

Ecoregion Number	Ecoregion Description	Abiotic Characterization	General Vegetative Communities	Typical Vegetation
63	Middle Atlantic Coastal Plain	Composed mostly of mineral-poor fens or savannahs, freshwater swamps and tidal marshes along the Delaware River and Delaware Bay.	Hardwood/cedar swamp, loblolly pine wetland forests, oak and mixed hardwood forest, oak holly forest, piedmont mesic hardwood forest	• **Hardwoods –** American holly (*Ilex opaca*); ash (*Fraxinus* spp.); Atlantic white cedar (*Chamaecyparis thyoides*); ald cypress (*Taxodium distichum*); black gum (*Nyssa sylvatica*); eastern red cedar (*Juniperus virginiana*); mockernut hickory (*Carya tomentosa*); oak (*Quercus* spp); seaside alder (*Alnus maritima*); sweet birch (*Betula lenta*); sweetgum (*Liquidambar styraciflua*) • **Conifer Trees –** Pine (*Pinus* spp.)
64	Northern Piedmont	Transitional region composed of low hills, irregular plains, and open valleys in contrast to the highlands with freshwater wetlands and meadowlands interspersed.	Hardwood floodplain, central Appalachian/piedmont swamp, mixed hardwood forest, loblolly pine plantations	• **Hardwoods –** Black ash (*Fraxinus nigra*); slack walnut (*Juglans nigra*); green ash (*Fraxinus pennsylvanica*); maple (*Acer* spp.); Mountain laurel (*Kalmia latifolia*); oak (*Quercus* spp.); sweet birch (*Betula lenta*); sweetgum (*Liquidambar styraciflua*); sycamore (*Platanus occidental*); tuliptree (*Liriodendron tulipifera*) • **Conifer Trees** – Loblolly pine (*Pinus taeda)*
65	Southeastern Plains	Mosaic of croplands, pastures, forest and wetland. Long growing seasons and abundant rainfall.	Piedmont mixed hardwood forest, floodplain forest	• **Hardwoods –** American holly (*Ilex opaca*); box elder (*Acer negundo*); oak (*Quercus* spp.); red maple (*Acer rubrum*); silver maple (*Acer saccharinum*); sweet birch (*Betula lenta*); sweetgum (*Liquidambar styraciflua*); tuliptree (*Liriodendron tulipifera*)

Sources: (DNREC, 2009a) (USEPA, 2013a)

Communities of Concern

Delaware contains vegetative communities of concern that include rare natural plant communities, plant communities with greater vulnerability or sensitivity to disturbance, and communities that provide habitat for 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 gives an indication of the level of potential impact to a particular community that could result from implementation of an action.

The natural communities of Delaware includes lists of all types of natural communities based on a system developed by The Nature Conservancy and NatureServe[61]. This classification does include aquatic habitats, which is better described by their physical characteristics. Historical occurrences are important for assessing previously undocumented occurrences or re-occurrences of previously documented species. Historical occurrences are not documented in the classification lists. Each natural community is assigned a rank based on its rarity and vulnerability. As with most state heritage programs, the Delaware Natural Heritage Program (DNHP) ranking system assesses rarity using a state rank (S1, S2, S3, S4, S5) that indicates its rarity within the state. Communities ranked as an S1 by the DNHP are of the greatest concern and are extremely rare. This ranking is typically based on the range of the community, the number of occurrences, the viability of the occurrences, recent trends, and the vulnerability of the community. As new data become available, ranks are revised as necessary to reflect the most current information (DNREC, 2009a).

Twenty-nine out of 130 vegetative communities are ranked as a S1 communities[62] in Delaware. These communities represent the rarest terrestrial habitat in the state and compose 22 percent of Delaware's total vegetative communities. Communities occur within the three ecoregions of Delaware (DNREC, 2009a). Delaware Appendix B, Table B-1, provides a description of the S1 communities along with their distribution and associated USEPA Level III ecoregions.

Nuisance and Invasive Plants

Nuisance and invasive plants is a broad category that includes a large number of undesirable plant species. Direct impacts to nuisance and invasive plants may be viewed as beneficial to the environment, but often such impacts result in the inadvertent and unintended spread and dispersal of these species. Construction sites in particular provide colonizing opportunities for nuisance and invasive species, and long-term maintenance activities can perpetuate a disturbance regime that facilitates a continued dispersal mechanism for the spread of these species.

Noxious weeds are typically non-native species that have been introduced into an ecosystem inadvertently; however, on occasion native species can be considered a noxious weed. Noxious

[61] NatureServe is a non-profit organization that provides high-quality scientific expertise for conservation projects with over 1,000 conservation professionals from the U.S., Canada, and Latin America (www.natureserve.org).

[62] S1 – Communities "at high risk because of extremely limited and/or rapidly declining population numbers, range and/or habitat, making it highly vulnerable to global extinction or extirpation in the state" (DNREC, 2009a).

weeds greatly affect agricultural areas, forest management, natural, and other open areas (U.S. Legal, 2015). The U.S. government has designated certain plant species as noxious weeds in accordance with the Plant Protection Act of 2000 (7 U.S. Code [U.S.C.] 7701 et seq.). As of September 2014, 112 federally recognized noxious weed species have been catalogued in the U.S., 88 of which are terrestrial, 19 are aquatic, and 5 are parasitic (USDA, 2015b).

Noxious weeds have many adverse effects to the environment and threaten agricultural production. In Delaware, the Noxious Weed Law helps manage these noxious plants along right of ways and on private lands and assists the public in controlling noxious weeds on their property. The Delaware Noxious Weed Law stipulates the no one should knowingly allow noxious weeds to grow taller than 24 inches in height or allow noxious weeds to produce seeds. In order to enact this law, Delaware has devised a plan that allows landowners and farmers to use management techniques from the Plant Industries section in order to help increase assistance and compliance with the weed law. This includes an equipment loan program and free access to herbicide treatments. There is a total of six plant species listed as noxious in Delaware, none of which occur on the Federal Noxious Weed List (Delaware Department of Agriculture, 2015a) (Delaware Department of Agriculture, 2015b) (USDA, 2015b):

- **Terrestrial Forbs, Grasses, and Grass-like Plants –** Johnsongrass (*Sorghum halepense*), Canada thistle (*Cirsium arvense*), burcucumber (*Sicyos angulatus*), giant ragweed (*Ambrosia trifida*), Texas panicum (*Uruchloa texana*), and Palmer amaranth (*Amaranthus palmeri*)

Invasive species are defined as having the potential to disturb natural systems, or are extremely detrimental to natural systems. These species tend to have characteristics that help them grow in very extreme environments and deter other species from growing in the area. Characteristics include shade tolerance and reproducing and spreading rapidly by vegetative means or by seed dispersal. In Delaware, there are 64 species listed as invasive species or have the potential to be harmful, 15 of which are strictly invasive in Delaware and 14 of which are restricted (Delaware Invasive Species Council, 2015) (DNREC, 2001).

4.1.6.4. Terrestrial Wildlife

This section discusses the terrestrial wildlife species in Delaware, divided among mammals, birds, reptiles and amphibians, and invertebrates. Terrestrial wildlife consist of those species, and their habitats, that live predominantly on land. Terrestrial wildlife include common big game species, small game animals, furbearers[63], nongame animals, game birds, waterfowl, and migratory birds as well as their habitats. A discussion of non-native and/or invasive terrestrial wildlife species is also included within this section. Information regarding the types and location of native and non-native/invasive wildlife is useful for assessing the importance of any impacts to these resources or the habitats they occupy. Delaware's Division of Fish and Wildlife is the primary regulatory body that manages the state's wildlife resources, overseeing 50,000 acres of land and approximately 800 wildlife species (DNREC, 2015n).

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

Mammals

Common and widespread mammalian species in Delaware include the white-tailed deer (*Odocoileus virginianus*), red fox (*Vulpes vulpes*), gray fox (*Urocyon cinereoargenteus*), eastern gray squirrel (*Sciurus carolinensis*), muskrat (*Ondatra zibethicus*), raccoon (*Procyon lotor*), and eastern cottontail (*Sylvilagus floridanus*). Some of these common species and others are widely hunted. Approximately 10 percent of land in Delaware is open for hunting. The following eight species of furbearers may be legally hunted or trapped in the Delaware: muskrat, mink (*Neovison vison*), otter (*Lontra canadensis*), raccoon, opossum (*Didelphis virginiana*), nutria (*Myocastor coypus*), beaver (*Castor canadensis*), red fox, coyote (*Canis latrans*), groundhog (*Marmota monax*), gray squirrel, and eastern cottontail (DNREC, 2015n).

One threatened mammal is located in Delaware. Section 4.1.6.6, *Threatened and Endangered Species and Species of Conservation Concern*, identifies this protected species. Delaware has identified 10 mammals as Tier 1 Species of Greatest Conservation Need (SGCN). The SGCN list consists of at-risk species that are rare or declining, and State Wildlife Grants can provide funding for efforts to reduce their potential to be listed as endangered. Tier 1 species are of highest concern in Delaware and are regionally important. Although these species have been targeted for conservation they are not currently under legal protection. The SGCN list is updated periodically and is used by the state to focus their conservation efforts and as a basis for implementing their State Wildlife Action Plan (SWAP) (DNREC, Division of Fish and Wildlife, 2006).

Birds

The Delaware Bird Records Committee (DBRC) has accepted 410 species of birds that are seen within the state. This includes accidental, vagrant, and regularly occurring species. Delaware has identified 184 birds as SGCN (DNREC, Division of Fish and Wildlife, 2006). The variety of ecological communities (i.e., coastal areas, large rivers and lakes, grasslands, etc.) in Delaware supports a large variety of bird species. Nearly half of the birds in Delaware are aquatic birds and most of the rest are songbirds.

Delaware has a devised a Breeding Bird Atlas where volunteers collect data of breeding bird species and their distribution throughout the state. These data assist the state in assessing changes and improve information on the status and abundance of SGCN (DNREC, Division of Fish and Wildlife, 2012).

Delaware Bay has one of the largest concentrations of migrating shorebirds in the western hemisphere (DNREC, Division of Fish and Wildlife, 2006). Delaware is located within the Atlantic Flyway, which spans more than 3,000 miles from the Arctic tundra to the Caribbean. Large numbers of migratory birds utilize these flyways and other migration corridors and pathways throughout the state each year during their annual migrations. “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, 2013a). 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 10.13 (USFWS, 2013a).

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 the entire state throughout the year. Golden eagles are generally found around mountains and cliffs where they nest. Golden eagles are infrequently observed throughout the state, and are seen primarily during winter months (eBird, 2015).

A number of Important Bird Areas (IBAs) have also been identified in Delaware (Figure 4.1.6-2). The IBA program is an international bird conservation initiative with a goal of identifying the most important places for birds, and to conserve these areas. 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[64] for native bird populations. IBAs provide essential habitat for one or more species of birds. In addition to the Delaware Coastal Zone, which spans the coastal region of the state, four IBAs have been identified in Delaware, with the majority occurring in the northern region of the state:

- New Castle County: Red Clay Valley, White Clay Creek State Park, Pea Patch Island
- Sussex County: Great Cypress Swamp Conservation Area

American Bird Conservancy and the National Audubon has designated Delaware's Coastal Zone as a 270,000-acre global IBA of which approximately 232,000 acres are wetlands and uplands. This area is important area for breeding, feeding, and migratory birds. Due to this area being an important spawning area for horseshoe crabs, many species rely on its vast amount of horseshoe crab eggs to get them through the journey from north to south. The Red Clay Valley IBA consists of hills, valleys, woodlands, grasslands, protected land, Hoopes Reservoir, the Red Clay Creek floodplain, and wetlands. (Delaware Audubon, 2015)

White Clay Creek State Park is an important area for the cerulean warbler (*Setophaga cerulean*), Kentucky warbler (*Geothlypis formosa*), prairie warbler (*Setophaga discolor*), state-listed grasshopper sparrow (*Ammodramus savannarum*), state-listed hooded warbler (*Setophaga citrina*), and many migrating birds. Pea Patch Island is located in the Delaware Bay and is home to the largest heronry of mixed species on the east coast which includes great blue heron (*Ardea herodias*), great egret (*Ardea alba*), little blue heron (*Egretta caerulea*), snowy egret (*Egretta thula*), cattle egret (*Bubulcus ibis*), yellow-crowned night-heron (*Nyctanassa violacea*), black-crowned night-heron (*Nycticorax nycticorax*), glossy ibis (*Plegadis falcinellus*), and tri-colored heron (*Egretta tricolor*) (Delaware Audubon, 2015).

[64] Critical habitat: "A designated area that is essential to the conservation of an endangered or threatened species that may require special management considerations or protection" (USEPA, 2015a).

Two threatened birds are located in Delaware. Section 4.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, identifies these protected species.

Reptiles and Amphibians

A total of 63 native reptile and amphibian species, such as sea turtles, snakes, and salamanders, occur in Delaware, including 11 state listed endangered species and 5 federally listed endangered species. Delaware has identified 5 amphibian and 11 reptiles as SGCN (DNREC, Division of Fish and Wildlife, 2006).

The Blackbird-Millington Corridor located in the Delmarva Peninsula in central Delaware includes seasonal ponds which provide habitat for many reptiles and amphibians found in the state. These species occur in a wide variety of habitats from the sandy habitats of the coastal plain to the vernal pools of the Delmarva Peninsula to the fresh water wetlands spread sporadically throughout the state to sea turtle found along the coast (DNREC, Division of Fish and Wildlife, 2006).

Delaware’s native reptile and amphibian species are protected under state law, which prohibits the collection and possession of species without a permit (Delaware General Assembly, 2008). Four threatened and endangered reptiles are located in Delaware, there are no federally listed amphibians. Section 4.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, identifies these protected species.

Invertebrates

Delaware is home to over 300 native species, including 200 species of bees, hornets, wasps, 105 species of butterflies and moths, beetles, flies, 130 species of dragonflies and damselflies, spiders, mites, and nematodes. Delaware has identified 93 invertebrates as SGCN (DNREC, Division of Fish and Wildlife, 2006).

These invertebrates provide an abundant food source for mammals, birds, reptiles, amphibians, and other invertebrates. In the U.S., one third of all agricultural output depends on pollinators. In natural systems, the size and health of the pollinator population is linked to ecosystem health, with a direct relationship between pollinator diversity and plant diversity. “Bees play an important role in natural and agricultural systems as pollinators of flowering plants that provide food, fiber, animal forage, and ecological services like soil and water conservation” (Delphia, O'Neill, & Prajzner, 2011). “As a group, native pollinators are threatened by habitat loss, pesticides, disease, and parasites” (NRCS, 2009). Bees are especially important in improving crop productivity and health (Delaware Department of Agriculture, 2007).

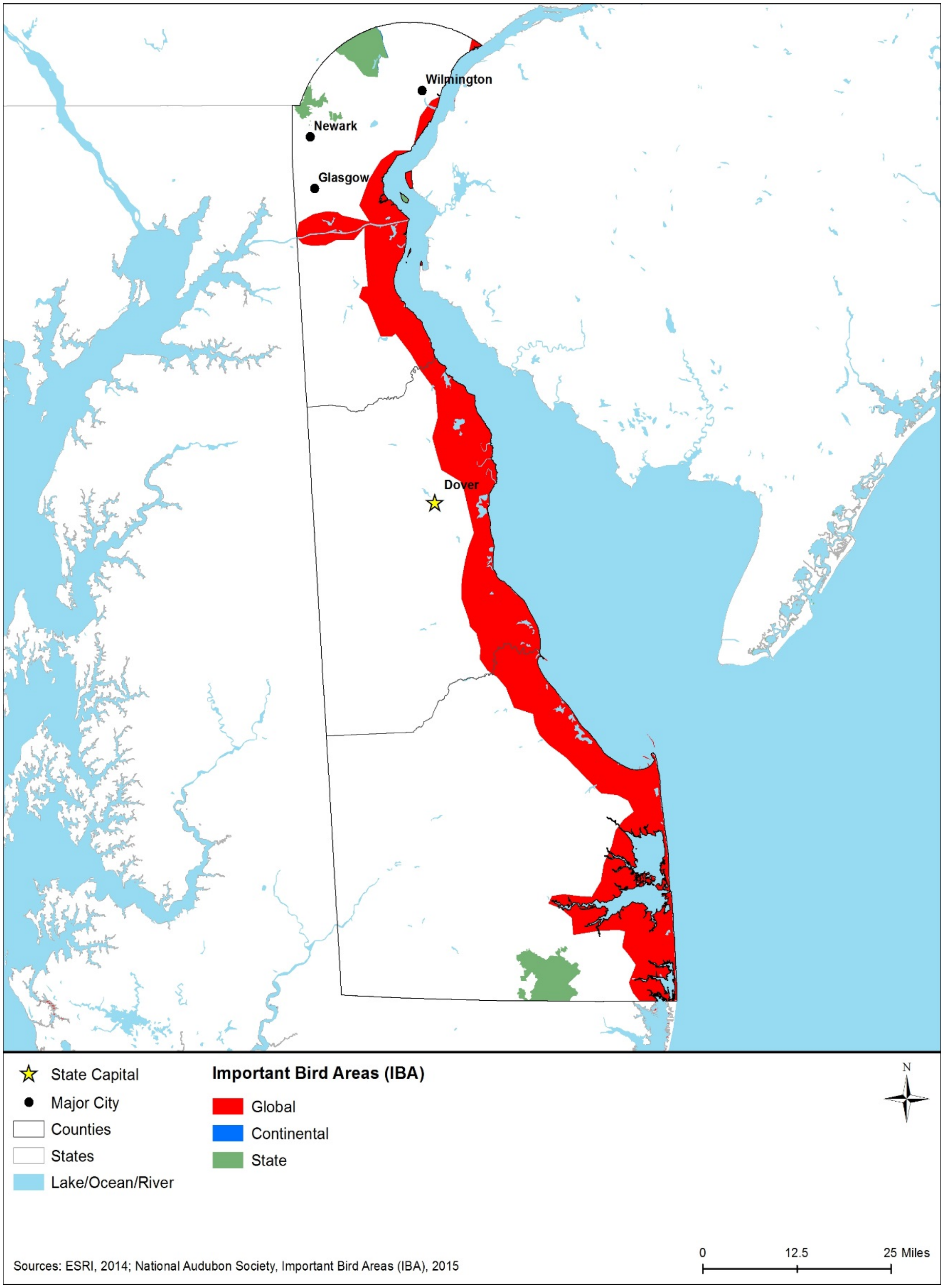


Figure 4.1.6-2: Important Birding Areas in Delaware

Invasive Wildlife Species

Delaware has adopted regulations that prohibit or regulate the possession, transport, importation, sale, purchase, and introduction of select terrestrial wildlife species on Division of Parks and Recreation lands under the Delaware Code Titles 7, 768, 770, and 795. Delaware can exempt certain reptiles and mammals that pose no significant threat (Delaware Invasive Species Council, 2015). There is no official list of prohibited wildlife species in the state; however, the Delaware Invasive Species Council keeps a list of plants and pests that are invasive. The only known mammal species that is invasive is the nutria. Nutria destroy wetland habitats by overgrazing and burrowing into flood control structures (USDA APHIS, 2010) (DNREC, 2015o). Other nuisance species include Snow goose (*Chen caerulescens*) and resident Canada goose (*Branta canadensis*) (DNREC, 2015p) (DNREC, 2010).

4.1.6.5. Fisheries and Aquatic Habitat

This section discusses the aquatic wildlife species in Delaware, including freshwater fish, saltwater fish and aquatic invertebrates. A summary of non-native and/or invasive aquatic species is also presented. According to NOAA, 130 species of fish use the Delaware River and Delaware Bay. Delaware has identified 30 fish as SGCN. Species vary from transitional cool and warm backwater fish, diadromous (i.e., anadromous[65] and catadromous[66]) and anadromous fish that use the Delaware River basin and the salty waters of the Atlantic Coast (DNREC, Division of Fish and Wildlife, 2006). The state provides 22 fishing and boating sights, 9 small pond areas, and maintains 14 artificial reefs (DNREC, Division of Fish and Wildlife, 2015a) (DNREC, Division of Fish and Wildlife, 2015b) (DNREC, Division of Fish and Wildlife, 2015c). Essential fish habitat (EFH) identified by the Magnuson-Stevens Fishery Conservation and Management Act, and defined below, exist in Delaware. Critical habitat for threatened and endangered fish species, as defined by the ESA, does not exist within Delaware.

Essential Fish Habitat

As described in Section 4.2.6.4, the Magnuson-Stevens Fishery Conservation and Management Act is the primary law governing marine fisheries management in U.S. federal waters. The Act calls for the identification and protection of fish habitats that are necessary for spawning, breeding, feeding, or growth to maturity; these habitats are termed "Essential Fish Habitat" or EFH (NOAA, 2015d). The NMFS provides an online mapping application[67] and website[68] to provide the public a means to obtain graphical representations of EFH. When assessing site-specific projects locations, this tool can be used to identify the potential for any conflicts between project activities and sensitive resources. Table 4.1.6-3 presents a summary of EFH offshore of Delaware.

[65] Anadromous: "Referring to the life cycle 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, 2015a) .
[66] Catadromous: "An organism which lives in fresh water and goes to the sea to spawn, such as some eels" (USEPA, 2015a) .
[67] http://www.habitat.noaa.gov/protection/efh/efhmapper/index.html.
[68] http://www.greateratlantic.fisheries.noaa.gov/hcd/list.htm.

Table 4.1.6-3: Essential Fish Habitats Offshore of Delaware

Common Name	Eggs	Larvae/YOY[69]	Juveniles	Adults
Atlantic albacore tuna	NA	NA	Eastern shore (in part)	NA
Atlantic bluefin tuna	NA	NA	New York Bight	NA
Atlantic cod	NA	NA	NA	Eastern shore
Atlantic herring	NA	NA	New York Bight (in part) and Delaware Bay	New York Bight and Delaware Bay
Dusky shark	NA	New York Bight	New York Bight	New York Bight
Clearnose skate	NA	NA	Eastern shore	Eastern shore and Delaware Bay
Little skate	NA	NA	New York Bight	New York Bight (in part) and Delaware Bay
Monkfish	New York Bight	New York Bight	Far offshore of New Jersey	Far offshore of New Jersey
Ocean pout	New York Bight (north)	New York Bight (north)	New York Bight (north)	New York Bight (north)
Red hake	New York Bight	New York Bight	New York Bight	New York Bight
Sand tiger shark	NA	New York Bight	New York Bight (south) and Delaware Bay	New York Bight (south) and Delaware Bay
Sandbar shark	NA	New York Bight (south)	New York Bight	New York Bight
Scalloped hammerhead shark	NA	NA	Eastern shore	Eastern shore (in part)
Shortfin mako shark	NA	New York Bight	New York Bight	New York Bight
Silver hake	New York Bight (in part)	New York Bight (in part)	New York Bight (in part)	Far offshore of New Jersey
Skipjack tuna	NA	NA	East-central shore	New York Bight
Thresher shark	NA	New York Bight	New York Bight	New York Bight
Tiger shark	NA	NA	New York Bight	New York Bight (in part)
White shark	NA	New York Bight	New York Bight	New York Bight
Witch flounder	New York Bight (in part)	New York Bight (in part)	NA	NA
Windowpane flounder	New York Bight and Delaware Bay	New York Bight and Delaware Bay	New York Bight and Delaware Bay	New York Bight and Delaware Bay
Winter flounder	New York Bight (in part) and Delaware Bay	New York Bight (in part) and Delaware Bay	New York Bight (in part) and Delaware Bay	New York Bight (in part) and Delaware Bay
Winter skate	NA	NA	New York Bight	Delaware Bay and NY Harbor
Yellowtail flounder	New York Bight (in part)	New York Bight (in part)	Far offshore of New Jersey	Far offshore of New Jersey

[69] 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." (USEPA, 2015a)

Shellfish and Other Invertebrates

Shellfish includes clams, mussels, oysters, crabs, scallops, and conchs. Approximately a dozen mussel species have historically been found in the Delaware Estuary; however, now only one species, the freshwater mussel, is present. The inland bays of Delaware are an important commercial and recreational area for both the hard clam (*Mercenaria mercenaria*) and the Atlantic oyster (*Crassostrea virginica*). Both species are native to Delaware. Delaware is working on setting up areas in Rehoboth Bath, Indian River Bay, and Little Assawoman Bay to establish shellfish aquaculture for these two species. (DNREC, 2015q)

Table 4.1.6-4: Shellfish and Other Invertebrates of Delaware

Category	Shellfish and Other Invertebrates
Clams	• Asiatic clam (*Corbicula fluminea*) • Hard clam (*Mercenaria mercenaria*) • Razor clam (*Siliqua patula*) • Surf clam (*Spisula solida*)
Conchs	• Channeled whelk (*Busycotypus canaliculatus*) • Knobbed whelk (*Busycon carica*)
Crabs	• Asian shore crab (*Hemigrapsus sanguineus*) • Blue crabs (*Callinectes sapidus*) • Chinese mitten crab (*Eriocheir sinensis*) • European green crab (*Carcinus maenas*) • Horseshoe crab (*Limulus Polyphemus*)
Lobster	• American lobster (*Homarus americanus*) • Red swamp crayfish (*Procambarus clarkia*)
Mussels	Freshwater mussels • Alewife floater (*Anodonta implicata*) • Creeper (*Strophitus undulates*) • Eastern elliptio (*Elliptio complanata*) • Eastern floater (*Pyganodon cataracta*) • Tidewater mucket (*Leptodea ochracea*) • Triangle floater (*Alasmidonta undulata*) • Yellow lampmussel (*Lampsilis cariosa*) Saltwater mussels • Blue mussels (*Mytilus edulis*)
Oysters	• Eastern oysters (*Crassostrea virginica*)
Scallops	• Atlantic sea scallop (*Placopecten magellanicus*) • Bay scallop (*Argopecten irradians*)

NA = Not Applicable

Sources: (Bott & Wong, 2012) (Silldorff & Schwartz, 2014) (State of Delaware, 2014a)

Invasive Aquatic Species

As previously discussed, Delaware has adopted regulations that prohibit or regulate the possession, transport, importation, sale, purchase and introduction of select invasive species, both plants and animals. Prohibited aquatic species includes four crustaceans, three fishes, and one mollusk. Species that have been detected in Delaware include the northern snakehead, flathead catfish, blue catfish, red swamp crayfish, Chinese mitten crab, Asian shore crab, European green crab, and Asiatic clam (DNREC, Division of Fish and Wildlife, 2015d).

4.1.6.6. 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 Delaware. The USFWS has identified three federally endangered[70] and eight federally threatened[71] species known to occur in Delaware[72] (USFWS, 2015d). None of these species have designated critical habitat[73] within Delaware (USFWS, 2015e). Additionally, one candidate species[74] is identified by USFWS as occurring within the state (USFWS, 2014b). Candidate species are not afforded statutory protection under the ESA (USFWS, 2014c). However, the USFWS recommends taking these species into consideration during environmental planning because they could be listed in the future (USFWS, 2015d). The 11 federally listed species include one mammal, four reptiles, two birds, and four plants (USFWS, 2015d); these species are discussed in detail under the following sections.

Mammals

One federally protected mammal is known to occur in Delaware. Details on this species are presented below and summarized in Table 4.1.6-5. The northern long-eared bat (*Myotis septentrionalis*) is found throughout the state. Information on the habitat, distribution, and threats to the survival and recovery of each of this species in Delaware is provided below.

Table 4.1.6-5: Federally Listed Mammal Species of Delaware

Common Name	Scientific Name	Federal Status [a]	Critical Habitat	Habitat Description
Terrestrial Mammals				
Northern Long-eared Bat	*Myotis septentrionalis*	T	No	Caves and tree crevices throughout Delaware

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

Terrestrial Mammals

Northern Long-eared Bat. The northern long-eared bat is a medium-sized (3 to 3.7 inches in length), brown furred, insectivorous bat with long ears, relative to other members of the genus *Myotis*. It was listed 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 (USFWS, 2015g). In summer their range includes New Castle County (USFWS, 2015f).

[70] Endangered species are "any species which is in danger of extinction throughout all or a significant portion of its range." (16 U.S.C. §1532(6))

[71] Threatened species are "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." (16 U.S.C. §1532(20))

[72] For purposes of this discussion, only listed species identified by USFWS will be discussed specifically as a threatened or endangered species in Delaware.

[73] 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))

[74] 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." (USFWS, 2014c)

This species hibernates in caves and mines that exhibit constant temperatures, high humidity, and no 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. Pregnant females then migrate to summer areas where they roost in small colonies (USFWS, 2015g).

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 U.S. Other threats include temperature or air flow impacts to their hibernating habitat, forest management practices that are incompatible with this species' habitat needs, habitat fragmentation, and wind farm operations (USFWS, 2015g).

Reptiles

Two federally endangered and two federally threatened turtles are known to occur in Delaware, as summarized in Table 4.1.6-6. No federally listed amphibian species are known to occur in Delaware. All three sea turtles are found off the coast of Delaware while the bog turtle (*Clemmys muhlenbergii*) is found sporadically throughout the state. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Delaware is provided below.

Table 4.1.6-6: Federally Listed Reptile Species of Delaware

Common Name	Scientific Name	Federal Status [a]	Critical Habitat	Habitat Description
Terrestrial Reptile				
Bog Turtle	*Clemmys muhlenbergii*	T	No	Wetlands and heavy vegetation within the northern region of Delaware
Marine Reptiles				
Hawksbill Sea Turtle	*Eretmochelys imbricata*	E	No	Marine visitor to the coast of Delaware during summer
Leatherback Sea Turtle	*Dermochelys coriacea*	E	No	Marine visitor to the coast of Delaware during summer
Green Sea Turtle	*Chelonia mydas*	T	No	Marine visitor to the coast of Delaware during the summer; rarely nests

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

Terrestrial Reptile

Bog Turtle. The bog turtle (*Clemmys muhlenbergii*) is a small turtle, averaging 3.1 to 4.5 inches in length characterized by a light brown to ebony shell and bright yellow, orange, or red blotches on each side of the head (USFWS, 2015i). The USFWS proposed a rule in 1997 to list the northern population of the bog turtle as threatened as well as the southern population due to similarity of appearance, under provisions of the Endangered Species Act of 1973 (62 FR 59605 59623, November 4, 1997). Regionally, the northern population of the bog turtle is known to occur in localized distributions from western Massachusetts and Connecticut southward to Maryland, and the southern population is known to occur from Virginia southward to Georgia

(USFWS, 2001). In Delaware, the bog turtle is known to occur in New Castle County in the northern part of the state (USFWS, 2015i).

The bog turtles prefer habitats that are open wetlands, sedge[75] meadows, calcareous fens[76], and boggy areas with cool, shallow, slow-moving water, deep and soft muck soils, and with tussock[77]-forming vegetation (USFWS, 2001). For hibernation, the bog turtle generally retreats back to densely vegetated areas in October and tend to emerge from hibernation in late March and April (USFWS, 2001). The bog turtle is omnivorous, it tends to mainly feed on insects but also consumes slugs, worms, frogs, plants, and beetles (PFBC, 2011).

Current threats to this species are habitat loss and fragmentation from development, vegetation succession, and invasion of nonnative plants, such as purple loosestrife (*Lythrum salicaria*) which out-complete native wetland plants. The illegal collection of bog turtles has also been a major threat to the bog turtles throughout the species' range (PFBC, 2015).

Marine Reptiles

Hawksbill Sea Turtle. The hawksbill sea turtle (*Eretmochelys imbricata*) is one of the smaller sea turtles. It was listed as endangered in 1970 (35 FR 8491 8498, Jun 6, 1970). This turtle has overlapping plates that are thicker than those of other sea turtles to protect 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 (USFWS, 2015k). Although in the Atlantic they range from the East Coast of the U.S. to northern Brazil, they are occasionally found offshore of New England (NOAA, 2015f).

This species prefers warm, shallow, coastal waters of reefs, lagoons, inlets, and bays with submerged aquatic vegetation. It is an omnivore, feeding mostly on sponges and is most often associated with the coral reef community. Nesting occurs on remote beaches in the Gulf of Mexico and the Caribbean Sea in two to three year cycles (USFWS, 2015k).

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 collection for meat, eggs, and parts, which was the historic threat to this species causing their decline (USFWS, 2015k).

Leatherback Sea Turtle. The leatherback sea turtle is "the largest and most migratory and wide ranging of all sea turtles," found in all of the world's oceans. Adult leatherback sea turtles can weigh up to 2,000 pounds and grow up to 8 feet in length (USFWS, 2015n). It was listed as endangered in 1970 (35 FR 8491 8498, June 2, 1970) and was grandfathered into the ESA of 1973 (NOAA, 2015e). The leatherback sea turtle ranges as far north as the Gulf of Maine and

[75] Sedge: "Plants of the family Cyperacae that resemble grasses, but have solid stems." (USEPA, 2015a)

[76] Fen: "A type of wet meadow with highly alkaline soil. Vegetation is primarily composed of herbaceous species, encircled by zones of plants of increasing height and woodiness." (USEPA, 2015a)

[77] Tussock: "A compact tuft of grass or sedges, or an area of raised solid ground that is held together by roots of low vegetation. Tussocks are found in wetlands or tundra." (Merriam Webster Dictionary, 2015)

Newfoundland, and may be found along the coast of Delaware during summer as an oceanic, visiting species (USFWS, 2015n).

Their diet consists of jellyfish and squid and while they may forage in coastal waters but they prefer open sea environments (USFWS, 2015n). Female leatherback sea turtles nest at 2 to 3 year intervals on beaches composed of coarse sand that are adjacent to deep water and subject to erosion (USFWS, 2015n). Major threats to the species include harvesting of their eggs, hunting, their incidental capture in fishing gear, and consumption of plastics that were mistaken for jellyfish (NOAA, 2015e).

***Green Sea Turtle*.** The green sea turtle occurs throughout tropical and subtropical oceans and is among the largest of the hard-shelled sea turtles growing to as much as 440 pounds and four feet in length. The breeding populations in Florida were listed as endangered in 1978 (43 FR 32800 32811) whereas all other populations were listed as threatened (NOAA, 2015j). They are found in the shallow waters (except during migration) of shoals, bays, lagoons reefs, and inlets, often where submerged aquatic vegetation exists, from Maine south to Florida, and throughout the Gulf of Mexico and the Caribbean Sea (USFWS, 2015p) (NOAA, 2015j). Breeding takes places in subtropical to tropical oceans every two, three, or four years between June and September, with peak nesting in June and July (USFWS, 2015p) (NOAA, 2015j). Hatching usually occurs at night, and many green sea turtle hatchlings seek refuge and food in masses of floating sea plants (USFWS, 2015p).

Green Sea Turtle Photo credit: USFWS

The collection of green sea turtles for food was the primary cause for the decline of this species; however, current threats include disease, loss or degradation of nesting habitat; disorientation of hatchlings by lighting; nest predation; marine pollution; watercraft strikes; and incidental take from channel dredging and commercial fishing operations (USFWS, 2015p) (NOAA, 2015j).

Birds

Two federally threatened bird species are listed and known to occur in Delaware, as summarized in Table 4.1.6-7. The piping plover (*Charadrius melodus*) and red knot (*Calidris canutus rufa*), is found in Delaware primarily during migration seasons. Information on the habitat, distribution, and threats to the survival and recovery the species is provided below.

Table 4.1.6-7: Federally Listed Bird Species of Delaware

Common Name	Scientific Name	Federal Status [a]	Critical Habitat	Habitat Description
Piping Plover	*Charadrius melodus*	T	No	Occurs on open front beaches, shorelines and barrier islands along coast of Delaware. Prefers sparse vegetation while nesting for protection from predators.
Red Knot	*Calidris canutus rufa*	T	No	Coastal areas in at least two Delaware counties during migration

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

Piping Plover. The piping plover is a small, pale-colored shorebird with a short beak and black band across the forehead, listed as endangered in 1985 (50 FR 50726, December 11, 1985) for the Great Lakes watershed of both the U.S. and Canada, and as threatened in the remainder of its range in the U.S., which includes the Northern Great Plains, Atlantic and Gulf Coasts, Puerto Rico, and the Virgin Islands (USFWS, 2015m). Piping plovers breed in three geographic regions of North America, comprising two separate subspecies (USFWS, 2015h). Those breeding within the northeastern U.S. and Canada are of the subspecies *C. m. melodus*, whose range extends from the Atlantic to the Great Lakes (USFWS, 2015m). In Delaware, piping plovers use coastal beaches for breeding only at Cape Henlopen State Park (DNREC, 2016).

This species feeds in the intertidal[78] zone of ocean beaches, ocean washover areas, mudflats, sandflats, 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, 2015o). Current threats to this species include habitat loss and habitat degradation, human disturbance, pets, predation[79], flooding from coastal storms, and environmental contaminants (USFWS, 2015o) (USFWS, 2015j).

Red Knot. Federally listed as a threatened species in 2014 (79 FR 73705 73748, December 11, 2014), the red knot is a large sandpiper that flies in large flocks along the Delaware Bay and the Atlantic Coast each spring. Red knots spend their winters in the southern tip of South America, northern Brazil, the Caribbean, and the southeastern and Gulf Coasts of the U.S. and breed in the tundra of the central Canadian Arctic. Some have been documented to fly more than 9,300 miles from south to north every spring and return south in autumn. Red knots are observed in two Delaware counties, primarily during migration periods when they are moving either to or from breeding areas in the Canadian Arctic (USFWS, 2005) (USFWS, 2015q).

The red knot stops along the Atlantic coast during the spawning season for the horseshoe crab (*Limulus polyphemus*), feeding on horseshoe crab eggs, and mussel and clam beds, which are important food sources to the species. 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, 2015q) (USFWS, 2014d).

[78] Intertidal: "The area of shoreline between the high tide and low tide marks" (USEPA, 2015a).
[79] Predation: "The act or practice of capturing another creature (prey) as a means for securing food" (USEPA, 2015a).

Plants

One federally endangered and three federally threatened species federally listed and known to occur in Delaware as summarized in Table 4.1.6-8. One additional plant species, the Hirst Brothers' Panic Grass (*Dichanthelium panicum hirstii*), has been proposed as a candidate species but is not yet listed (USFWS, 2014b). These species are found in various counties and habitats throughout Delaware. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Delaware is provided below.

Table 4.1.6-8: Federally Listed Plant Species of Delaware

Common Name	Scientific Name	Federal Status [a]	Critical Habitat	Habitat Description
Canby's Dropwort	*Oxypolis canbyi*	E	No	Open and sparse wetlands in the middle of the state
Seabeach Amaranth	*Amaranthus pumilus*	T	No	Atlantic coastal beaches, Sussex County
Small Whorled Pogonia	*Isotria medeoloides*	T	No	Coastal areas above high tide line in the southern half of the state
Swamp Pink	*Helonias bullata*	T	No	Shaded, forested wetlands throughout the state

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

Canby's Dropwort. Federally listed as an endangered plant species in 1986 (51 FR 6690 6693, February 25, 1986), Canby's dropwort (*Oxypolis canbyi*) is a perennial herb which 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, 2015s). The species' range extends along Atlantic coastal states from Maryland to Georgia, and locally is known or believed to occur in Kent County, Delaware (USFWS, 2015t).

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, 2015s).

Seabeach Amaranth. Seabeach amaranth (*Amaranthus pumilus)* was federally listed as threatened in 1993 (58 FR 18035 18042, April 7, 1993). This annual produces round leaves on red stems spreading close to the ground (USFWS, 2015w) (USFWS, 2011). Regionally, seabeach amaranth ranges from New York to South Carolina along the east coast. Locally, the species is known or believed to occur in Sussex County in the southern half of the state (McAvoy, W., 2002).

The seabeach amaranth grows in coastal areas along barrier beaches just above the high tide line, sharing habitat with other protected species, such as the piping plover (*Charadrius melodus*) and roseate tern (*Sterna dougallii dougallii*). The plants trap sand and subsequently can create mounds up to 3 cubic yards in size. Threats to seabeach amaranth include beach stabilization structures, off-road vehicles, habitat fragmentation, and webworms (*Hyphantria cunea*) that prey heavily on the plants (USFWS, 2011).

Small Whorled Pogonia. The threatened small whorled pogonia *(Isotria medeoloides)* is a member of the orchid family which grows between 10 to 14 inches in height with greenish yellow flowers. 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 06, 1994). Regionally this species is known to occur sparsely distributed from Maine south to Georgia and eastern to Illinois (USFWS, 2008). Locally, the small whorled pogonia has been observed in the Kent and New Castle Counties within Delaware (USFWS, 2015u).

Small whorled pogonia Photo credit: USFWS

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, 2008). In some locations populations are most abundant in dry east or southeast facing hillsides. One distinct feature of this species is that it can remain dormant underground for multiple years before reappearing (USFWS, 1992). Current threats to small whorled pogonia include habitat loss due to urban expansion and forestry practices (USFWS, 2008).

Swamp Pink. Federally listed in 1988 (53 FR 35076 35080, September 9, 1988), the threatened swamp pink (*Helonias bullata*) is an obligate wetland species[80] 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 1 to 3 foot tall stalks in clusters of 30 to 50 individual small pink flowers with blue anthers. 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, 2015l). Swamp pink is found in all counties in Delaware (USFWS, 2015r).

The swamp pink is found in shaded forested wetland areas. Threats include human development that changes the physical and hydraulic conditions of the wetlands and invasive species (USFWS, 2015l).

[80] 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." (US Army Corps of Engineers 2012)

4.1.7. Land Use, Recreation, and Airspace

4.1.7.1. Definition of the Resource

The following summarizes major land uses, recreational venues, and airspace considerations in Delaware, 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 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, 2012b).

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, beaches, caves, lakes, forests, 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, 2014a). 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 and 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.

4.1.7.2. Specific Regulatory Considerations

Municipal and county governments are the primary planning entities for land use in Delaware, with the Office of State Planning Coordination assisting in integrating and providing information to support local planning efforts (Office of State Planning Coordination, 2014). Delaware State Law requires all incorporated municipalities to maintain current comprehensive plans (see Title 22 of Delaware Code). Depending on the municipality, a planning commission of between five and nine local citizens is either elected or appointed (State of Delaware, 2015e). Municipalities with populations greater than 2,000 must include a land use plan in their comprehensive plan. These land use plans define the proposed land uses for all public and private areas within the municipality and include policies, statements, goals, planning components, and a map. Analysis of existing land use and the most advantageous future land use "should be tied in with the vision of the community and the results of the various other planning elements, such as community character, affordable housing, redevelopment potential, environment and open space, etc." when creating policy positions (Office of State Planning Coordination, 2015).

Because the nation's airspace is governed by federal laws, there are no specific Delaware state laws that would alter the existing conditions relating to airspace for this Draft PEIS.

4.1.7.3. Land Use and Ownership

For the purposes of this analysis, Delaware has been classified into three primary land use groups: forest and woodlands, agricultural, and developed. Land ownership within Delaware has been classified into four main categories: private, federal, state, and tribal.

Land Use

Table 4.1.7-1 identifies the major land uses in Delaware. Agriculture is comprised of the largest portion of land use with 40.8 percent of Delaware's total land area occupied by this category (Figure 4.1.7-1). Forest and woodland is the second largest area of land use with 19.9 percent of the land occupied for this use. Developed areas account for approximately 7.9 percent of the total land area. The remaining percentage of land includes public land and other land covers, shown in Figure 4.1.7-1, that are not associated with specific land uses (USGS, 2012c).

Table 4.1.7-1: Major Land Uses in Delaware

Land Use	Square Miles	Percent of Land
Forest and Woodland	389	19.9%
Agricultural Land	797	40.9%
Developed Land	154	7.9%
Other[81]	608	31.3%

Source: (USGS, 2012c) (U.S. Census Bureau, 2015a)

Forest and Woodland

Forest and woodland areas can be found throughout the state, many of them interspersed with, and adjacent to, agricultural areas. These forests are scattered across the state rather than in large concentrated areas (Figure 4.1.7-1). Most forest and woodland areas throughout Delaware are privately owned.[82] Section 4.6, Biological Resources, presents additional information about terrestrial vegetation.

<u>State Forests</u>

State Forests account for 29.7 square miles of state land and are typically smaller parcels of land located in Delaware's interior and towards the western border (Delaware Department of Agriculture, 2015c). State Forests are under the administration of, and managed by, the Delaware Forest Service under the state Department of Agriculture. State Forests "are managed for a variety of objectives including: timber production, wildlife habitat enhancement, forest management demonstration, and recreational opportunities." (Delaware Department of Agriculture, 2015c).

<u>Private Forest and Woodland</u>

Private landowners own the majority of Delaware's total forestland. These private forestlands indirectly provide some public benefit, including forest products, wildlife habitat, jobs, scenic beauty, and outdoor recreation opportunities. Scattered throughout the state, forests and woodlands on private lands often border agricultural fields, and suburban neighborhoods. For additional information regarding forest and woodland, see Section 4.1.6, Biological Resources and Section 4.1.8, Visual Resources.

Agricultural Land

Agricultural land exists in every region of the state except the northern tip, with the largest concentrations across the center of the state (Figure 4.1.7-1). More than one-third of Delaware's total land area is classified as agricultural land (approximately 41 percent, or 797 square miles). In 2012, there were 2,451 farms in Delaware and most were owned and operated by small, family businesses, with the average farm size of slightly more than 200 acres (USDA, 2012). Some of the state's largest agricultural uses include poultry, corn, and dairy products (USGS, 2012d). The USDA Census of Agriculture website

[81] Includes open water and recently disturbed land.

[82] Total acreage of private land could not be obtained for the state.

(http://www.agcensus.usda.gov/Publications/2012/Full_Report/Census_by_State/Delaware/) provides detailed information by county.

Developed Land

Developed land in Delaware tends to be concentrated in the Wilmington metropolitan area and surrounding cities, towns, and suburbs in the northern tip of the state (Figure 4.1.7-1). Although only eight percent of Delaware land is developed, these areas are highly utilized for residential, commercial, industrial, recreational, and government purposes. Table 4.1.7-2 lists the top five developed areas within the state and their associated population estimates, and Figure 4.1.7-1 displays these areas under the Developed category.

Table 4.1.7-2: Top Five Developed Metropolitan Areas

Metropolitan Area	Population Estimate
New Castle County (Wilmington, part of Philadelphia Area)	552,778
Dover Metro Area	171,987
Wilmington city (proper), Delaware	71,817
Dover city, Delaware	37,355
Newark city, Delaware	33,008
Middletown town, Delaware	19,910
Smyrna town, Delaware	11,170
Total State Population	935,614

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

Land Ownership

Land ownership within Delaware has been classified into four main categories: private, federal, state, and tribal (Figure 4.1.7-2).

Private Land

The majority of land in Delaware is privately owned, with most of this land falling under the land use categories of agricultural, forest and woodland, and developed (Figure 4.1.7-1). 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.[83]

[83] Total acreage of private land could not be obtained for the state.

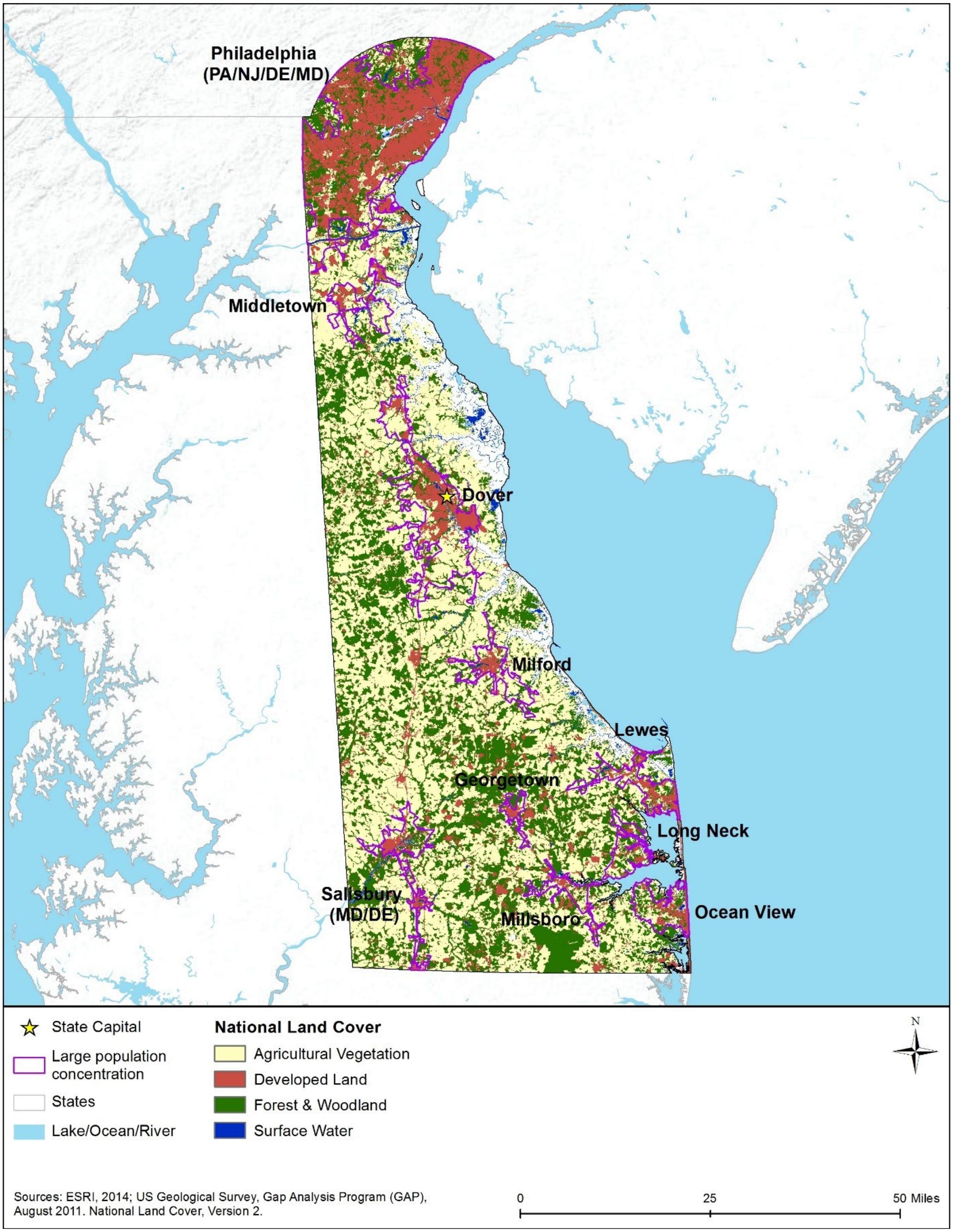


Figure 4.1.7-1: Land Use Distribution

Federal Land

The federal government manages 46 square miles (two percent) of Delaware land with a variety of land types and uses, including wilderness areas and military bases (Figure 4.1.7-2). Two federal agencies manage federal lands throughout the state (Table 4.1.7-3: Federal Land in Delaware).

Table 4.1.7-3: Federal Land in Delaware

Agency	Square Miles	Representative Type
Department of Defense	5	Military Bases
USFWS	41	Wilderness Areas
Total	46	NA

Source: USGS 2015

- The Department of Defense manages five square miles used for military bases; and
- The USFWS owns and manages 41 square miles consisting of two NWRs in Delaware, both located along the Atlantic coast (USGS, 2012c).

State Land

The Delaware state government owns over 164 square miles of Delaware land consists of forests and woodlands, historic sites, and recreation areas (Table 4.1.7-4).

Table 4.1.7-4: State Land in Delaware

Agency	Square Miles	Type
Department of Agriculture	30	State Forests
DNREC	134	State Parks, Wildlife Areas
Total	164	NA

Sources: (Delaware Department of Agriculture, 2015c) (DNREC, 2014b)

In addition, State Wildlife Areas are lands owned by Delaware and managed primarily for the conservation of fish and wildlife, including research on wildlife species and habitat management. Wildlife Areas are under the control and management of the DNREC's Division of Fish and Wildlife. There are 20 Wildlife Areas scattered throughout the state (DNREC, 2014b) (Table 4.1.7-5: Wildlife Areas in Delaware).

State Parks contain natural, historic, cultural, and/or recreational resources of significance to Delaware residents and visitors. The Division of Parks and Recreation under DNREC manages 18 state parks and over 150 miles of trails throughout Delaware (Delaware State Parks, 2015b) (Figure 4.1.7-2 and Table 4.1.7-6: State Parks in Delaware).

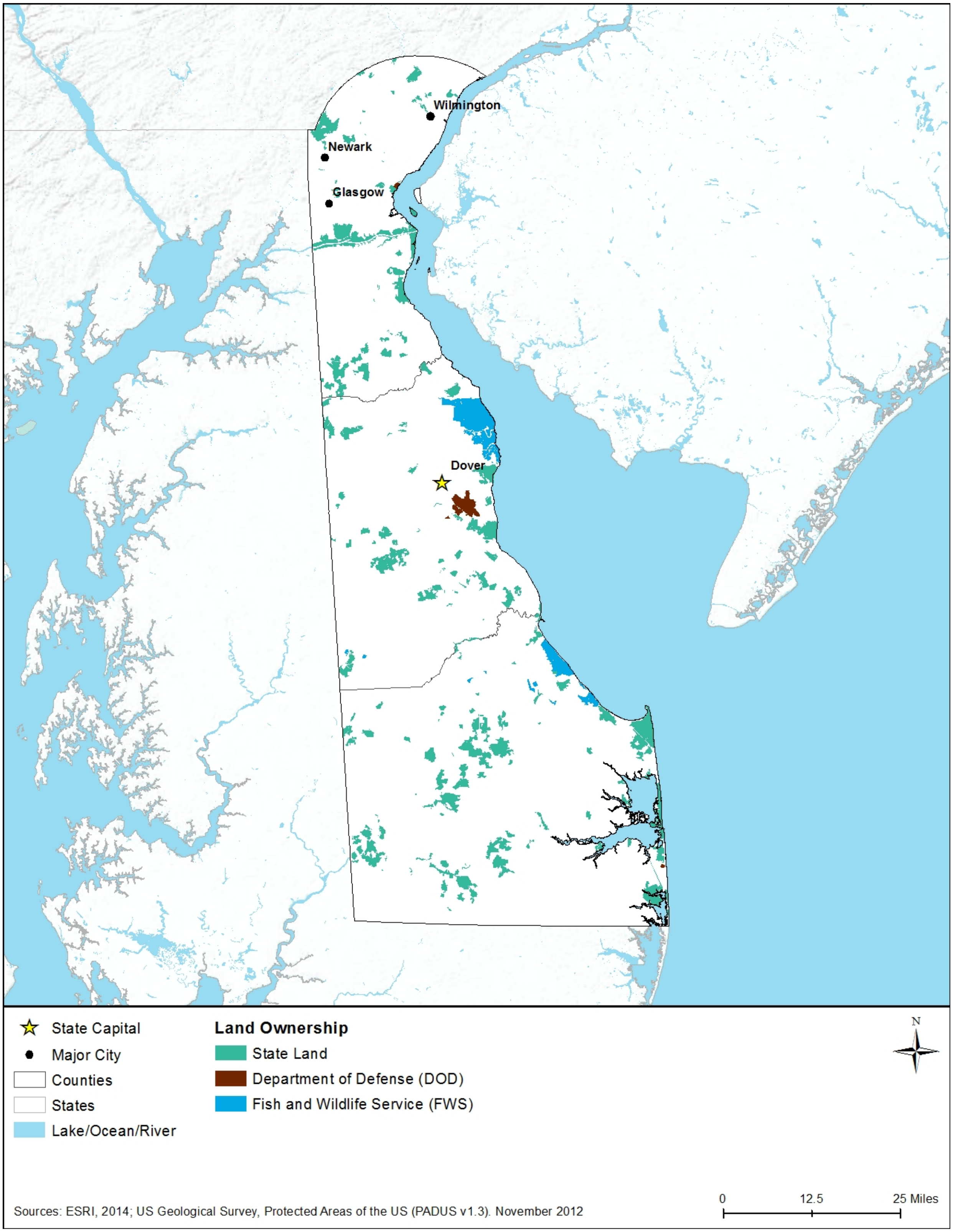


Figure 4.1.7-2: Land Ownership Distribution

Table 4.1.7-5: Wildlife Areas in Delaware

Wildlife Area Name	
C & D Canal Wildlife Area	McGinnis Pond
Augustine Wildlife Area	Milford Neck Wildlife Area
Blackbird Reserve Wildlife Area	Prime Hook Wildlife Area
Tony Florio Woodland Beach Wildlife Area	Marshy Hope Wildlife Area
Ted Harvey Conservation Area	Industrial Forest Wildlife Area
Blackiston Wildlife Area	Nanticoke Wildlife Area
Little Creek Wildlife Area	Midlands Wildlife Area
Fortney/Urban Tracts	Assawoman Wildlife Area
Norman G. Wilder Wildlife Area	Cedar Swamp Wildlife Area
Okie Preserve	Old Furnace Wilderness Ares

Table 4.1.7-6: State Parks in Delaware

State Park Name	
Auburn Heights Preserve	Fox Point State Park
Brandywine Creek State Park	White Clay Creek State Park
Alapocas Run State Park	Fort Delaware State Park
Wilmington State Parks/Brandywine Zoo	Fort DuPont State Park
Bellevue State Park	Lums Pond State Park
Delaware Seashore State Park	Port Penn Interpretive Center
Holts Landing State Park	First State Heritage Park
Fenwick Island State Park	Killens Pond State Park
Trap Pond State Park	Cape Henlopen State Park

Tribal Land

No land in Delaware is held in trust by the federal or state government on behalf of a Native American tribe or tribes as permanent tribal homelands. Delaware does not have any federally recognized tribes currently located in the state, and the Bureau of Indian Affairs does not manage any land in the state. Delaware recognizes two tribes, the Lenape and Nanticoke Tribes, both of which have State Designated Tribal Statistical Areas with the U.S. Census. These are “statistical geographic areas identified and delineated for state recognized tribes that are not federally recognized and do not have an American Indian reservation or off-reservation trust land” (U.S. Census Bureau, 2014). For additional information on Native American tribes in Delaware, see Section 11.4, Cultural Resources.

4.1.7.4. Recreation

Delaware is part of the Northeast megalopolis, the most developed area in the United States that begins in the suburbs of Boston, Massachusetts and reaches to the suburbs of D.C. in northern Virginia. The state consists of rolling hills and pastures on the west, continuing to the sandy beaches on the east, leading into the Delaware Bay and Atlantic Ocean. Delaware is the northernmost portion of the Delmarva Peninsula, known for beach towns that are popular vacation destinations.

On the community level, towns and cities provide an assortment of indoor and outdoor recreational facilities, including athletic fields and courts, playgrounds, picnicking areas, beaches, marinas and boating locations, zoos, and multiple-use trails commensurate with the population's distribution and interests. On the state level, Delaware has 18 parks and an interpretive center (Delaware State Parks, 2015a). Federally, the National Park Service (NPS) and USFWS manage areas with recreational attributes. Delaware also contains a NERR (see Section 4.1.4) (Recreation.gov, 2015).

This section discusses recreation, calling out specific areas representative of recreational opportunities in Delaware. For information on visual aspects, see Section 4.1.8, Visual Resources, and for information on the historical significance of locations, see Section 4.1.11, Cultural Resources.

Delaware's state sport is bicycling, and Delaware is the fourth most bicycle-friendly state in the U.S. Trail-related activities are the most popular recreational activity in Delaware, with 53 percent of residents considering themselves enthusiasts. Many bike and nature trails connect, and are accessible from various neighborhoods. Yearly biking events include the Amish Country Bike Tour with an annual attendance of approximately 2,000, and the Bike to the Bay, a two-day event with courses ranging from 17 to 175 miles long. The DNREC anticipates additional construction for new trails and continual improvements to existing trails (McLaughlin, 2015).

The First State National Historic Park is a conglomerate of four areas, and is Delaware's only urban park. The park includes galleries, museums, and thematic tours focusing on the history of the state (NPS, 2015c).

The USFWS owns and operates two wildlife refuges in Delaware. The Bombay Hook NWR is 16,251 acres along the Delaware Bay. Activities within the Bombay Hook NWR include a 12-mile wildlife scenic drive, trails, observation towers, and hunting (USFWS, 2015v). The Prime Hook NWR is 10,144 acres on the west shore of the Delaware Bay. Prime Hook is a stopover site for migratory birds travelling the Atlantic Flyway, and provides protected breeding habitat for many migrating bird species. Activities within the refuge include hunting, fishing, wildlife observation, and photography (USFWS, 2013b).

The Dover International Speedway and adjacent Dover Downs Hotel and Casino is located in central Delaware hosts two NASCAR race weekends per year, with seating for 95,500 fans (Dover International Speedway, 2015).

South of the Delaware River, the shore consists of a series of beach towns with beaches on both bayside and ocean-side. These towns are known for boardwalk activities, including miniature golf, arcades, and amusement parks. Water recreation along the shore include boating, parasailing, wake boarding, water skiing, windsurfing, and dolphin watching (Visit Delaware, 2015).

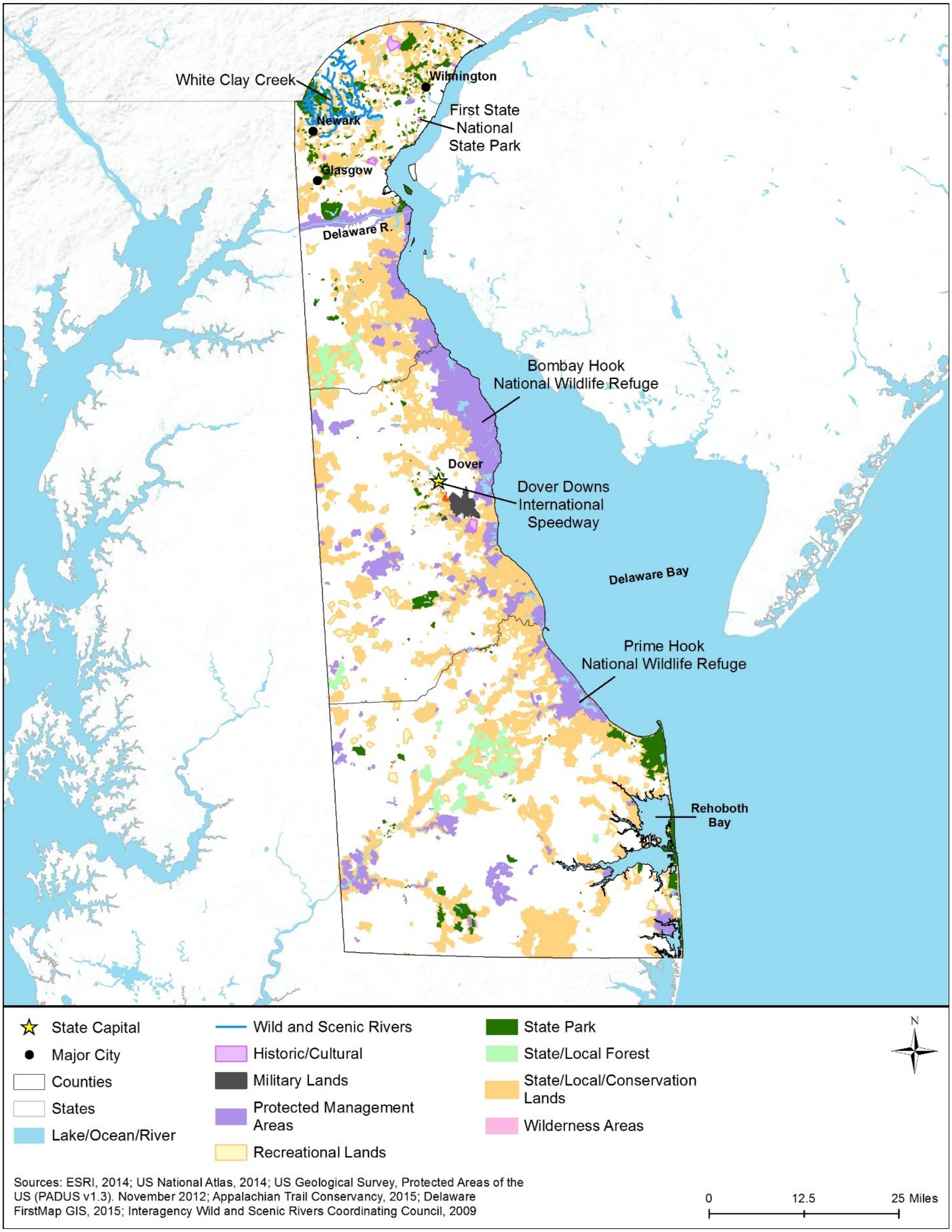


Figure 4.1.7-3: Delaware Recreation Map

4.1.7.5. Airspace

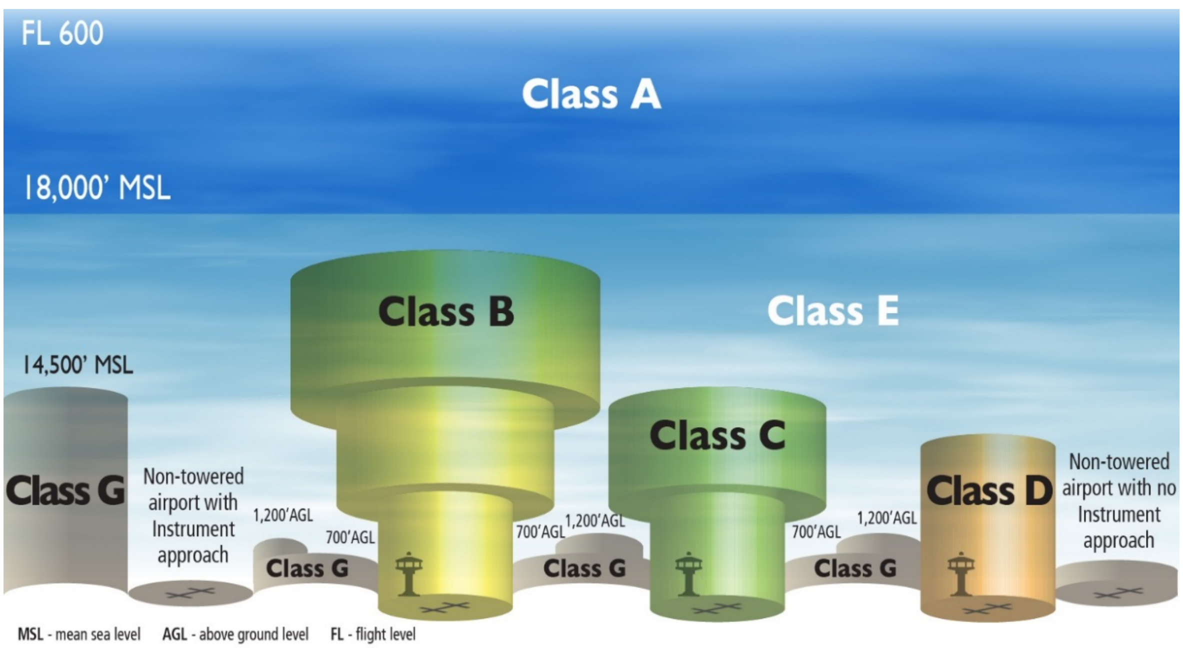
The FAA uses the NAS to provide for aviation safety. The NAS includes Special Use Airspace (SUA) consisting of Restricted Areas, Warning Areas, and Military Operation Areas (MOAs). The FAA controls the use of the NAS with various procedures and practices (such as established flight rules and regulations, 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 4.1.7-4 depicts the different classifications and dimensions for controlled airspace. Air Traffic Control (ATC)[84] service is based on the airspace classification." (FAA, 2008)



Source: Derived from (FAA, 2008)

Figure 4.1.7-4: National Air Space Classification Profile

[84] ATC: Approved authority service to provide safe, orderly and expeditious flow of air traffic operations. (FAA, 2008)

Controlled Airspace

- **Class A:** Airspace from 18,000 feet to 60,000 feet Mean Sea Level (MSL)[85]. Includes the airspace over waters off the U.S. coastlines (48 contiguous States and Alaska) within 12 Nautical Miles (NM). All operations must be conducted under Instrument Flight Rules (IFR).[86]
- **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 4.1.7-7).

Other Airspace Areas

Other airspace areas, explained in Table 4.1.7-8, 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.

[85] 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, 2015c).
[86] IFR - Rules for the conduct of flights under instrument meteorological conditions. (FAA, 2015h)

Table 4.1.7-7: 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."
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 49.7. 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)

Table 4.1.7-8: Other Airspace Designations

Type	Definition
Airport Advisory	There are 3 types: • Local Airport Advisory – Operated within 10 statute (5,280 feet/mile) miles 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.
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 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 as a result 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.

Delaware Airspace

The Office of Aeronautics is a branch of the DelDOT, Division of Planning. The Office of Aeronautics is responsible for managing public-use airports with the intent to "enhance

Delaware's economic development by fostering and promoting a safe and efficient aviation system for the movement of goods, services, and people and to encourage and promote aviation and aviation safety" (State of Delaware, 2015f). Delaware has no established FAA FSDO (FAA, 2015e).

Delaware airports are classified as those included in the State Aviation System Plan (SASP) and those that are not part of the SASP. The SASP documents the strategic plan for maintaining and improving a State's public airports system to support aviation needs, as well as addressing key issues associated with their airports (National Association of State Aviation Officials (NASAO), 2015). Figure 4.1.7-5 presents the different aviation airports/facilities located in Delaware. There are approximately 41 airports (public and private) within Delaware as presented in Table 4.1.7-9 and Figure 4.1.7-5.

Table 4.1.7-9: Type and Number of Delaware Airports/Facilities

Type of Airport or Facility	Public	Private
Airport	10	21
Heliport	1	9
Seaplane	0	0
Ultralight	0	0
Balloonport	0	0
Gliderport	0	0
Total	11	30

Source: (U.S. Department of Transportation, 2015)

There are Class D and E controlled airports in Delaware as follows:

- Two Class D –
  - New Castle County Airport, Wilmington
  - Dover Air Force Base, Dover
- One Class E – New Castle County Airport (FAA, 2014b)

There are no SUAs for Delaware; however, the restricted areas (R4006 and R4008) of Maryland extend into the state as presented in Figure 4.1.7-6 (FAA, 2015f). There is one TFR (9/3124) from the surface up to and including 1,500 feet Above Ground Level (AGL). It is located west of Wilmington in the Greenville/Washington area (FAA, 2015g). Figure 4.1.7-7 presents the MTRs in Delaware consisting of one Visual Route (VR) 1709 and seven Slow Routes (SLs) 800, 801, 805, 844, 845, and 847. Warning Area, W396 (A), is located off the state's southern coastline.

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 is one national park within Delaware that has to comply with this agency directive (NPS, 2015d).

Obstructions to Airspace Considerations

Any proposed construction meeting the criteria of FAA regulations and state laws requires notification to the FFA and Office of Aeronautics via the FAA Form 7480-1 and the Office of Aeronautics Notification Form for *Proposed Construction/Alternation in Airport Zones*. Any new construction or modifications to existing structures above 200 feet AGL near an airport will need to be evaluated by the Office of Aeronautics and the FAA. The request for review by the state should be 45 days prior to planned construction start date, and the Office of Aeronautics' review is typically one week upon receipt of the form/supporting data (DelDOT 2015c).

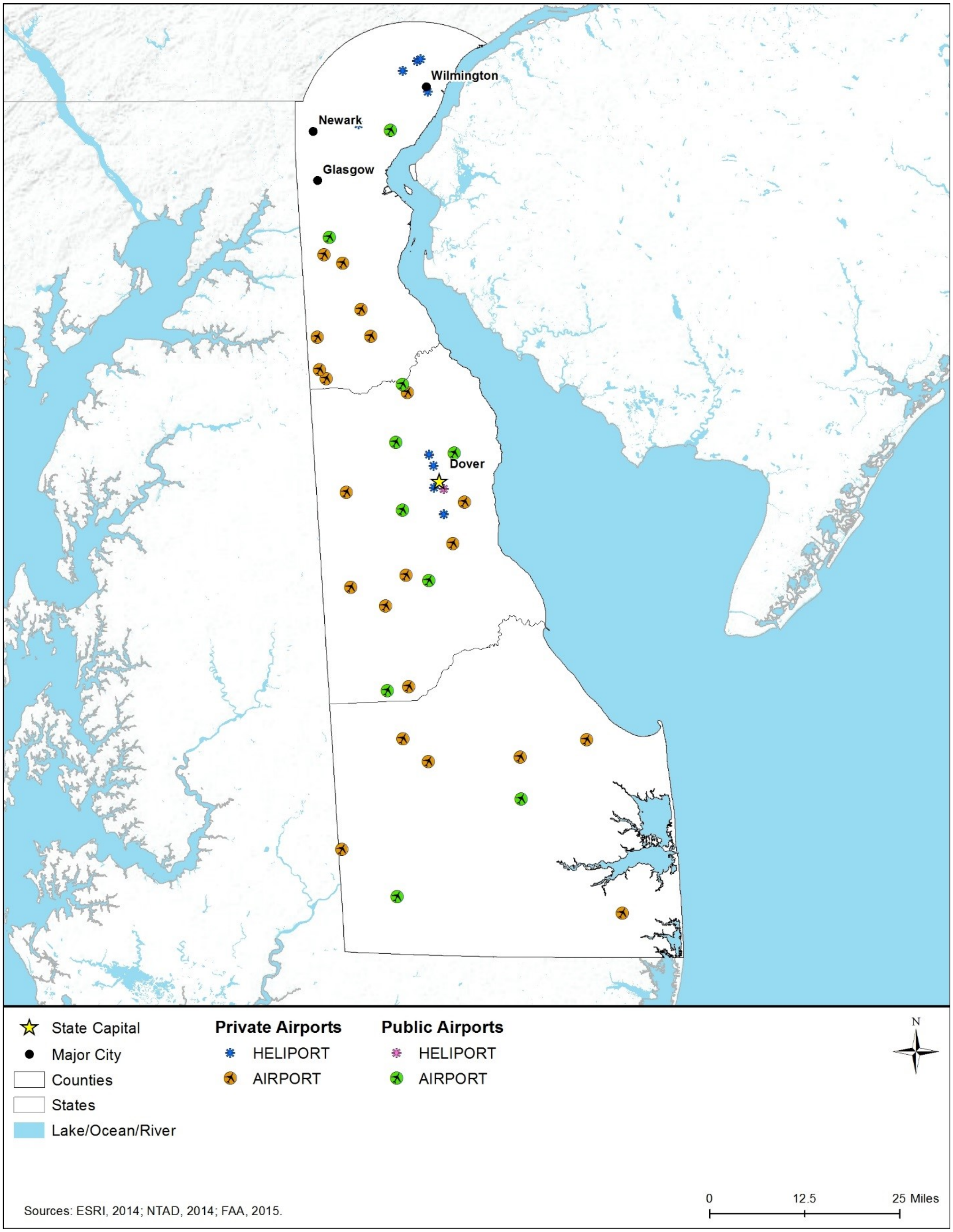


Figure 4.1.7-5: Composite of Delaware Airports/Facilities

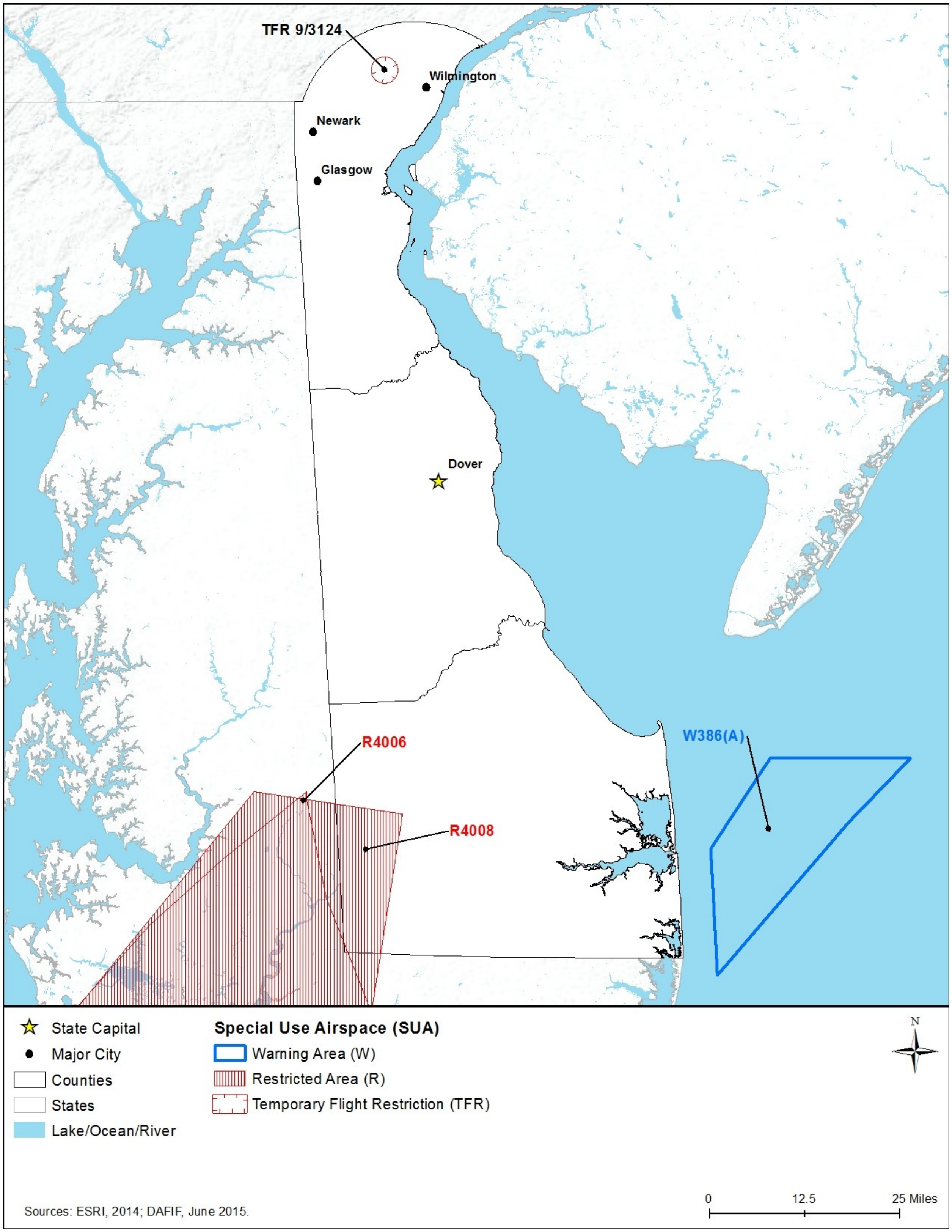


Figure 4.1.7-6: SUAs/TFR in Delaware

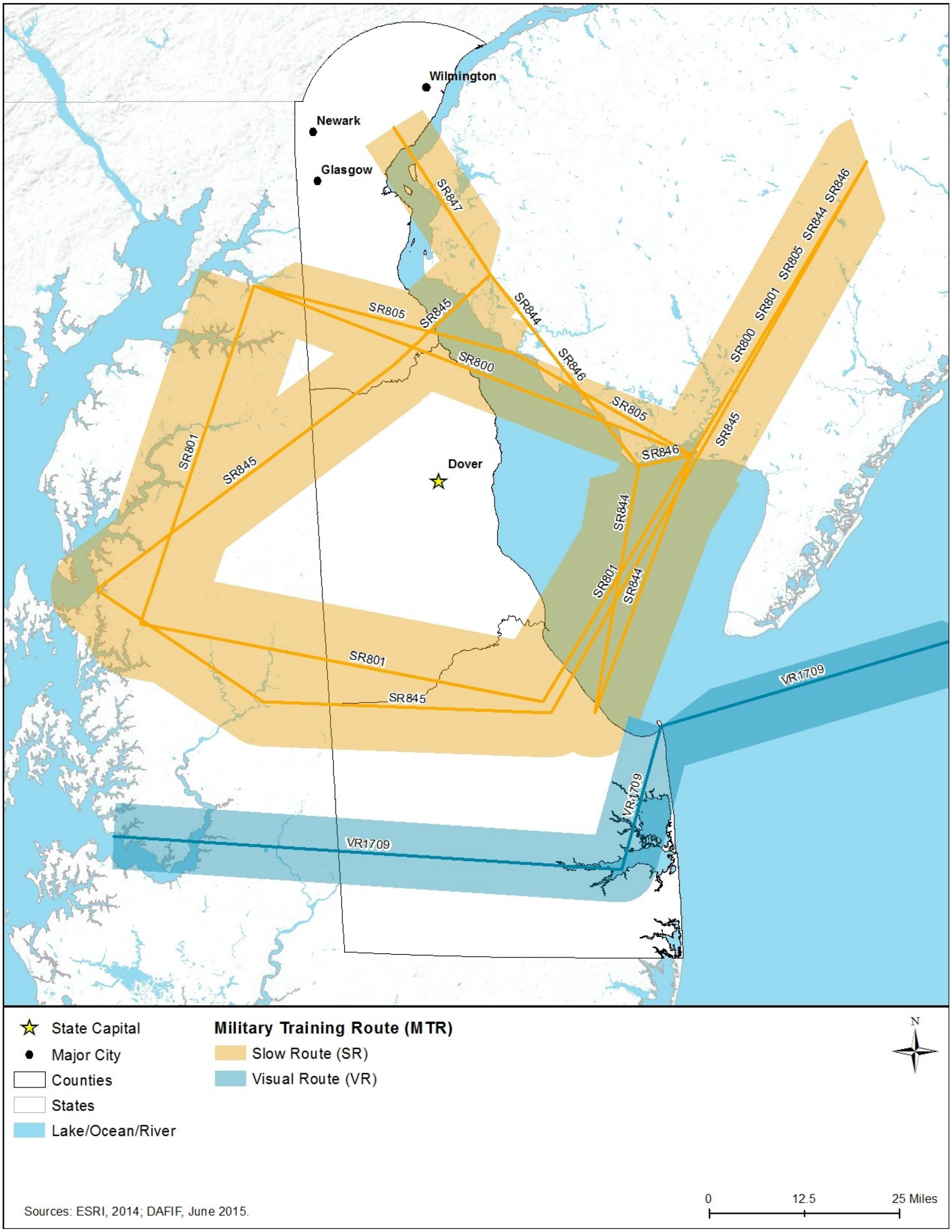


Figure 4.1.7-7: MTRs in Delaware

4.1.8. Visual Resources

4.1.8.1. 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. A general definition of visual resources used by the Bureau of Land Management (BLM) is “the visible physical features on a landscape (e.g., land, water, vegetation, animals, structures, and other features)” (BLM, 1984).

4.1.8.2. Specific Regulatory Considerations

Table 4.1.8-1 presents the one state policy regarding scenic and visual resources for Delaware.

Table 4.1.8-1: Relevant Visual Resources Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Assessing Visual Effect on Historic Properties	Delaware State Historic Preservation Office	“To avoid adverse visual effects on historic properties whenever feasible, or if avoidance is not possible, to minimize those effects through project alternatives, or mitigate effects through recordation, landscape treatments, and other means” (Delaware Division of Historic and Cultural Affairs, 2003)

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, cities, and villages as they look at the future planning of their municipalities.

4.1.8.3. Character and Visual Quality of the Existing Landscape

Delaware is predominantly within the Middle Atlantic Coastal Plain ecoregion, featuring ample coastlines, beaches, wetlands, coastal marshes, and swamps with very little elevation change (from sea level to 100 feet) (USEPA, 2012c). The northernmost portion of the state bordering Pennsylvania is within the low, rolling hills of the Northern Piedmont ecoregion, with a tiny slice of land immediately to the south bordering Maryland within the Southeastern Plains ecoregion (USEPA, 2012c). Historic towns, lush countryside, pine and riparian forests, rivers, wetlands, beaches, and seaside boardwalks make up some of the numerous scenic resources of Delaware.

Delaware does not specify management for visual or scenic resources in their statewide planning regulations aside from historic resources; however, scenic resources are indirectly protected though the designation and management of wildlife habitat, parks, and refuges throughout the state. Other areas such as trails, rivers, and roadways are also considered valued for their scenic resources. The areas listed below have additional management, significance, or protection through state or federal policy, as well as being identified as a visually significant area.

4.1.8.4. Visually Important Historic Properties and Cultural Resources

Visual and aesthetic qualities of historic properties can contribute to the overall importance of a particular site. Scenic qualities relate to the integrity of the appearance and setting of these properties or resources. Viewsheds (the natural environment visible from one or more viewing points) can also contribute to the significance of historic properties or cultural resources. Viewsheds containing historic properties and cultural resources may be considered important because of their presence in the landscape. Figure 4.1.8-1 shows areas that are included in the National Register of Historic Places (NRHP) that may be considered visually sensitive. In Delaware, there are 692 NRHP listed sites, which include 13 National Historic Landmarks, 2 National Historic Trails, and 1 National Historical Park and National Monument. Some state historic sites may also be included in the NRHP, whereas others are not designated at this time.

Planning and management of cultural resources using *The Secretary of the Interior's Standards for the Treatment of Historic Properties and the Guidelines for the Treatment of Cultural Landscapes* requires the NPS to protect all aspects of the historic landscape, such as forests, gardens, trails, structures, ponds, and farming areas (NPS, 1995). The standards and guidelines "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 the historic properties and the visual resources therein (NPS, 1995). Figure 4.1.8-4 shows areas that are included in the NRHP that may be considered 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, 2015e). Generally, NHLs are comprised of historic buildings such as residences, churches, civic buildings, and institutional buildings. Other types of historic properties include battlefields and canals. The importance of NHL-designated properties can be attributed to scenic or aesthetic qualities that may be considered visual resources or visually sensitive at these sites. There are 13 National Historic Landmarks in Delaware; the majority are historic homes and buildings, such as the Jacob Broom House, with one fort (Fort Christina) and the New Castle Historic District. By comparison, there are over 2,500 NHLs in the United States. The scenic and visual resources of these Delaware landmarks and surrounding areas are managed for consistency with the historic resource and aesthetics of the landscape (NPS, 2015f).

National Historic Trails

There are two multi-state National Historic Trails within Delaware, the Captain John Smith Chesapeake and the Washington-Rochambeau. The Captain John Smith Chesapeake trail is the first of two designated national water trails in the U.S. with many of the trail's routes solely for travel by boat. At close to 3,000 miles, this water trail travels through the Chesapeake Bay and its tributaries within Delaware, District of Columbia, Maryland, and Virginia, following the historic routes of Captain John Smith's voyages in 1607–1609 (NPS, 2015g). The Washington-Rochambeau Revolutionary Route passes through natural areas and historic sites along the 680-mile land and water route that General Washington and General Rochambeau traveled for the siege of Yorktown through Delaware, District of Columbia, Connecticut, Massachusetts, Rhode Island, New York, New Jersey, Pennsylvania, Maryland, and Virginia (NPS, 2015h).

Figure 4.1.8-1: Chesapeake Bay, Captain John Smith Chesapeake National Water Trail

Source: (Captain John Smith Chesapeake National Historic Trail, 2015)

National Historical Parks

First State National Historical Park and National Monument is a series of four separate locations spanning from the northern border of Pennsylvania south to the town of Dover, Delaware covering a total of about 1,000 acres. The park's four areas encompass scenic forests, farmland, riparian forest and riverbanks along the Brandywine River, historic buildings, and historic sites managed under the visual resource program of the NPS. (NPS, 2015i)

State Historic Sites

There are 12 State Historic Sites throughout Delaware, which include homes, lighthouses, churches, mills, forts, seafront, farms, forests, ponds, meadows, and other historic locations (Table 4.1.8-2: Delaware State Historic Sites and Scenic Values). The scenic resources are a part of what makes these areas special and are managed for consistency with the surrounding landscapes. (Delaware Division of Historical and Cultural Affairs, 2015)

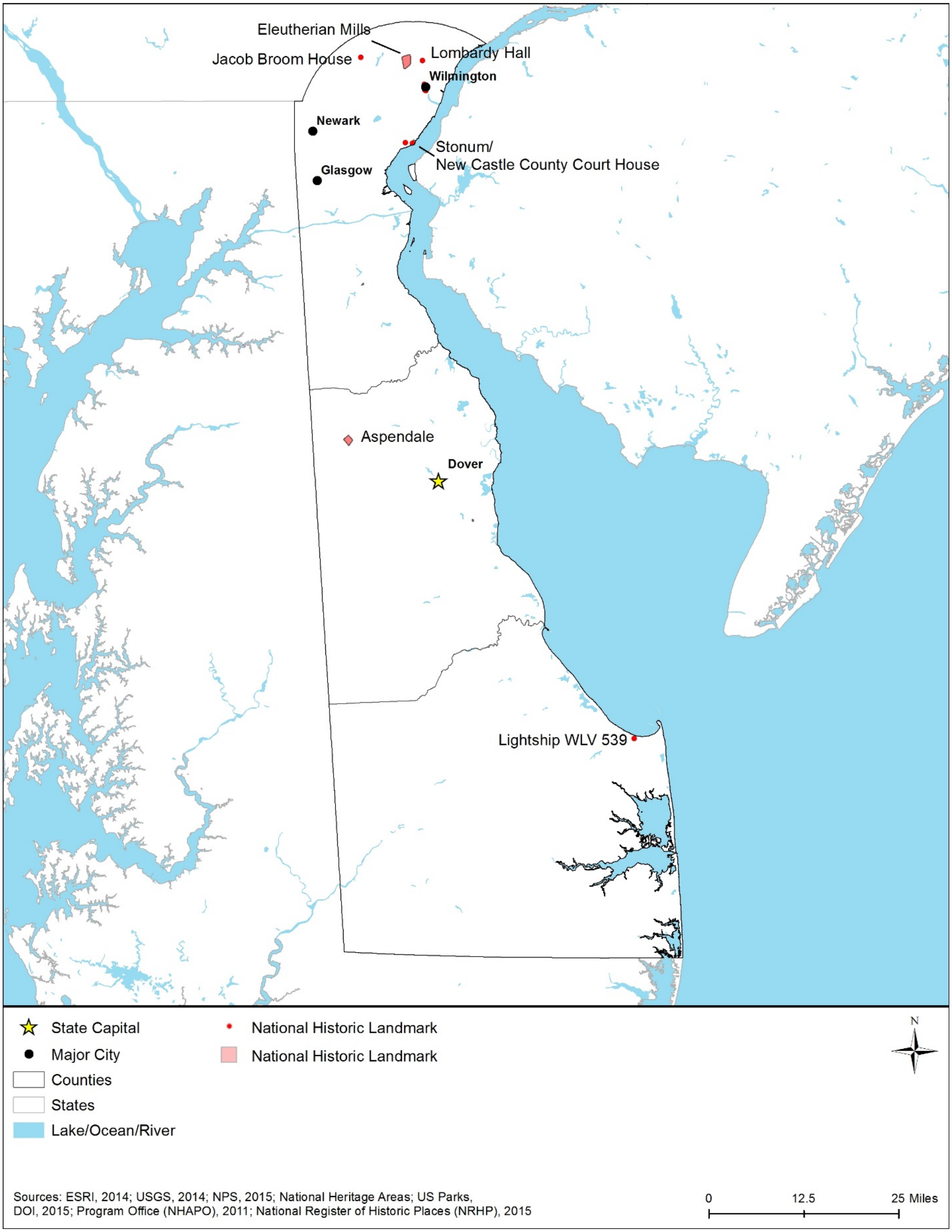


Figure 4.1.8-2: Cultural and Heritage Resources that May Be Visually Sensitive

Table 4.1.8-2: Delaware State Historic Sites and Scenic Values

Site Name and Location	Scenic Value
Abbot’s Mill, Milford	Nature preserve with ponds and a historic mill
Belmont Hall, Smyrna	Historic building
Cooch-Dayett Mills, Newark	Historic mill, stream, forested area
The Delaware Breakwater East End Lighthouse, Lewes	Historic lighthouse, seaside and ocean views
The Fenwick Island Lighthouse, Fenwick Island	Historic lighthouse, seaside and ocean views
Fort Christina National Historic Landmark, Wilmington	River, stream, historic fort
Hale-Byrnes House, Newark	Historic building, creekside view
Milford Museum, Milford	Historic building
Old Sussex County Court House, Georgetown	Historic building
Pencader Heritage Museum, Newark	Historic building
Prince George’s Chapel, Dagsboro	Historic chapel
Robinson House, Claymont	Historic building

Source: (Delaware Division of Historical and Cultural Affairs, 2015)

4.1.8.5. Parks and Recreation Areas

Parks and recreation areas often contain scenic resources and tend to be visited because of their associated visual or aesthetic qualities. Figure 4.1.7-3 in Section 4.1.7, Land Use, Recreation, and Airspace identifies parks and recreational resources in Delaware. Figure 4.1.8-4 displays natural areas that may be visually sensitive, including park and recreation areas.

U.S. National Park System

The First State National Park, described above in the historic resources section, is the only National Park in Delaware. The area is managed and protected by the NPS.

State Parks

The 18 state parks in Delaware provide open space and scenic vistas both within towns and in natural areas away from civilization. The parks are separated into the following five groups:

- Historic (6): Auburn Heights Preserve, Bellevue State Park, Fort Delaware State Park, First State Heritage Park, Fort DuPont State Park, and Port Penn Interpretive Center
- Beaches (4): Cape Henlopen State Park, Delaware Seashore State Park, Fenwick Island State Park, Holts Landing State Park
- Ponds (3): Lums Pond State Park, Killens Pond State Park, Trap Pond State Park
- Scenic (3): White Clay Creek, Brandywine State Park, Fox Point State Park
- Urban (2): Wilmington State Park/Brandywine Zoo, Alapocas Run State Park

The lands and scenic resources within and surrounding the parks may be protected from intrusions into vistas from structures or other infrastructure. (Delaware State Parks, 2015a)

State Trails

There are numerous trails within many of Delaware’s state parks designated for hiking, biking, and equestrian use; a few are water trails for canoeing and kayaking (Delaware State Parks, 2015b). About 312 miles of trails are managed by the state, with about half of the trails within the state parks (State of Delaware, 2015g). The scenic resources surrounding the trails and adjacent areas could receive some level of protection depending on location and existing visual surroundings.

4.1.8.6. Natural Areas

Natural areas vary by state depending on the amount of public or state lands within each state. Although many areas may not be managed specifically for visual resources, these areas exist because of their natural resources, and the resulting management may also protect the scenic resources therein.

State Forests

There are three state managed forests within Delaware: Blackbird State Forest, Taber State Forest, and Redden State Forest. These lands cover over 19,000 acres and are managed for timber harvest, recreation, and wildlife habitat. (Delaware Forest Service, 2015).

Rivers Designated as National or State Wild, Scenic or Recreational

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). These rivers have outstanding natural, cultural, and recreational values, including potential visual resources. The entire watershed of White Clay Creek within Pennsylvania and Delaware is the first watershed to be protected under a wild and scenic designation (Wild and Scenic White Clay Creek, 2015). White Clay Creek is the only river in Delaware with a wild and scenic designation (Figure 4.1.8-3). Within Pennsylvania and Delaware, 31.4 miles of river are designated as scenic, and 167.6 miles are designated as recreational (Figure 4.1.8-4). This river is managed under the national wild and scenic rivers program, protecting the scenic and recreational character of the river and the visual resources surrounding it (Wild and Scenic White Clay Creek, 2015).

Figure 4.1.8-3: White Clay Creek Wild and Scenic River

Source: (NPS, 2006b)

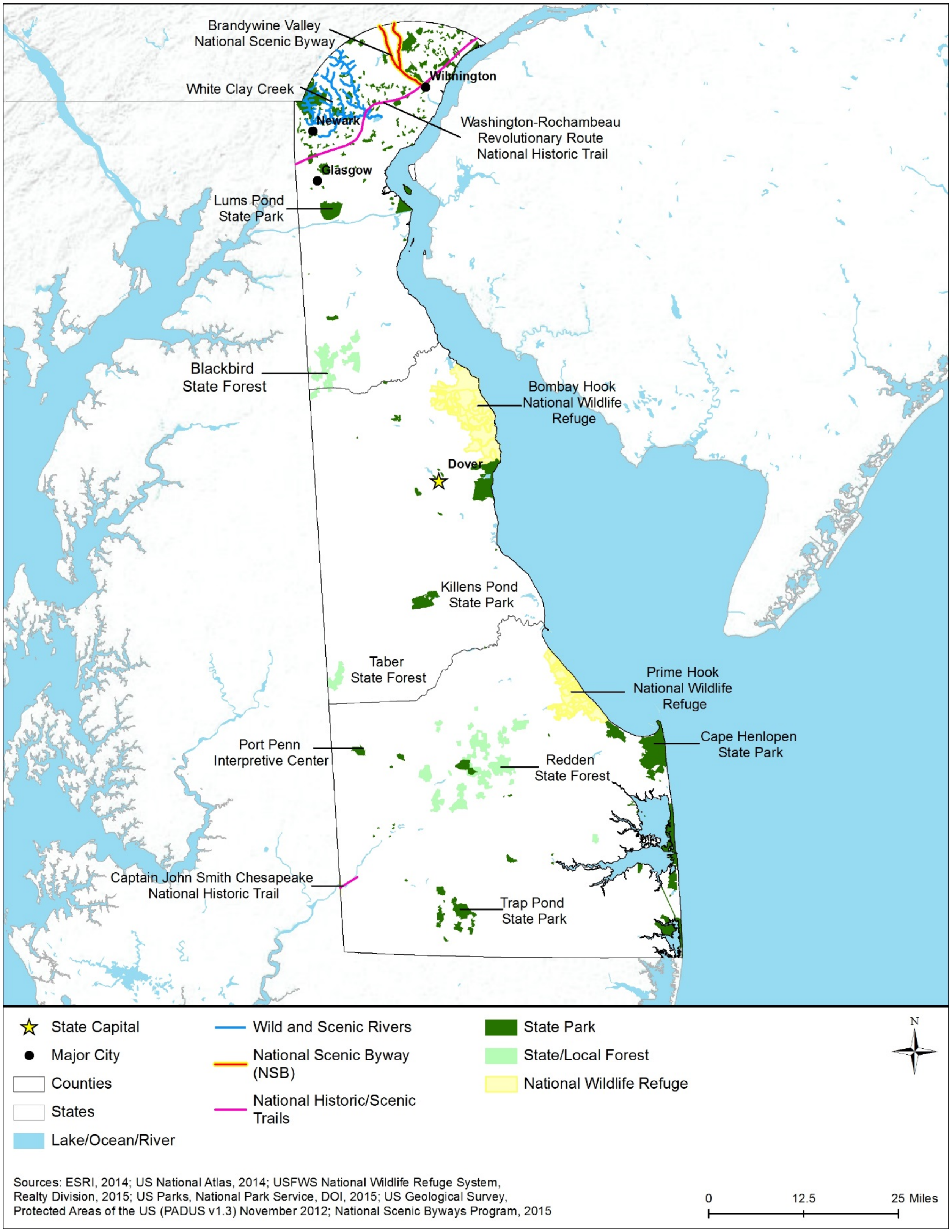


Figure 4.1.8-4: Natural Areas that May be Visually Sensitive in Delaware

National Wildlife Refuges (NWR)

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, 2015x). Delaware has two NWRs managed by the USFWS; both Bombay Hook and Prime Hook contain protected habitat for plants and wildlife without disturbance from development and habitat loss (USFWS, 2015y). Bombay Hook NWR is 16,251 acres of predominantly tidal salt marsh along the Atlantic coast with some areas of freshwater and upland habitat (USFWS, 2013c). Prime Hook NWR is 10,144 acres along the Delaware Bay containing fresh and saltwater marshes, upland forest and grassland, and forested swamps (USFWS, 2013d). Although management specific for visual resources may not be considered, tall structures are often discouraged due to conflicts with avian and other wildlife species.

State Game Refuges and State Wildlife Management Areas

There are 20 state wildlife and conservation areas throughout the state (DNREC, Division of Fish and Wildlife, 2014). These areas contain protected habitat for plants and animals without disturbance from development and habitat loss.

Ecological Reserves

The Delaware NERR consists of two sites, Blackbird Creek and St. Jones Reserves, covering a total of 6,206 acres of coastal and estuarine areas (see Section 4.1.5, Water Resources). These are protected areas for conservation and study and research of ecology, wildlife, and other natural resources. (DNREC, 2015r)

4.1.8.7. Additional Areas

State and National Scenic Byways

National Scenic Byways are roadways designated because of their vistas, scenic, or aesthetic landscapes. The National Scenic Byways Program is managed by the U.S. Department of Transportation, Federal Highway Administration (FHWA, 2015a). Delaware has one National Scenic Byway, the Brandywine Valley National Scenic Byway, which passes through historic towns, farmland, cultural areas, forests, as well as beautiful landscape and scenic vistas (Figure 4.1.8-4) (Delaware Greenways, 2011).

Similar to National Scenic Byways, Delaware Scenic Byways are transportation corridors that are of particular statewide interest. There are five Delaware Byways, all designated for their unique features described in Table 4.1.8-3 (DelDOT, 2015d).

Table 4.1.8-3: Scenic Byways in Delaware

Name	Scenic Features
Brandywine Valley (national)	Historic, farmland, cultural, landscapes, forests
Red Clay	Historic mills, woodlands, floodplains
Bayshore	Coastal marshland, river and bay views, historic plantations, cultural sites
Harriet Tubman Underground Railroad	Historic route, cultural sites
Lewes Gateway to the Nation	Historic sites, historic towns, ocean views, sand dunes
Naticoke Heritage	Historic towns, farmlands, forests, landscapes

Sources: (Delaware Greenways, 2011) (DelDOT, 2015d)

4.1.9. Socioeconomics

4.1.9.1. 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)). 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. When applicable, it includes qualitative factors such as community cohesion. Socioeconomics provides important context for analysis of FirstNet projects, and in addition, FirstNet projects 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.

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. This PEIS addresses environmental justice in a separate section (Section 4.1.10). This PEIS also addresses the following topics, sometimes included within socioeconomics, in separate sections: land use and recreation (Section 4.1.7, Land Use, Recreation, and Airspace), infrastructure (Section 4.1.1, Infrastructure), and aesthetic considerations (Section 4.1.8, Visual Resources).

The financial arrangements for deployment and operation of the FirstNet network 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 NPSBN. This socioeconomics section provides some additional, broad context, including data and discussion of state and local government revenue sources that FirstNet may affect.

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

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.

4.1.9.2. 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.

4.1.9.3. Communities and Populations

This section discusses the population and major communities of Delaware (DE) and includes the following topics:

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

Statewide Population and Population Growth

Table 4.1.9-1 presents the 2014 population and population density of Delaware in comparison to the East region[87] and the nation. The estimated population of Delaware in 2014 was 935,614. The population density was 480 persons per square mile (sq. mi.), which is higher than the population density of both the region (312 persons/sq. mi.) and the nation (90 persons/sq. mi.). In 2014, Delaware was the 45th largest state by population among the 50 states and the District of Columbia, 49th largest by land area, and had the seventh greatest population density (U.S. Census Bureau, 2015d; U.S. Census Bureau, 2015e).

[87] The East region is comprised of the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, Virginia, and West Virginia, as well as the District of Columbia. Throughout the socioeconomics section, figures for the East region represent the sum of the values for all "states" (including the District of Columbia) in the region, or an average for the region based on summing the component parameters. For instance, the population density of the East region is the sum of the populations of all its states, divided by the sum of the land areas of all its states.

Table 4.1.9-1: Land Area, Population, and Population Density of Delaware

Geography	Land Area (sq. mi.)	Estimated Population 2014	Population Density 2014 (persons/sq. mi.)
Delaware	1,949	935,614	480
East Region	237,157	73,899,862	312
United States	3,531,905	318,857,056	90

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

Population growth is an important subject for this PEIS given FirstNet's mission. Table 4.1.9-2 presents the population growth trends of Delaware from 2000 to 2014 in comparison to the East region and the nation. The state's annual growth rate dropped slightly in the 2010 to 2014 period compared to 2000 to 2010, from 1.37 percent to 1.03 percent. The growth rate of Delaware in the latter period was twice the growth rate of the region, at 0.50 percent, and slightly above the nation's growth rate of 0.81 percent.

Table 4.1.9-2: Recent Population Growth of Delaware

Geography	Population			Numerical Population Change		Rate of Population Change (AARC)[a]	
	2000	2010	2014 (estimated)	2000 to 2010	2010 to 2014	2000 to 2010	2010 to 2014
Delaware	783,600	897,934	935,614	114,334	37,680	1.37%	1.03%
East Region	69,133,382	72,444,467	73,899,862	3,311,085	1,455,395	0.47%	0.50%
United States	281,421,906	308,745,538	318,857,056	27,323,632	10,111,518	0.93%	0.81%

Sources: (U.S. Census Bureau, 2015f; U.S. Census Bureau, 2015d)
AARC = Average Annual Rate of Change (compound growth rate)

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 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 4.1.9-3 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. 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 Delaware's population will increase by approximately 150,000 people, or 16.0 percent, from 2014 to 2030. This reflects an average annual projected growth rate of 0.93 percent, which is very similar to the historical growth rate from 2010 to 2014 of 1.03 percent. The projected growth rate of the state is twice that of the region (0.57 percent) and slightly higher than the projected growth rate of the nation (0.80 percent).

Table 4.1.9-3: Projected Population Growth of Delaware

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) 2014 to 2030
Delaware	935,614	1,092,562	1,078,635	1,085,599	149,985	16.0%	0.93%
East Region	73,899,862	78,925,282	82,842,294	80,883,788	6,983,926	9.5%	0.57%
United States	318,857,056	360,978,449	363,686,916	362,332,683	43,475,627	13.6%	0.80%

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

Population Distribution and Communities

Figure 4.1.9-1 presents the distribution and relative density of the population of Delaware. 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, 2015g).

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, 2015h; 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. Figure 4.1.9-1 shows the largest population concentration in the Delaware portion of the Philadelphia area, which is consistent with Table 4.1.9-4 below.

Table 4.1.9-4 provides the populations of the 10 largest population concentrations in Delaware, based on the 2010 census. It also shows the changes in population for these areas between the 2000 and 2010 censuses.[88] In 2010, the largest population concentration was the Delaware portion of the Philadelphia area, which had over 480,000 people. The only other area with a population over 100,000 was the Dover area, at approximately 111,000. The other areas were much smaller, with populations ranging between approximately 29,000 and 9,000. The smallest of these 10 population concentrations was the Georgetown area with a 2010 population of 9,034.

[88] 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.

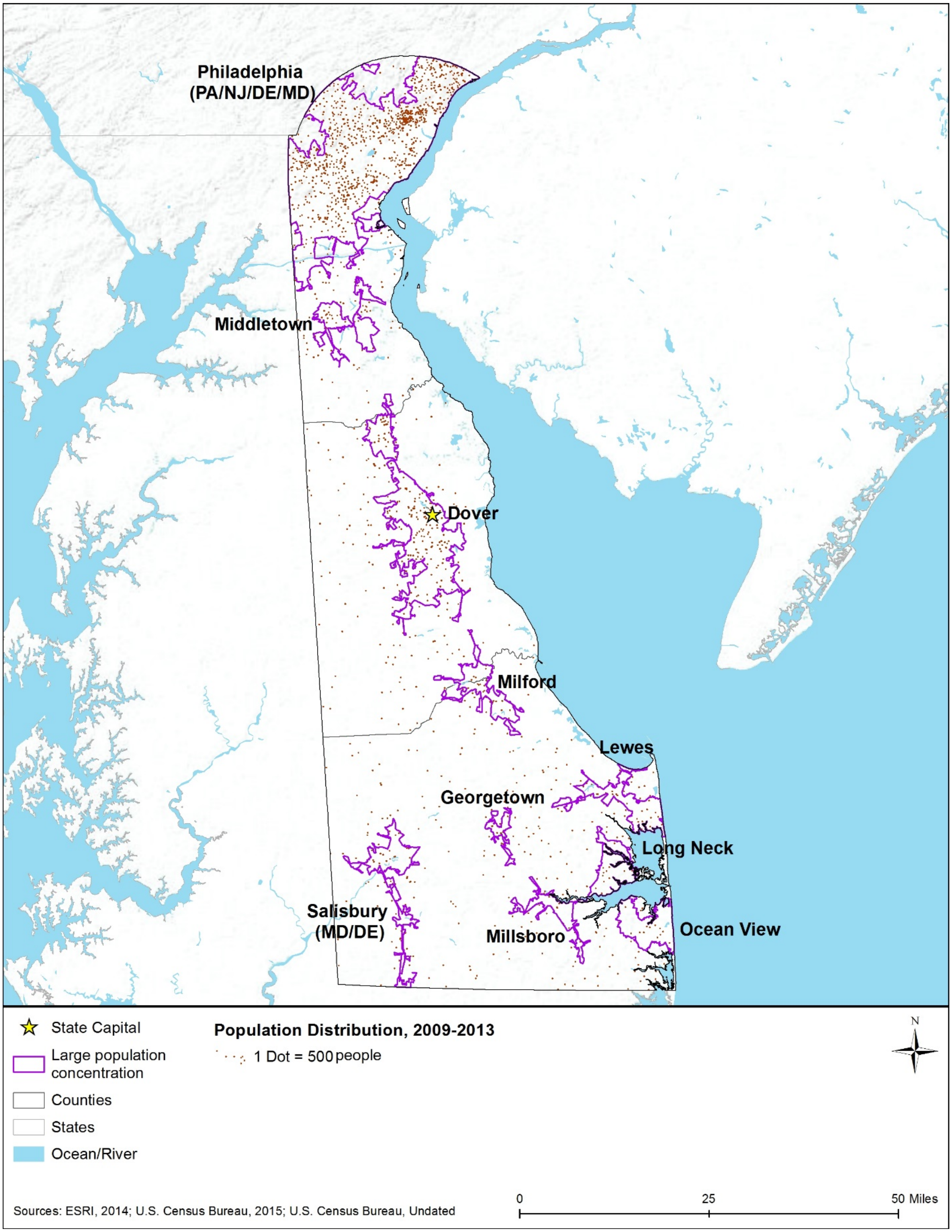


Figure 4.1.9-1: Population Distribution in Delaware, 2009–2013

The Delaware portion of the Philadelphia area experienced minimal population growth from 2000 to 2010, at an annual rate of 0.36 percent. All other areas experienced annual growth rates of at least 2.75 percent. However, some of the growth rates in Table 4.1.9-4 are due to expansion of some areas' Census Bureau boundaries to take in existing development/population, and thus are not good indicators of organic growth (net in-migration and/or births exceeding deaths).

Table 4.1.9-4 also shows that the top 10 population concentrations in Delaware accounted for over 80 percent of the state's population in 2010. Further, population growth in the 10 areas from 2000 to 2010 amounted to 124.9 percent of the entire state's growth. This figure of over 100 percent indicates that the population of the remainder of the state, as a whole, declined from 2000 to 2010.

Table 4.1.9-4: Population of the 10 Largest Population Concentrations in Delaware

Area	Population				Population Change 2000 to 2010	
	2000	2010	2009–2013	Rank in 2010	Numerical Change	Rate (AARC)
Dover	65,044	110,769	113,170	2	45,725	5.47%
Georgetown	6,886	9,034	8,298	10	2,148	2.75%
Lewes	15,787	24,129	24,169	5	8,342	4.33%
Long Neck	7,315	14,150	15,107	7	6,835	6.82%
Middletown*	6,165	29,415	30,191	3	23,250	16.91%
Milford	11,407	18,009	18,555	6	6,602	4.67%
Millsboro	4,700	9,395	9,832	9	4,695	7.17%
Ocean View	7,330	12,342	12,519	8	5,012	5.35%
Philadelphia (PA/NJ/DE/MD) (DE Portion)	464,548	481,625	485,464	1	17,077	0.36%
Salisbury (MD/DE) (DE Portion)*	1,440	24,588	23,306	4	23,148	32.81%
Total for Top 10 Population Concentrations	590,622	733,456	740,611	NA	142,834	2.19%
Delaware	783,600	897,934	908,446	NA	114,334	1.37%
Top 10 Total as Percentage of State	75.4%	81.7%	81.5%	NA	124.9%	NA

Sources: (U.S. Census Bureau, 2015h; U.S. Census Bureau, 2015j; U.S. Census Bureau, 2015k)
AARC = Average Annual Rate of Change (compound growth rate)
*The large population increases from 2000 to 2010 for many of the listed areas, particularly those marked with an asterisk, reflect large increases in the land area included in each urban area. For example, in 2000 the DE portion of the Salisbury area comprised only 0.5 square miles, but this same area comprised nearly 21 square miles in 2010. Thus, much of the "growth" was due to expansion of the area's Census Bureau boundary to take in existing development/population.
NA = Not Applicable

4.1.9.4. 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 projects are public services such as medical and emergency medical services and facilities. This PEIS addresses public services in Section 4.1.1, Infrastructure. Project-level NEPA analyses may need to examine other institutions, depending on specific locations and specific types of actions.

Economic Activity

Table 4.1.9-5 compares several economic indicators for Delaware to the East region and the nation. The table presents two indicators of income[89] – 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 4.1.9-5, the per capita income in Delaware in 2013 ($29,484) was $3,368 lower than that of the region ($32,852), and $1,300 higher 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 4.1.9-5 shows that in 2013, the MHI in Delaware ($58,244) was $2,260 lower than that of the region ($60,504), and $5,994 higher 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 4.1.9-5 compares the unemployment rate in Delaware to the East region and the nation. In 2014, Delaware's statewide unemployment rate of 5.7 percent was lower than the rate for both the region (6.0 percent) and the nation (6.2 percent).[90]

[89] 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. Census Bureau, 2015q)

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

Table 4.1.9-5: Selected Economic Indicators for Delaware

Geography	Per Capita Income 2013	Median Household Income 2013	Average Annual Unemployment Rate 2014
Delaware	$29,484	$58,244	5.7%
East Region	$32,852	$60,504	6.0%
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)

Figure 4.1.9-2 and Figure 4.1.9-3 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 4.1.9-2 (U.S. Census Bureau, 2015h; U.S. Census Bureau, 2015i). Following these two maps, Figure 4.1.9-3 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 Delaware.

Figure 4.1.9-2 shows that counties with a MHI above the national median were located in the northern portions of the state. The southern portions of the state had MHI levels below the national average. Table 4.1.9-6 is mostly consistent with those observations. Table 4.1.9-6 shows that MHI in the Philadelphia area (Delaware portion) and the Middletown area was above the state average. MHI in the Dover area was somewhat below the state average. MHI in all other population concentrations was below the state average. MHI was lowest in the Salisbury area (Delaware portion), and the Georgetown area. These are the fourth and tenth smallest of the areas shown in the table.

Figure 4.1.9-3 presents variations in the 2014 unemployment rate across the state, by county. It shows that New Castle and Sussex counties (north and south parts of the state, respectively) had unemployment rates below the national average (that is, better employment performance) and Kent County (central portion of the state) had an unemployment rate above the national average. Table 4.1.9-6 shows that the largest population concentration in Delaware (i.e., Philadelphia area), had a 2009–2013 unemployment rate that was consistent with the state average. Unemployment rates in the other population concentrations varied considerably. At 14.4 percent, Long Neck had the highest unemployment rate. The unemployment rate was lowest in Ocean View at 5.4 percent.

Detailed employment data provides useful insights into the nature of a local, state, or national economy. Table 4.1.9-7 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 was somewhat higher in Delaware than in the East region and the nation. The percentage of government workers was slightly lower in the state than in the region and nearly matched the national percentage. The percentage of self-employed workers was lower in the state than in the region and the nation.

By industry, Delaware has a mixed economic base. In 2013, it had similar percentages (plus or minus two percent) in all industries compared to the region and nation. One notable exception was in the "finance and insurance, and real estate and rental and leasing" industry. Delaware had 9.6 percent of its workers in this industry, compared to 7.3 percent for the region and 6.6 percent for the nation. The only other exception was the "educational services, and health care and social assistance" industry. Delaware had 25.3 percent of its workers in this industry, compared to 23.0 percent for the nation (but very close to the figure of 25.6 percent for the region).

Table 4.1.9-6: Selected Economic Indicators for the 10 Largest Population Concentrations in Delaware, 2009–2013

Area	Median Household Income	Average Annual Unemployment Rate
Dover	$55,274	9.3%
Georgetown	$44,955	11.1%
Lewes	$58,629	5.7%
Long Neck	$49,167	14.4%
Middletown	$88,764	6.9%
Milford	$51,010	13.7%
Millsboro	$47,635	7.5%
Ocean View	$58,669	5.4%
Philadelphia (PA/NJ/DE/MD) (DE Portion)	$62,549	8.8%
Salisbury (MD/DE) (DE Portion)	$39,751	10.2%
Delaware	$59,878	8.9%

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

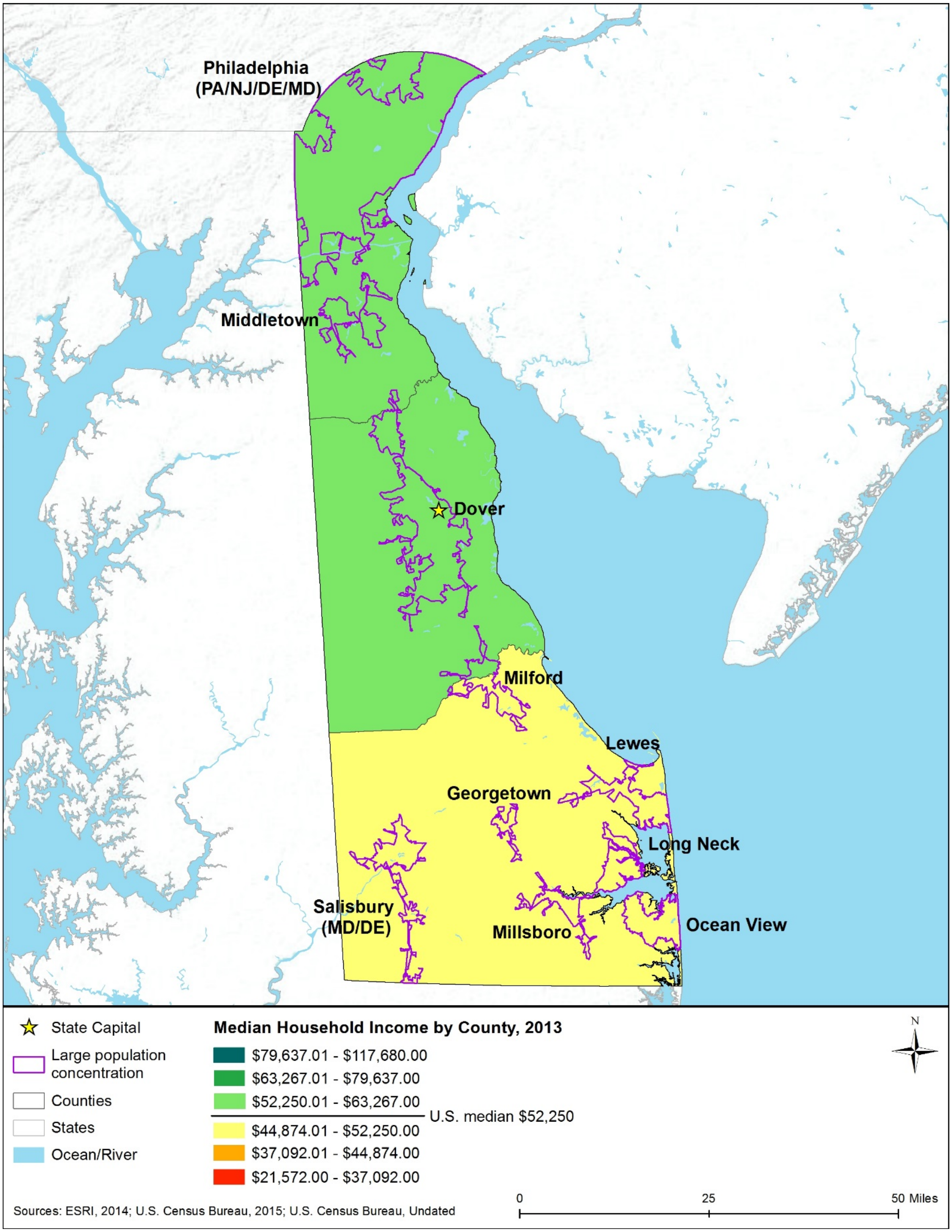


Figure 4.1.9-2: Median Household Income in Delaware, by County, 2013

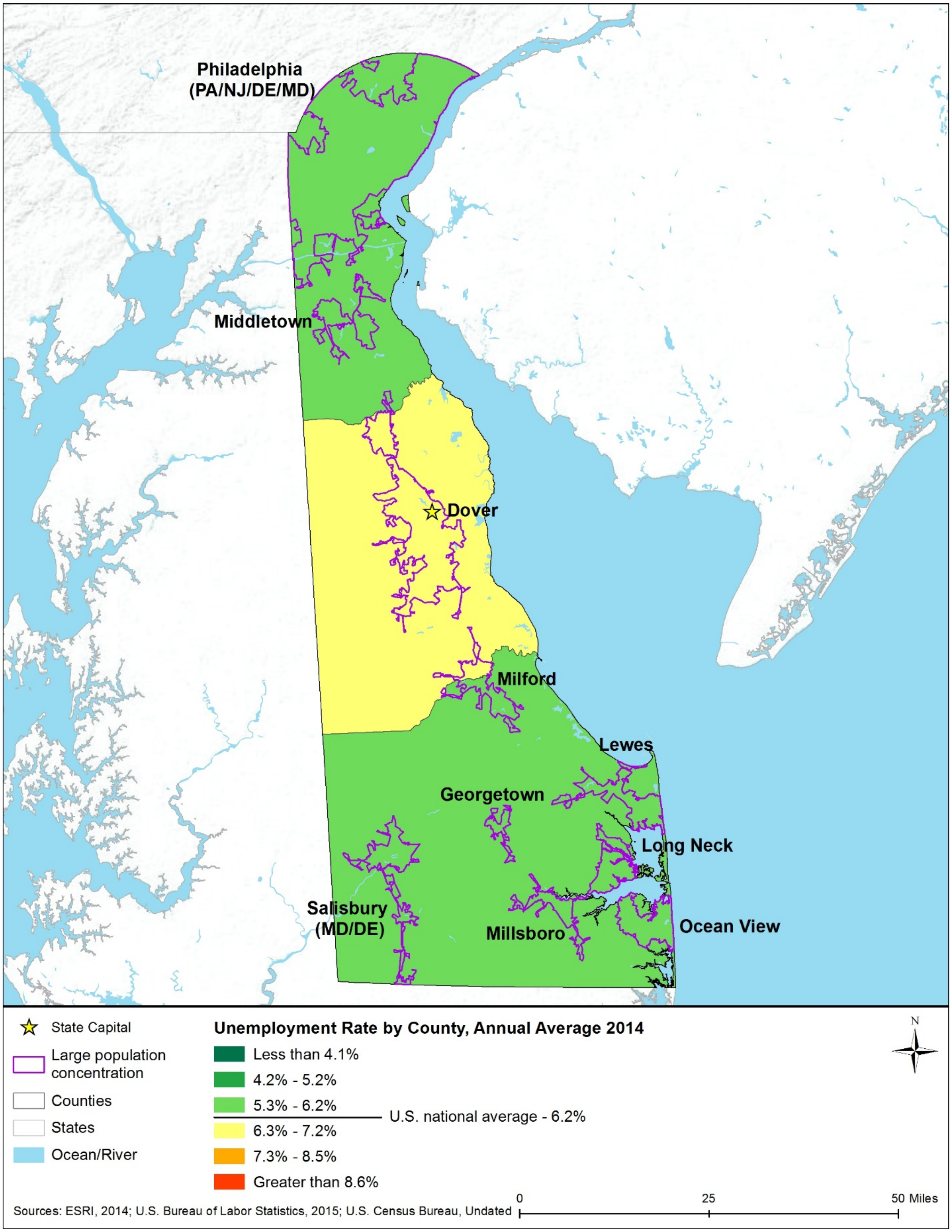


Figure 4.1.9-3: Unemployment Rates in Delaware, by County, 2014

Table 4.1.9-7: Employment by Class of Worker and by Industry, 2013

Class of Worker and Industry	Delaware	East Region	United States
Civilian Employed Population 16 Years and Over	430,247	35,284,908	145,128,676
Percentage by Class of Worker			
Private wage and salary workers	82.1%	79.3%	79.7%
Government workers	14.2%	15.1%	14.1%
Self-employed in own not incorporated business workers	3.7%	5.4%	6.0%
Unpaid family workers	0.1%	0.1%	0.2%
Percentage by Industry			
Agriculture, forestry, fishing and hunting, and mining	0.7%	0.9%	2.0%
Construction	5.4%	5.8%	6.2%
Manufacturing	8.6%	8.5%	10.5%
Wholesale trade	1.7%	2.5%	2.7%
Retail trade	12.3%	11.1%	11.6%
Transportation and warehousing, and utilities	5.1%	4.6%	4.9%
Information	1.2%	2.3%	2.1%
Finance and insurance, and real estate and rental and leasing	9.6%	7.3%	6.6%
Professional, scientific, management, administrative, and waste management services	10.6%	12.3%	11.1%
Educational services, and health care and social assistance	25.3%	25.6%	23.0%
Arts, entertainment, and recreation, and accommodation and food services	9.1%	8.9%	9.7%
Other services, except public administration	5.0%	4.9%	5.0%
Public administration	5.5%	5.5%	4.7%

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

Table 4.1.9-8 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 4.1.9-7 for 2013.

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 4.1.9-9 compares Delaware to the East region and nation on several common housing indicators.

As shown in Table 4.1.9-9, in 2013, Delaware had a higher percentage of housing units that were occupied (82.3 percent) than the region (88.4 percent) or nation (87.5 percent). Of the occupied units, Delaware had a considerably higher percentage of owner-occupied units (71.7 percent) than the region (62.8 percent) or nation (63.5 percent). This is reflected in the higher percentage of detached single-unit housing (also known as single-family homes) in Delaware in 2013 (58.3 percent) compared to the region (52.7 percent), although the Delaware figure was below the national percentage (61.5 percent). The homeowner vacancy rate in Delaware (1.9 percent) matched the rate for the nation and was slightly higher than the rate for the region (1.6 percent). This rate reflects "vacant units that are 'for sale only'" (U.S. Census Bureau, 2015q). The vacancy rate among rental units was higher in Delaware (9.3 percent) than in the region (5.5 percent) or nation (6.5 percent).

Table 4.1.9-8: Employment by Selected Industries for the 10 Largest Population Concentrations in Delaware, 2009–2013

Area	Construction	Transportation and Warehousing, and Utilities	Information	Professional, Scientific, Management, Administrative, and Waste Management Services
Dover	5.0%	4.9%	1.1%	6.5%
Georgetown	9.4%	3.9%	1.7%	10.4%
Lewes	4.9%	2.7%	1.9%	10.9%
Long Neck	9.1%	5.3%	0.4%	9.5%
Middletown	4.2%	5.0%	1.5%	9.1%
Milford	6.9%	4.2%	0.8%	6.3%
Millsboro	8.7%	7.1%	1.2%	6.5%
Ocean View	10.4%	2.2%	0.9%	12.4%
Philadelphia (PA/NJ/DE/MD) (DE Portion)	5.0%	4.6%	1.8%	11.3%
Salisbury (MD/DE) (DE Portion)	6.1%	5.0%	1.8%	6.7%
Delaware (statewide)	6.2%	4.7%	1.6%	9.9%

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

Table 4.1.9-9: Selected Housing Indicators for Delaware, 2013

Geography	Total Housing Units	Housing Occupancy & Tenure				Units in Structure
		Occupied Housing	Owner-Occupied	Homeowner Vacancy Rate	Rental Vacancy Rate	1-Unit, Detached
Delaware	412,015	82.3%	71.7%	1.9%	9.3%	58.3%
East Region	31,108,124	88.4%	62.8%	1.6%	5.5%	52.7%
United States	132,808,137	87.5%	63.5%	1.9%	6.5%	61.5%

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

Table 4.1.9-10 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 4.1.9-10 shows that during this period, the percentage of occupied housing units ranged widely from 33.4 to 95.3 percent across these population concentrations.

Table 4.1.9-10: Selected Housing Indicators for the 10 Largest Population Concentrations in Delaware, 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
Dover	43,106	88.6%	68.5%	3.1%	10.0%	60.3%
Georgetown	2,279	89.1%	52.0%	7.8%	0.0%	64.3%
Lewes	24,539	44.4%	82.7%	6.5%	21.0%	53.6%
Long Neck	12,369	51.9%	85.7%	6.9%	4.0%	42.3%
Middletown	10,125	95.3%	85.2%	2.8%	4.2%	68.7%
Milford	7,961	86.4%	70.3%	3.9%	12.8%	70.6%
Millsboro	4,437	80.2%	68.8%	3.6%	13.4%	56.0%
Ocean View	17,446	33.4%	84.4%	7.0%	26.2%	60.7%
Philadelphia (PA/NJ/DE/MD) (DE Portion)	198,321	91.9%	68.3%	1.6%	11.0%	52.4%
Salisbury (MD/DE) (DE Portion)	9,898	86.8%	63.9%	5.9%	4.8%	65.0%
Delaware (statewide)	407,865	82.3%	72.5%	2.7%	10.5%	58.4%

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

Property Values

Property values have important relationships to both the wealth and affordability of communities. Table 4.1.9-11 provides indicators of residential property values for Delaware and compares these values to values for the East region and nation. The figures on median value of owner-occupied units are from the U.S. 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, 2015q). The table shows that the median value of owner-occupied units in Delaware in 2013 ($226,200) was slightly lower than the corresponding value for the East region ($249,074), and considerably higher than the value for the nation ($173,900).

Table 4.1.9-11: Residential Property Values in Delaware, 2013

Geography	Median Value of Owner-Occupied Units
Delaware	$226,200
East Region	$249,074
United States	$173,900

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

Table 4.1.9-12 presents residential property values for the largest population concentrations in the state from 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 (2009 to 2013).

Only the Lewes, Middletown, and Ocean View areas had median values considerably higher than the state median value ($235,800), ranging from $290,100 to $363,700. The Delaware portion of the Philadelphia area had a median property value close to the state value ($239,700). All other population concentrations had property values below the state value. Lowest values occurred in areas with lower median household incomes (Table 4.1.9-6), such as the Delaware portion of the Salisbury area, the Long Neck area, and the Georgetown area.

Table 4.1.9-12: Residential Property Values for the 10 Largest Population Concentrations in Delaware, 2009–2013

Area	Median Value of Owner-Occupied Units
Dover	$197,600
Georgetown	$186,400
Lewes	$363,700
Long Neck	$163,800
Middletown	$290,100
Milford	$197,700
Millsboro	$219,800
Ocean View	$325,800
Philadelphia (PA/NJ/DE/MD) (DE Portion)	$239,700
Salisbury (MD/DE) (DE Portion)	$168,700
Delaware	$235,800

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

Government Revenues

State and local governments obtain revenues from many sources. FirstNet projects 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[91] 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 4.1.9-13 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 were 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

[91] 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).

infrastructure. General and selective sales taxes may change, reflecting expenditures during system development and maintenance.

Table 4.1.9-13 shows that the state government in Delaware received more total revenue on a per capita basis than counterpart governments in the region and nation. However, the opposite was true for Delaware local governments, which received less per capita total revenue than other local government entities. The Delaware state government had a higher level of intergovernmental revenue,[92] while Delaware local governments had lower levels than their regional and national counterparts did. The Delaware state government obtained no revenue from property taxes. Local governments in Delaware obtained lower levels of property taxes per capita than local governments in the region or nation.

Table 4.1.9-13: State and Local Government Revenues, Selected Sources, 2012

Type of Revenue		Delaware		Region		United States	
		State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount
Total Revenue	($M)	$8,015	$3,246	$522,354	$431,898	$1,907,027	$1,615,194
	Per capita	$8,740	$3,539	$7,132	$5,897	$6,075	$5,145
Intergovernmental from Federal	($M)	$1,814	$76	$135,435	$20,289	$514,139	$70,360
	Per capita	$1,978	$83	$1,849	$277	$1,638	$224
Intergovernmental from State	($M)	$0	$1,373	$0	$120,274	$0	$469,147
	Per capita	$0	$1,497	$0	$1,642	$0	$1,495
Intergovernmental from Local	($M)	$67	$0	$9,810	$0	$19,518	$0
	Per capita	$73	$0	$134	$0	$62	$0
Property Taxes	($M)	$0	$696	$2,215	$144,319	$13,111	$432,989
	Per capita	$0	$759	$30	$1,971	$42	$1,379
General Sales Taxes	($M)	$0	$0	$49,123	$15,874	$245,446	$69,350
	Per capita	$0	$0	$671	$217	$782	$221
Selective Sales Taxes	($M)	$491	$14	$38,070	$5,996	$133,098	$28,553
	Per capita	$535	$15	$520	$82	$424	$91
Public Utilities Taxes	($M)	$60	$5	$4,314	$2,261	$14,564	$14,105
	Per capita	$65	$5	$59	$31	$46	$45
Individual Income Taxes	($M)	$1,193	$56	$102,813	$18,838	$280,693	$26,642
	Per capita	$1,301	$61	$1,404	$257	$894	$85
Corporate Income Taxes	($M)	$262	$5	$14,112	$6,733	$41,821	$7,210
	Per capita	$286	$5	$193	$92	$133	$23

Sources: (U.S. Census Bureau, 2015t; U.S. Census Bureau, 2015u)

Note: This table does not include all sources of government revenue. Summation of the specific source rows does not equal total revenue.

[92] Intergovernmental revenues are those revenues received from the federal government or other government entities such as shared taxes, grants, or loans and advances.

State and local governments in Delaware reported no general sales taxes. Selective sales taxes, and public utility taxes specifically, were similar on a per capita basis for the Delaware state government compared to others in the region and nation, but lower for Delaware local governments. Individual income tax revenues for the Delaware state government, on a per capita basis, were lower than those collected by other state governments in the region, but higher than those of counterparts in the nation. Individual income tax revenues collected by Delaware local governments were lower than those collected by counterparts at the regional and national levels. Corporate income taxes for the Delaware state government, on a per capita basis, were higher than those for the region and nation.

4.1.10. Environmental Justice

4.1.10.1. 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 1.8.11). The fundamental principle of environmental justice as stated in the EO 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" (Executive Office of the President, 1994). 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-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 (U.S. Department of Commerce, 2013a).

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, 1997). Additionally, the USEPA Office of Environmental Justice (USEPA, 2015e) offers guidance on Environmental Justice issues and provides an "environmental justice screening and mapping tool," EJSCREEN (USEPA, 2015j).

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, 1997)

4.1.10.2. Specific Regulatory Considerations

The DNREC established the Community Involvement Advisory Council (CIAC) in 1999. This advisory committee was chartered to address or prevent barriers for the inclusion of under-served populations. This Committee currently advises the Secretary of DNREC to advocate for local communities statewide. CIAC helps ensure that no community in the state of Delaware is disproportionately affected, and facilitates community participation in the environmental decision making process. The committee is comprised of representatives from environmental organizations, under-served or adversely affected communities, local nonprofit organizations, local government, academic institutions, health care organizations, and business/industry. (University of California, Hastings College of Law, 2010)

Delaware also established a Community Ombudsman position to act as a liaison between DNREC, local communities, and community organizations. This position was primarily created to engage communities in identifying and addressing environmental justice issues, and to ensure under-served communities are informed. The Community Ombudsman also oversees the operation of a Community Fund, the Community Environmental Project Fund, which obtains funds from revenue collected from civil and administrative penalties. The funds are dedicated to finance environmental projects that:

- Mitigate or eliminate environmental pollution, remove human health risks, or improve native habitats; and
- Benefit local communities where the violation occurred (University of California, Hastings College of Law, 2010).

Projects that often qualify for funding include projects that support DNREC's environmental goals and promote community involvement and support (e.g., volunteer hours, matching funds, donated in-kind services) and programs to improve public health in environmental justice communities. For example, DNREC funded two monitoring projects to improve air quality, retrofitted diesel school and transit buses to reduce emissions, worked to replace fleet engines at the Port of Wilmington. (University of California, Hastings College of Law, 2010)

4.1.10.3. Environmental Setting: Minority and Low-Income Populations

Table 4.1.10-1 presents 2013 data on the composition of Delaware's population by race and by Hispanic origin. The state's population has considerably higher percentages of individuals who identify as Black/African American (21.6 percent) than the populations of the East region and the nation. (Those percentages are, for Black/African American, 14.4 percent for the East region and 12.6 percent for the nation). The state's population of persons identifying as White (68.9 percent) is slightly smaller than that of the East region (72.1 percent) or the nation (73.7 percent).

The percentage of the population in Delaware that identifies as Hispanic (8.7 percent) is considerably lower than in the East region (12.2 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. Delaware's All Minorities population percentage (36.0 percent) is slightly higher than that of the East region (34.0 percent) and somewhat lower than that of the nation (37.6 percent).

Table 4.1.10-2 presents the percentage of the population living in poverty in 2013, for the state, region, and nation. The figure for Delaware (12.4 percent) is slightly lower than that for the East region (13.3 percent) and lower than the figure for the nation (15.8 percent).

Table 4.1.10-1: 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		
Delaware	925,749	68.9%	21.6%	0.4%	3.6%	0.1%	2.5%	2.9%	8.7%	36.0%
East Region	73,558,794	72.1%	14.4%	0.3%	5.8%	0.0%	4.8%	2.7%	12.2%	34.0%
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, 2015v)
"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 4.1.10-2: Percentage of Population (Individuals) in Poverty, 2013

Geography	Percent Below Poverty Level
Delaware	12.4%
East Region	13.3%
United States	15.8%

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

4.1.10.4. 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 4.1.10-1 visually portrays the results of the environmental justice population screening analysis for Delaware. The analysis used block group data from the Census Bureau's American Community Survey 2009-2013 5-Year Estimates (U.S. Census Bureau, 2015x; U.S. Census Bureau, 2015y; U.S. Census Bureau, 2015z; U.S. Census Bureau, 2015aa) and Census Bureau urban classification data (U.S. Census Bureau, 2015ab; U.S. Census Bureau, 2015i).

Figure 4.1.10-1 shows that Delaware has many areas with high potential for environmental justice populations. The distribution of these high potential areas occurs primarily in or near the 10 largest population concentrations, particularly the state's portion of the Philadelphia and Salisbury areas, and the Middletown, Dover, Milford, Georgetown, and Millsboro areas. The distribution of areas with Moderate Potential for environmental justice populations is fairly even across the state.

It is important to understand how the data behind Figure 4.1.10-1 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 4.1.10-1 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 projects, 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 projects 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 NEPA criteria), and "appreciably exceeds or is likely to appreciably exceed the risk or rate to the general population or other appropriate comparison group" (CEQ, 1997). The Environmental Consequences section (Section 4.2.10) addresses the potential for disproportionately high and adverse environmental or human health impacts on environmental justice populations.

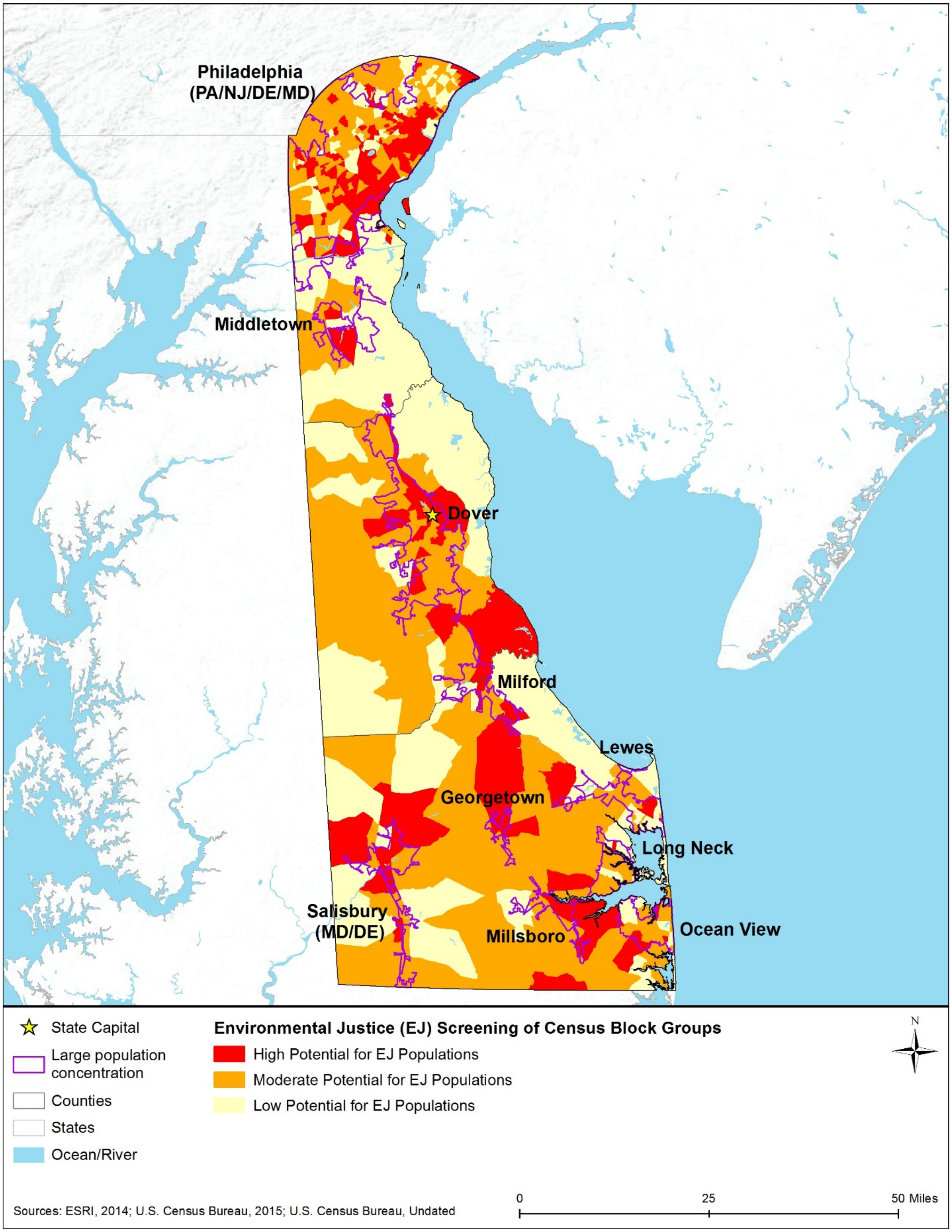


Figure 4.1.10-1: Potential for Environmental Justice Populations in Delaware, 2009–2013

4.1.11. Cultural Resources

4.1.11.1. Definition of the 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 National Register of Historic Places (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, n.d.); and
- Advisory Council on Historic Preservation's (ACHP) guidance for protection and preservation of sites and artifacts with traditional religious and cultural importance to an Indian tribes or Native Hawaiian organizations (Advisory Council on Historic Preservation, 2004).

4.1.11.2. 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), the American Indian Religious Freedom Act, ARPA, and NAGPRA. Appendix C summarizes these pertinent federal laws.

While Delaware does not have a state law that is similar to the NHPA, the Delaware State Historic Preservation Office (SHPO) must review development projects that involve major land use changes if requested to do so by the Office of State Planning Coordination (refer to Table 4.1.11-1). 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 4.1.11-1: Relevant Delaware Cultural Resources Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Delaware Code, Title 29, Chapter 92, Land Use Planning	Delaware SHPO	SHPO reviews of local development projects, which "provides for state agency review of major land use change proposals prior to submission to local governments." (Delaware Office of State Planning Coordination, 2015)

4.1.11.3. Cultural and Natural Setting

The Delaware region has been inhabited by human beings for at least 12,000 years (Custer, 1984). The majority of the evidence early human habitation of Delaware and the surrounding region comes from the study of archeological sites of pre-European contact and historic populations. In addition to hundreds of archaeological sites listed in the state's inventory, there are 29 archaeological sites listed on the NRHP in Delaware, of which there are 15 prehistoric and 14 historic (NPS, 2015j).

Materials from many archeological sites are displayed and interpreted at various locations across the state. The Delaware SHPO is responsible for protecting, preserving and making sure such sites are documented for future generations. Archeological sites within the state can be found in a wide variety of settings, from forests and flood plains to waterways. Pre-European contact archeological sites range from temporary fishing encampments to large permanent villages (Moeller, 1980). There are also many "resource procurement sites" or areas where the activity appears to have consisted of a single action lasting for perhaps just a few hours, such as hunting sites that typically identify where animals were killed and butchered. Groups of people also gathered at resource-rich waterfront locations to harvest and process fish and shellfish such as oysters and clams (Custer, 1994). Evidence at archaeological sites in Delaware may be found in relatively shallow deposits, within one to two feet of the surface. However, in many cases throughout the state, natural factors have caused sites to be buried under multiple layers of sediment, such as floodplain deposits, often found along streams, rivers, and coastal plains. These deposits can range between one and ten feet below the current surface, with older sites in the deeper sediments. Disturbed ground, such as urban areas, may contain archaeological resources within the deeper or shallower strata than in undisturbed areas (Harris, 1979).

Archaeologists typically divide large study areas into regions, based on the environment that early humans may have thrived in (Figure 4.1.3-1). Delaware is divided into provinces and regions. The physiographic provinces consist of the Coastal Plains and Piedmont. The regions are divided into the Appalachian Highlands and Atlantic Plain. By understanding the topography, archaeologists are able to discern what types of sites may be present based on previous research.

There are three distinct periods associated with prehistoric human populations that inhabited Delaware and the greater northeast geography of North America: The Paleoindian period (12,000 to 10,000 B.C.), Archaic (10,000 to 3,000 B.C.), and Woodland (3,000 B.C. to A.D. 1600). Figure 4.1.11-1 shows a timeline representing the periods that represent the evolving culture that existed within this region. The dates associated with each period are estimated using either radio carbon dating techniques and by associating the artifacts discovered with those of similar ones, which have been previously assigned to a particular period (Kerber, 2012; Noble Keegan, K and William F. Keegan, 1999; Lavin, 2013; Holiday, Johnson, & Stafford, 1999; Institute of Maritime History, 2015; Pauketat, 2012) (Custer, 1984).

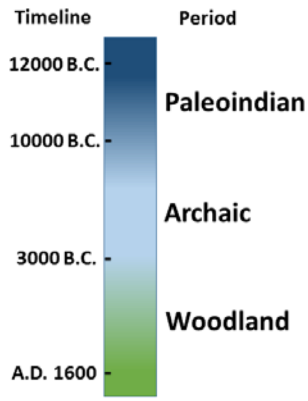


Figure 4.1.11-1: Timeline of Prehistoric Human Occupation

Sources: (Institute of Maritime History, 2015; Pauketat, 2012)

Paleoindian Period (12,000 - 10,000 B.C.)

The Paleoindian Period represents the earliest human inhabitants of Delaware and the northeastern United States. Evidence of early humans in Delaware is based on a variety of sources such as published site reports and technical reports that have been prepared for various state agencies. The discovery of fluted projectile points ("arrowheads") scattered on the ground, at prehistoric campsites, and other more prominent sites throughout the state allow archaeologists to further their understanding of these early inhabitants and to protect important sites that are discovered (Stanzeski, 2006).

Based on available evidence, Paleoindians were nomads that lived in small groups. Early hypotheses in American archaeology suggested that the Clovis fluted point was not invented until prehistoric people reached North America and began hunting the large game of that period (Ritchie, 1969). However, more recent studies show that such technology was prevalent in northeastern Asia, the Arabian Peninsula, and Spain prior to human arrival into North America (Charpentier & Inizan, 2002). Most of the oldest known evidence of human settlement in Delaware is based on the discovery of fluted points found in surface and shallow deposits throughout the state (Gingerich, 2007; Stanzeski, 2006). Archaeologists hypothesize that the people of this period formed small bands that followed migratory game. There is evidence of human habitation throughout the state.

Early Paleoindian settlers used the Clovis fluted point technology to hunt large game. Findings at the Thomas Paleoindian archaeological site (7NC-D-4) in New Castle County, Delaware included numerous tools such as gravers, scrapers, combination tools and hammerstones. These tools are evidence that the people were preparing hides from large animals and conducting woodworking activities (Stanzeski, 2006). These bands established seasonal camps, some of which likely became permanent settlements. No skeletal remains of these people have been identified to date in Delaware, so their appearance is unknown. It is assumed that they were related to people who migrated to North America via a land bridge at the Bering Strait during the latter part of the last ice age (Late Pleistocene epoch) (Ritchie, 1969; Laub, 2000; Robinson, 2011).

Archaic Period (10,000 B.C. to 3,000 B.C.)

Up until the Archaic, there was a general warming trend and an increase in precipitation in this region. As temperatures continued to rise, vegetation began to increase and a more verdant and extensive deciduous forest environment took over. Forests of hemlock, and then oak, began to emerge over widespread areas. Seasonal differences became more distinguishable, providing a greater variety of food sources that drove changes in society, allowing people to spend more time in one area while foraging for food. Women and children were able to stay in one location, while the men left on hunting expeditions. The flora and fauna developed into much like present day Delaware (Custer, 1984) (Custer, 1994).

During this period, the region became increasingly attractive for human occupation, with its dense mesic (temperate) forest and well balanced ecosystems that supported a large diversity of plants and animals. Swamps and bogs, especially in areas with poor drainage such as floodplains, were also prevalent throughout the state (Custer, 1984). Figure 4.1.11-1 above represents the different physiographic regions in the state.

Few Archaic archaeological sites have been discovered in Delaware, and none have been found intact. Archeologists have surmised the Early Archaic culture began developing instruments such as choppers, narrow-bladed projectile points, beveled adzes, and various other small tools and ornaments, such as pendants. However, because no intact archaic site has been found in Delaware, archaeologists must make inferences based on what they do find at various sites

Archaeologists Have Defined Three Categories of Archaic Period Sites

1. Macroband Base Camps – Camps that served multiple family units, likely in areas that had a wide range of abundant food sources. Excavations at macroband base camps have discovered a wide variety of tools and large amounts of debris, indicating that people occupied these sites for relatively long periods. The prevalence and scale of these camps demonstrate that inhabitants of this period were more sedentary than their predecessors, and they could successfully exploit multiple natural resources.
2. Microband Base Camps – Camps that likely served small family based units (or possibly a small number of families). Microband sites were in areas that likely could support only a small group. The density of tools and quantify of debris found at microband camps are much smaller than at the macroband sites.
3. Procurement Sites – Sites used for extracting resources. Procurement sites were only used for extracting resources. Types of resources exploited from these sites included cobblestone to make tools, various food sources such as berries and other edible plants, fish along stream beds, and other lithic materials to make tools. Sites such as these are found throughout Delaware.

Source: (Custer, 1984)

within the state and region. Sites such as the Harry's Farm site near Shawnee on the Delaware, assemblages from the Upper Delaware Valley of Pennsylvania, and the Miller Field site along the Delaware River in Warren County have revealed ground stone tools such as axes, gouges, grinding stones, and plant processing tools to help inhabitant begin to exploit the natural resources of the period (Custer, 1984) (Stoltman, 1992).

Archaeological evidence suggests that by the Middle Archaic Period, the climate in Delaware had changed significantly enough to support an ecological environment much like that which exists today. By this period, the region had abundant wild game, fowl, edible nuts, berries, tubers, roots, and various herbs, which could support larger populations of semi-nomadic peoples. Archaic period groups often selected riverine locations where they could harvest salmon, shad, and sturgeon, and other freshwater fish and shellfish. (Stanzeski, 2006).

Although there are more sites recorded in Delaware that represent the Middle Archaic than the Early Archaic, there is little archaeological evidence about how the inhabitants lived. Throughout the northeastern region of the United States, coastal sites that may have contained thriving communities of semi-nomadic peoples have become subsequently submerged underwater, as a consequence of rising sea levels over time. Archaeologists have determined that Middle Archaic people in the Delaware region used materials such as quartz, quartzite, and shale to develop tools, which is in indicator of technology advancement. For instance, the Delaware area Indians used the dugout canoe for waterway travel and fishing (Custer, 1984) (Stanzeski, 2006).

Seasonal exploitation of the flora and fauna were becoming the predominant way of life. The forests were beginning to become much like they are presently and were dominated by such species as oak, alder, birch, pine, hemlock, beech, hickory, and chestnut. Aquatic and wild vegetable food sources were also thriving within this region. The warmer climate, and abundance and variety of food sources, which became established due to the changing environment, gave rise to human population increases, either through new migration of extant groups within the region, via an increase of indigenous populations, or both. Large sites across the state from this period have been well documented along major rivers and served as base camps that allowed larger populations of people to gather during various times of the year. This allowed for exchange of ideas and information, and allowed for the development of a more sophisticated social life, including the marrying of partners (Custer, 1984).

The activities associated with these sites included the use of a more advanced tool assemblage. Projectile points, scrapers, adzes, gouges, axes, drills, blades, weights, pendants, pestles, and atlatl weights for spear throwing are well documented at these sites. Flint artifacts in the archaeological record indicate migration and trading with peoples outside the Delaware area. Some of these materials included quartz, quartzite, and rhyolite (Custer, 1994) (Custer, 1987) (Custer, 1984).

Woodland Period (3,000 B.C. – A.D. 1600)

There are very few sites in Delaware that represent the early part of the Woodland period of human occupation in this region. There is no indication that people were living in houses during this period. The hunting and fishing activities developed during the Archaic Period appear to have remained the predominant means of subsistence, rather than horticulture. Early Woodland sites show use of chipped stone technology, and development of thick narrow projectile points, some made from non-local sources. Archaeological evidence shows that most campsite were small, occupied seasonally as the people moved around in search of food, with , with deer, tree nuts, and shellfish being the largest food sources (Custer, 1984) (Kensley, 1972). The late and terminal Archaic periods gave rise to what is now known to be the Adena culture, "who focused their settlement-subsistence systems along the major mid-drainage estuarine settings of the Delmarva Peninsula's Coastal Plain (Custer, 1987).

Technologies became more sophisticated during the Middle Woodland period. Pottery became more elaborate, with more complex decorations, including incised lines and cord wrapped stick impressions. Rudimentary horticulture began throughout the state, and a sedentary lifestyle became more prevalent (Custer, 1984) (Kensley, 1972).

During the Late Woodland period the people of the Delaware region began to demonstrate more advanced horticultural activities, including archaeological evidence of maize cultivation. Environmental diversity and the ability to grow crops on a seasonal scale played a significant role in the development of the people living in Delaware until the time of European contact. The domestication of plants gave rise to societies such as small villages to large fortified communities. Interactions among various communities created a trade network and shaped their way of life (Stewart, 1993).

4.1.11.4. Federally Recognized Tribes of Delaware

According to the Bureau of Indian Affairs and the National Council of State Legislators, there are no federally recognized Tribes in Delaware (National Conference of State Legislatures, 2010; U.S. Department of the Interior, 2015). However, the Lenape and Nanticoke Tribes inhabited the current region of Delaware, as shown in Figure 4.1.11-2.

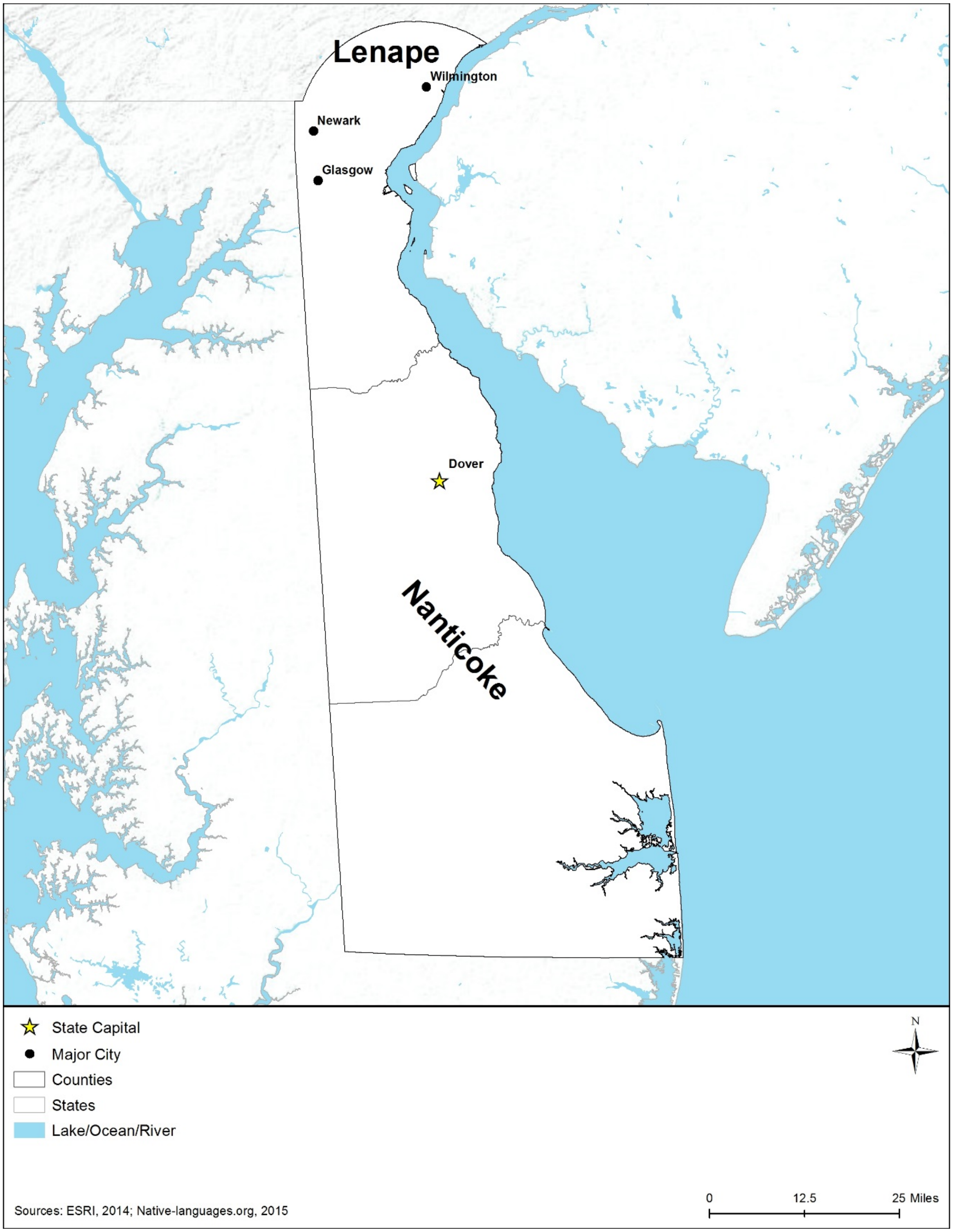


Figure 4.1.11-2: Native American Tribes in Delaware

4.1.11.5. Significant Archaeological Sites of Delaware

As previously mentioned in Section 4.1.11, there are 29 archaeological sites listed on the NRHP for Delaware. Table 4.1.11-2 presents the names of the sites, the city they are closest to, and type of site. Both prehistoric and historic archaeological sites are listed. Based on the relative location of the sites listed within the table, there is a high probability that other previously unknown sites in their vicinity may be present, especially in areas that may have or may not have been previously disturbed. A complete listing of NRHP sites can be found on the NRHP website at www.nps.gov/nr/ (NPS, 2013b).

Delaware State Cultural Resources Database and Tools

Delaware Cultural Resources Information System (CHRIS)

The Division of Historical and Cultural Affairs maintains the Cultural and Historical Resources Information System (CHRIS) for determining potential impacts to cultural resources for project specific “areas of potential effects” (APE).* CHRIS is a Geographic Information System (GIS) available to the public, which allows users to access a myriad of Delaware’s cultural resources databases, including more than 1.5 million pages of digitized images that include National Register documents, building and archaeological inventory forms, survey reports, and a wide variety of additional legacy data. CHRIS can be accessed at (http://history.delaware.gov/preservation/research/gis.shtml). Individuals may partly access CHRIS as a guest user; for access to the full system, individuals must apply for an account at http://history.delaware.gov/information/GISdata/User%20Account%20Application.pdf (State of Delaware, 2015h).

Delaware State Historical Historic Preservation Office (SHPO)

The Delaware SHPO website at http://history.delaware.gov/preservation/ hosts a number of resources for conducting further research on the pre-history of the state. Services and information that is available are: Historic Preservation Office contact information, information on how to protect historic properties, information on tax incentives for preserving historic sites and buildings, information on cemeteries, information on the discovery of human remains, a historic property research center, a link to the NRHP website, a preservation help center, guidelines on conducting archaeological and historical surveys in Delaware, and information on preservation planning (State of Delaware, 2015h).

* An APE “is the geographic area or areas within which an undertaking may directly or indirectly cause changes in the character or use of historic properties, if any such properties exist” (36 CFR 800.4(a)(1) (U.S. Department of Commerce, 2013b).

Table 4.1.11-2: Archaeological Sites on the National Register of Historic Places in Delaware

Location (Closest City)	Site Name	Type of Site
Bethany Beach	Poplar Thicket	Historic (Bird Sanctuary)
Bethany Beach	Wilgus Site	Prehistoric
Concord	Pine Grove Furnace Site	Historic
Dover	Hughes-Willis Site	Prehistoric
Dover	Island Field Site	Prehistoric
Dover	Saint Jones Neck	Prehistoric
Felton	Hughes Early Man Site	Prehistoric
Frankford	Baltimore Mills Historic Archaeological Site	Historic
Kenton	Cheney Clow	Historic
Kitts Hummock	Byfield Historic District	Historic
Kitts Hummock	Lower St. Jones Neck Historic District	Historic
Lewes	Cape Henlopen Archeological District	Historic
Lewes	De Vries Palisade	Historic
Lewes	Roosevelt Inlet Shipwreck	Historic (Shipwreck)
Lewes	Townsend Site	Prehistoric
Lewes	Wolfe's Neck Site	Prehistoric
Middleford	Deep Creek Furnace Site	Historic
Milford	Archaeological Site No. 7KF 4 and 23	Prehistoric
Millsboro	Indian River Archaeological Complex	Prehistoric
Millsboro	Warren T. Wright Farmhouse Site	Historic
Odessa	Duncan Beard Site	Historic
Odessa	Hells Island Site	Prehistoric
Rehoboth Beach	Avery's Rest Site	Historic
Rehoboth Beach	Thompson's Loss and Gain Site	Historic
Rehoboth Beach	Warrington Site	Prehistoric
Sandtown	Dill Farm Site	Prehistoric
Seaford	Barnes Woods Archaeological District	Prehistoric
Stanton	Clyde Farm Site	Prehistoric
Wilmington	Beaver Valley Rock Shelter Site	Prehistoric

Source: (NPS, 2014b)

4.1.11.6. Historic Context

Sir Henry Hudson first arrived in what is now Delaware in 1609, and while no lasting settlements were established, the Dutch claimed the territory (Hudson was sailing for the Dutch) (Munroe, 2006). In 1638, Sweden established the colony of New Sweden, anchored by Fort Christina (now Wilmington). During the 1650s, Sweden sacked Fort Casimir, built in 1651 by the Dutch, and ousted the Dutch governor. This success was fleeting and in 1655, the Dutch had regained control and incorporated Delaware into the larger colony of New Netherlands (Hoffecker, Waldron, Williams, & Benson, 1995). During the late 17th century, control of Delaware flipped between England and the Netherlands, but England ultimately prevailed (Munroe, 2006).

Following the American Revolution, Delaware became the first state to ratify the American Constitution. Delaware supported the Union during the Civil War, and gunpowder facilities owned by the du Pont family produced gunpowder for the Union forces (Munroe, 2006).[93] Fort Delaware, on Pea Patch Island in the Delaware River, protected Wilmington and Philadelphia and served as a prisoner of war camp for Confederate soldiers (Delaware State Parks, 2015). Following the Civil War, Delaware continued to operate as a manufacturing hub, while the southern portion of the state remained rural. In the early 20th century, Pierre S. du Pont was instrumental in establishing the Delaware public school system; examples of these historic school buildings still exist (Munroe, 2006).

During World War I (WWI) Delaware manufactured goods for the war effort; however, during the Great Depression many factories closed permanently. Agricultural production in the south aided in easing economic hardships during the depression, and during World War II (WWII) Delaware again served as a producer of goods for the war effort. Factories produced gunpowder and ships, with Wilmington being a prolific center of ship construction (Munroe, 2006).

Following WWII, Delaware experienced a growth of wealth associated with its industries, which was facilitated by its central location. Delaware's population increased in the late 1940s, and continued to climb during the 1950s and 1960s in the form of suburban development between Wilmington and Dover. The population increased in the southern portion of the state, but at a slower rate, and was associated with the development of beach communities in previously rural areas (Munroe, 2006). The growth of the Bethany Beach, DE, area is an example of this trend.

Delaware has 692 NRHP listed sites, as well as 13 NHLs (NPS, 2014b). Delaware contains no National Heritage Areas (NPS, 2015k). Figure 4.1.11-3 shows the location of NRHP sites in Delaware.[94]

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[93] Certain members of the du Pont family have also spelled their name Du Pont.

[94] See Section 4.1.7 for a more in-depth discussion of additional historic resources as they relate to recreational resources.

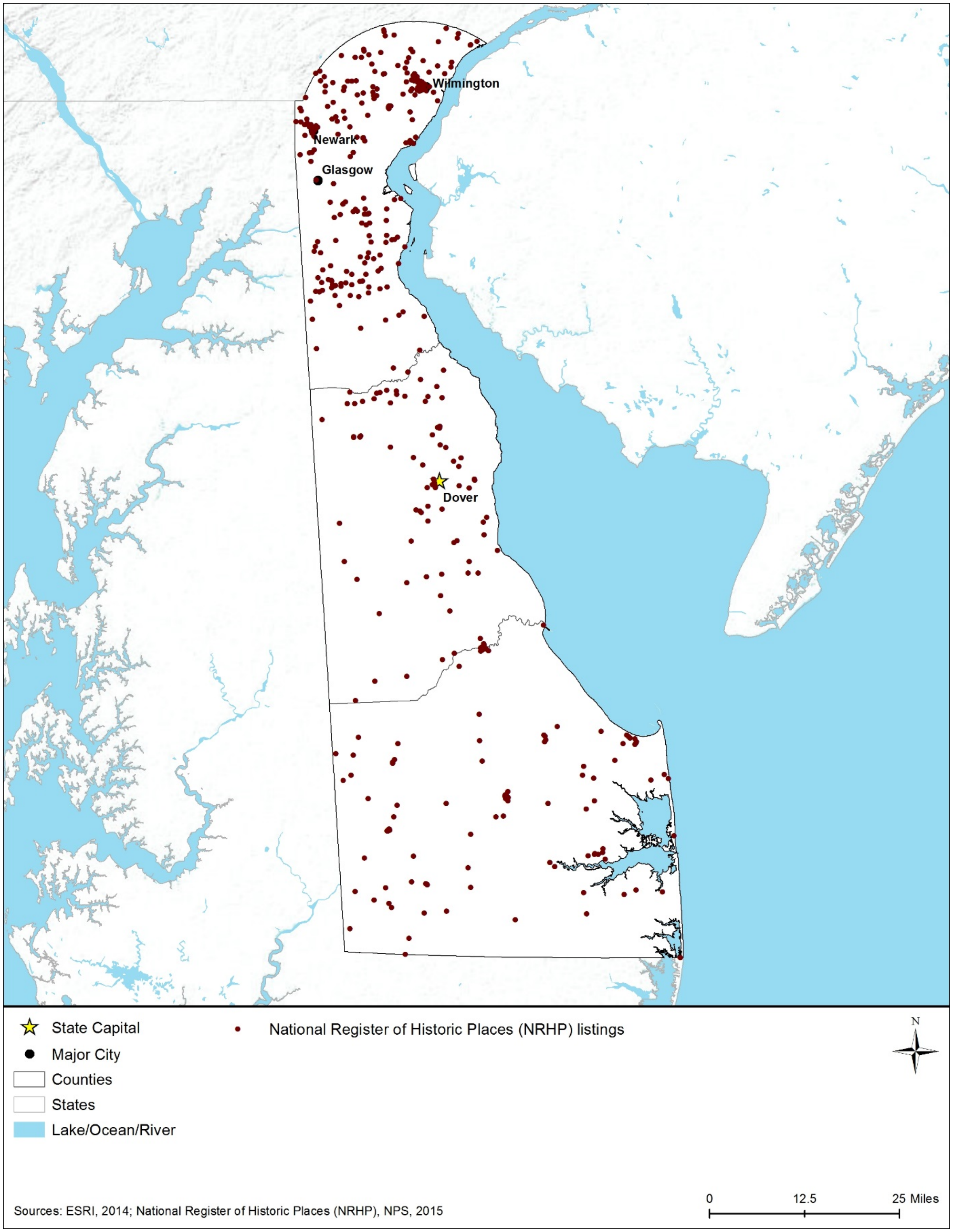

Figure 4.1.11-3: National Register of Historic Places Sites in Delaware

4.1.11.7. Architectural Context

Architecturally, Delaware is reflective of its neighbors. Maryland has had a strong influence on building types found in southern Delaware, while Pennsylvania and New Jersey have influenced what was built in the north. Delaware is composed of three counties: New Castle County in the north, Kent County in the central portion of the state, and Sussex County in the south. The population of Delaware has always been centered around Wilmington, in New Castle County, while the south has traditionally been rural and involved in agriculture. Wilmington is the largest city in the state and has historically housed the large majority of Delaware's manufacturing capabilities (Maynard, 2008).

While Delaware has limited Swedish or Finnish architecture, these countries are attributed with bringing the log house to America (Maynard, 2008). The abundance of good lumber made log construction an easy and logical choice for early settlers, with log structures at one time being very common in New Castle County, which was originally settled by Swedes. After wresting control of the colony from Sweden, the Dutch exerted their own architectural influence. Front facing gabled structures with stepped gable parapets were popular in urban areas. These structures were similar to the Dutch buildings found in New Amsterdam during the same period. While a few examples of this housing type exist today, they are thought to post-date Dutch control of the colony (Maynard, 2008).

After the British gained control of Delaware in the late 17th century, buildings became more English in style, with Georgian architecture being popular up until the American Revolution. In rural areas of northern Delaware, stone farmhouses were similar to those being constructed in neighboring Pennsylvania, while buildings in Wilmington resembled those in Philadelphia (Maynard, 2008). In the south, both frame and masonry structures resembled Maryland architecture (Lanier & Herman, 1997). Structures were often "earthfast," or post-in-ground, as was typical of the Chesapeake Bay area. Brick structures often featured decorative patterning using glazed bricks. While most structures during this time were built of wood, a disproportionate number of brick structures have survived due to their superior durability (Carson & Lounsbury, 2013). Structures were also built of "Wilmington Complex gneiss," a stone with a bluish tint that is distinctive to northern Delaware (Maynard, 2008).

During the late 18th and early 19th centuries the Federal style was popular (McAlester & McAlester, 2013). Unlike other parts of the country, Greek Revival did not become as popular in Delaware during the mid-19th century, because Delaware did not experience the same growth as the rest of the country at this time. However, in some cases, Greek Revival details were added to older houses as updates, and examples of this remain today. During the mid-to-late 19th century, Italianate and Victorian Era housing styles grew in popularity. Throughout the 19th century, Delaware remained rural, with popular housing styles not being constructed as widely as in the other parts of the country. As a result, Delaware was replete with early intact architecture until the suburban boom of the mid-20th century (Maynard, 2008).

During the late 19th century, streetcar suburbs, brought about by the growth of industry, grew in popularity around Wilmington. This growth continued into the 20th century with automobile suburbs eventually replacing streetcar suburbs. Housing styles ranged from Victorian-style houses in the late 19th century, to Colonial Revival houses and bungalows prior to WWII. Following WWII, suburbanization began to occur on a larger scale and at a frenzied pace, resulting in the destruction of much of Delaware's remaining historic rural landscapes. Housing types included minimal traditional, ranch houses and split-levels (Maynard, 2008).

Waterways and transportation infrastructure had a strong influence on architecture throughout the state. The Delaware River facilitated the shipment of good, which allowed Wilmington to grow into an industrial hub. While Delaware had a large collection of lighthouses along the Delaware River, many have not survived. As automobile transportation increased, most of the state's covered bridges were replaced due to capacity issues. Canals, such as the Chesapeake and Delaware Canal; roadways, including turnpikes during the 19th century and the Interstate Highway System during the 20th century; and especially railroads, allowed for people, goods, and architectural trends to spread throughout the state (Maynard, 2008).

The du Pont family has had a significant impact on the state of Delaware. The French-born American chemist Éleuthère Irénée du Pont de Nemours (1771-1834) first started a gunpowder factory on Brandywine Creek near Wilmington in 1802. Profits made during wartime production resulted in the construction of several grand mansions. These structures ranged in style from early Federal style architecture to French chateau architecture with International influences (Maynard, 2008). Today, Eleutherian Mills, the du Pont family's first home and powder yards, has been converted into the Hagley Museum and Library. Winterthur Museum, the former home of Henry Francis du Pont (1880-1969), is another former du Pont estate that has been converted into a museum (Munroe, 2006).

Figure 4.1.11-4: Representative Architectural Styles of Delaware

- Left – Kingston-Upon-Hill (Dover, DE) – (Historic American Buildings Survey, 1933a)
- Right Top – J. Walker Farm (Marshallton, DE) – (Historic American Buildings Survey, 1933b)
- Right Middle – DuPont Powder Mill (Hagley Museum – Greenville, DE) – (Historic American Buildings Survey, 2016a)
- Right Bottom – Aspendale (Downs Chapel) (Kenton, DE) – (Historic American Buildings Survey, 2016b)

4.1.12. Air Quality

4.1.12.1. 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[95] 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)[96] or micrograms per cubic meter ($\mu g/m^3$) determined over various periods of time (averaging time).[97] This section discusses the existing air quality in Delaware. The USEPA designates areas within the United States as attainment,[98] nonattainment,[99] maintenance,[100] or unclassifiable[101] 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.

4.1.12.2. Specific Regulatory Considerations

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_X), particulate matter ($PM_{2.5}$ and PM_{10}), ozone (O_3), and oxides of sulfur (SO_X). The NAAQS establish various standards, either primary[102] or secondary,[103] 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.

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, 2011a). HAPs can have severe adverse impacts on human health and the

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[95] Topography: The unique features and shapes of the land (e.g., valleys and mountains).

[96] Equivalent to 1 milligram per liter (mg/L)

[97] 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, 2015m)

[98] Attainment areas: Any area that meets the national primary or secondary ambient air quality standard for the pollutant. (USEPA, 2015n)

[99] 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, 2015n)

[100] 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, 2015n)

[101] 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, 2015n)

[102] 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, 2016)

[103] 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, 2016)

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, Delaware maintains its own air quality standards, which are referred to as the Delaware Ambient Air Quality Standards (DAAQS). While state air quality standards typically mimic national air quality standards, Delaware established a separate standard for dioxin. Table 4.1.12-1 provides an overview of the DAAQS as defined by DNREC regulations.

Table 4.1.12-1: Delaware Ambient Air Quality Standards (DAAQS)

Pollutant	**Averaging Time**	**Primary Standard**		**Secondary Standard**		**Notes**
		μg/m³	**ppm**	**μg/m³**	**ppm**	
CO	8-hour	10	9	Same as Primary		40 CFR 50.8
	1-hour	40	35	Same as Primary		40 CFR 50.8
Dioxins	Annual	0.000001	-	-	-	For the purposes of determining compliance with this standard the commissioner may use a concentration of 7.0 picograms per cubic meter (pg/m³) 8-hour average.
Lead	3 month	0.15	-	Same as Primary		Rolling average; 40 CFR 50.16
NO_X	Annual	-	0.053	Same as Primary		40 CFR 50.11
	1-hour	-	0.1	Same as Primary		40 CFR 50.11
O_3	8-hour	-	0.075	Same as Primary		Daily max; 40 CFR 50.15
	1-hour	235	0.12	Same as Primary		USEPA revoked the one-hour standard for ozone in June 2005 but Delaware has maintained the one-hour standard in its regulations (Regulation 1103). The one-hour standard is achieved when the expected number of days, averaged over three years, with a maximum hourly average of greater than 0.12 ppm (235 μg/m3) is less than or equal to one. **This is a Delaware-specific standard.**
PM_{10}	24-hour	150	-	Same as Primary		40 CFR 50.6
$PM_{2.5}$	Annual	12	-	15	-	40 CFR 50.18; 40 CFR 50.13
	24-hour	35	-	Same as Primary		40 CFR 50.18 and 40 CFR 50.13
SO_X	1-hour	-	0.075	-	-	40 CFR 50.17
	24-hour	-	0.14	-	-	40 CFR 50.4 **This is a Delaware-specific standard.**
	Annual	-	0.03	-	-	40 CFR 50.4 **This is a Delaware-specific standard.**

Pollutant	Averaging Time	Primary Standard		Secondary Standard		Notes
		μg/m^3	ppm	μg/m^3	ppm	
	3-hour	-	-	0.5 ppm	0.5	40 CFR 50.5
Suspended Particulates	Annual	75	-	60	-	An annual geometric mean, based on 24-hour average concentrations.
	24-hour	260	-	150	-	Must not be exceeded more than once per year, based on 24-hour average concentrations
Hydrogen Sulfate	3-minute	-	0.06	-	-	The average concentration of hydrogen sulfide taken over any consecutive three minutes.
	1-hour	-	0.003	-	-	The average concentration of hydrogen sulfide taken over any consecutive 60 minutes.

Source: (DNREC, 2014c)

Title V Operating Permits/State Operating Permits

Delaware 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, 2015f). The overall goal of the Title V program is to "reduce violations of air pollution laws and improve enforcement of those laws" (USEPA, 2015f). Delaware Regulations Administrative Code (DAC), Title 7, Part 1130 "Title V State Operating Permit Program" describes the applicability of Title V operating permits (DNREC, 2015s). Delaware requires Title V operating permits for any major source or new stationary source if it emits or has the potential to emit pollutants in excess of the major source thresholds (see Table 4.1.12-2) or if it is subject to HAP regulations (unless exempted). The permit issued to a facility contains both state and federal portions and incorporates a reporting schedule (USEPA, 2014b).

Table 4.1.12-2: Major Air Pollutant Source Thresholds

Any Pollutant	100 Tons per Year
Single HAP	10 Tons per Year
Total/Cumulative HAPs	25 Tons per Year

Source: (USEPA, 2014b)

Exempt Activities

Delaware Regulations Administrative Code (DAC), Title 7, Part 1102 establishes the procedures for obtaining approval for construction and modification for emission generating equipment. Section 2.0 of Part 1102 outlines activities that are exempt from applying for and obtaining a permit to operate. The following equipment are exempt from obtaining permits assuming emissions are documented and records are properly maintained:

- "Equipment without an air contaminant control device that has actual emissions to the atmosphere of any air contaminant or contaminants, in the aggregate, during each and every day that are less than 0.2 pound per day, provided that:

    - The actual emissions are quantified and documented; and
    - Records are maintained at the facility and are made available to the Department upon request which document that the equipment qualifies for this exemption."
- "Equipment with an air contaminant control device that has actual emissions to the inlet of the air contaminant control device of any air contaminant or contaminants, in the aggregate, during each and every day that are less than 0.2 pound per day, provided that:
    - The actual emissions are quantified and documented; and
    - Records are maintained at the facility and are made available to the Department upon request which document that the equipment qualifies for this exemption."
- "Any person who operates fuel burning equipment which uses only natural gas, LP [liquefied petroleum] gas, or other desulfurized fuel gas and has a rated heat input of less than 100 million BTUs [British-Thermal Units] per hour, or any other equipment, that was exempted from the requirement to have a permit by 3.1 of this regulation…" [DAC Title 7 Part 1102]

Additionally, the following equipment and activities are exempted from obtaining permits as defined by Appendix A of DAC Title 7 Part 1102:

- "External combustion fuel burning equipment which:
    - Uses any fuel and has a rated heat input of less than 10 million [BTUs] per hour.
    - Uses only natural gas, LP gas, or other desulfurized fuel gas and has a rated heat input of less than 15 million [BTUs] per hour.
- Internal combustion engines in vehicles used for transport of passengers or freight.
- Maintenance, repair, or replacement in kind of equipment for which a permit to operate has been issued.
- Equipment which emits only nitrogen, oxygen, carbon dioxide, or water vapor.
- Lawnmowers, tractors, farm equipment and construction equipment.
- Stationary gasoline storage tanks that:
    - Have a capacity less than 2000 gallons and that were constructed prior to January 1, 1979; or
    - Have a capacity less than 250 gallons and that were constructed after December 31, 1978.
- Any stationary storage tank not subject to control by the provisions of this [DAC] regulation, which contains any liquid having a true vapor pressure less than 0.5 psi at 70ºF or is less than 5000 gallons capacity
- Any internal combustion engine associated with a stationary electrical generator that: 1) has a standby power rating of 450 kilowatts or less that is used only during times of emergency; 2) is located at any residence; or 3) is located at any commercial poultry producing premise, as these terms are defined in [Title] 7 [of DAC] Part 1144.
- Any internal combustion fuel burning equipment, which is not associated with a stationary electrical generator, and has an engine power rating of 450 [horsepower] or less" (DNREC, 2006a).

Any action with an emissions source not exempted, including generators and other emission sources, must be installed and operated in compliance with all applicable Delaware regulations.

Temporary Emissions Sources Permits

Delaware requires emergency and distributed generators follow specific emission standards. Both emergency and distributed generators must not exceed the following emissions standards when operating at full capacity:

- Emergency generator
  - Existing emergency generator. The owner or operator of an existing emergency generator shall operate the generator in conformance with the generator manufacturer's instructions, such as following maintenance and operating requirements to help minimize emissions.
  - New emergency generator. A new emergency generator shall meet the applicable emissions standards set by the USEPA for non-road engines (40 CFR 89, 90, 91, 92, 94, 1039, or 1048 July 1, 2004 Edition).
- Distributed generator. The following standards do not apply to distributed generators while operating to provide emergency electric power during an emergency.
  - Existing Distributed generator
    - Except as provided for in 3.2.1.2 of [Part 1144 of DAC], an existing distributed generator shall meet the following emission standards" (see Table 4.1.12-3).
  - New Distributed generator
    - "Except as provided for in 3.2.2.2 of this regulation, a new distributed generator shall meet the following emission standards" as defined in Table 4.1.12-4. (DNREC, 2006b)

Table 4.1.12-3: Existing Distributed Generator Emission Standards

Pollutant	Emission Standard (lbs/MWh)
Nitrogen Oxides	4
Nonmethane Hydrocarbons	1.9
Particulate Matter (liquid-fueled reciprocating engines only)	0.7
Carbon Monoxide	10
Carbon Dioxide	1,900

Source: (DNREC, 2006b)

Table 4.1.12-4: New Distributed Generator Emission Standards

	Emission Standards (lbs/MWh)		
Pollutant	Installed On or After Effective Date	Installed On or After January 1, 2008	Installed On or After January 1, 2012
Nitrogen Oxides	2.2	1	0.6
Nonmethane Hydrocarbons	0.5	0.5	0.3
Particulate Matter (liquid-fueled reciprocating engines only)	0.7	0.7	0.07
Carbon Monoxide	10	10	2
Carbon Dioxide	1,900	1,900	1,650

Source: (DNREC, 2006b)

Generators may operate under the following conditions:

- "An emergency generator may operate for an unlimited number of hours during an emergency.
- An emergency generator may operate for an unlimited number of hours during testing or for maintenance purposes, pursuant to the definition of an emergency generator, except as restricted by 4.4 of [DAC Title 7 Part 1144].
- A distributed generator may operate at any time, except as restricted by 4.4 of [DAC Title 7 Part 1144].
- No emergency or distributed generator shall be used during testing or for maintenance purposes before 5 p.m. on a day which has a Ground Level Ozone Pollution Forecast or Particle Pollution Forecast of 'Code Red' or 'Code Orange' as announced by the Department" (DNREC, 2006b).

Any action using a generator will need to abide by these standards to remain in compliance with Delaware regulations.

- Delaware defines an emergency as:
- "An electric power outage due to: a failure of the electrical grid; onsite disaster; local equipment failure; or public service emergencies such as flood, fire, natural disaster, or severe weather conditions (e.g., hurricane, tornado, blizzard, etc.); or
- When there is a deviation of voltage or frequency from the electrical provider to the premises of 3% or greater above, or 5% or greater below, standard voltage or frequency." (DNREC, 2006b)

State Preconstruction Permits

Delaware requires a preconstruction review for any new or modified stationary source. Stationary sources, in general, require Title V permits and contribute a significant amount of air pollution. DAC Title 7 Part 1125 states that, "any stationary source which will impact an attainment area or an unclassifiable area as designated by USEPA pursuant to Section 107 of the CAA Amendments of 1990, is subject to the provisions of 3.0 of [DAC Title 7 Part 1125], Prevention of Significant Deterioration (PSD)." Section 4.0 [DAC Title 7 Part 1125] establishes specific limits on criteria pollutants (see Table 4.1.12-1), as well as other hazardous air pollutants. Additionally, "any stationary source which will impact a nonattainment area as designated by the USEPA pursuant to Section 107 of the CAA is subject to 2.0 of [DAC Title 7 Part 1125], Emission Offset Provisions (EOP)" (DNREC, 2014d).

The regulations state that no stationary source can be constructed until the Department verifies, "that the source will comply with any applicable emissions limit or New Source Performance Standard or Emissions Standard for a Hazardous Air Pollutant as set forth in 7 DE Admin. Code 1100 Regulations Governing the Control of Air Pollution" (DNREC, 2014d).

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 state implementation plan (SIP) (USEPA, 2013b). 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 (U.S. Government Publishing Office, 2010).

The estimated pollutant emissions are compared to *de minimis* levels. These values are the minimum thresholds for which a conformity determination must be performed (see Table 4.1.12-5). All Delaware counties lie in the Ozone Transport Region (OTR). As a result, lower *de minimis* thresholds for VOCs and NOX could apply depending on the attainment status of a county.

Table 4.1.12-5: *De Minimis* Levels

Pollutant	Area Type	TPY
Ozone (VOC or NO_X)	Serious Nonattainment	50
	Severe Nonattainment	25
	Extreme Nonattainment	10
Ozone (NO_X)	Marginal and Moderate Nonattainment inside an OTR	100
	Maintenance	100
Ozone (VOC)	Marginal and Moderate Nonattainment inside an OTR	50
	Maintenance within an OTR	50
CO, SO_2, NO_2	All Nonattainment and Maintenance	100
PM_{10}	Serious Nonattainment	70
	Moderate Nonattainment and Maintenance	100
$PM_{2.5}$ (Direct Emissions) (SO_2) (NO_X (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: (U.S. Government Publishing Office, 2010)

If an action does not result in an emissions increase above the *de minimis* levels in Table 4.1.12-5, 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 4.1.12-4, 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[104], 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).

State Implementation Plan (SIP) Requirements

Delaware's SIP is composed of many related actions to ensure ambient air concentrations of the six criteria pollutants comply with the NAAQS. Delaware's SIP is a conglomeration of separate actions taken for each of the pollutants. All of Delaware's SIP actions are codified under 40 CFR Part 52 Subpart HH. A list of all SIP actions for all six criteria pollutants can be found on USEPA's website (http://www.epa.gov/air/urbanair/sipstatus/reports/de_infrabypoll.html) (USEPA, 2015g).

4.1.12.3. Environmental Setting: Ambient Air Quality

Nonattainment Area

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 4.1.12-1 and Table 4.1.12-6 present the nonattainment areas in Delaware as of January 30, 2015. Table 4.1.12-6 contains a list of the counties and their respective current nonattainment status of each criteria pollutant. The year(s) 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., $PM_{2.5}$, O_3, and SO_x). Unlike Table 4.1.12-6, Figure 4.1.12-1 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.

[104] Conformity: Compliance with the State Implementation Plan.

Table 4.1.12-6: Delaware Nonattainment and Maintenance Areas by Pollutant and County

County	Pollutant and Year USEPA Implemented Standard										
	CO	Lead		NO_X	PM_{10}	$PM_{2.5}$		O_3		SO_X	
	1971	1979	2008	1971	1987	1997	2006	1997	2008	1971	2010
Kent								X-4			
New Castle						M	M	X-4	X-5		
Sussex								X-4	X-5		

Source: (USEPA, 2015h)

X-1 = Extreme Nonattainment Area
X-2 = Severe Nonattainment Area
X-3 = Serious Nonattainment Area
X-4 = Moderate Nonattainment Area
X-5 = Marginal Nonattainment Area
X-6 = Unclassified Nonattainment Area
M = Maintenance Area

Air Quality Monitoring and Reporting

Delaware measures air pollutants at 11 sites across the state as part of the National Air Monitoring Stations Network and the State and Local Air Monitoring Stations Network. Delaware prepares State Ambient Air Quality Reports containing pollutant data summarized by region. These reports are available for download from the Division of Air Quality website (http://www.dnrec.delaware.gov/Air/Pages/Air-Quality.aspx). Delaware reports real-time pollution levels of O_3 on the website to inform the public, as O_3 is the main pollutant of concern.

Throughout 2013, O_3 measurements exceeded the federal and state standard of 0.075 ppm two times in the cities of Brandywine (New Castle County) and Lewes (Sussex County). No other criteria pollutants exceed federal or state standards. (DNREC, 2013d)

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). These are different from the air quality classification levels defined in Table 4.1.12-1 as part of the DAAQS. 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 (USEPA, 2013d).

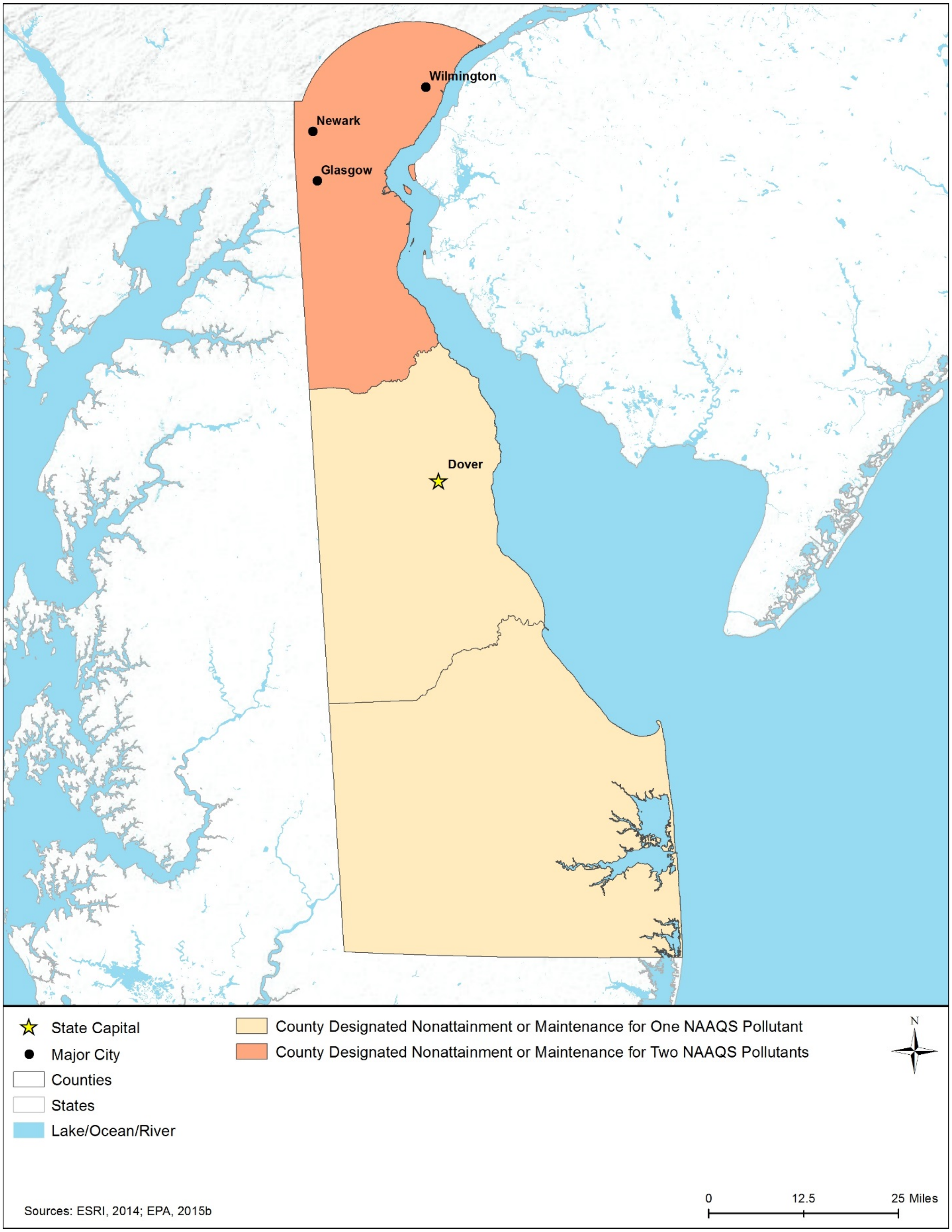


Figure 4.1.12-1: Nonattainment and Maintenance Counties in Delaware

In a 1979 USEPA memorandum, the Assistant Administrator for Air, Noise, and Radiation (Hawkins, 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[105] of a Class I area. "The EPA'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 EPA guidance for modeling air quality impacts under the PSD program has tended to focus more on the requirements for a Class II modeling analysis. Such guidance has provided that applicants need not model beyond the point of significant impact or the source or 50 kilometers[106] (the normal useful range of EPA-approved Gaussian plume models" (USEPA, 1992).

Delaware does not contain any Federal Class I areas; all land within the state is classified as Class II (USEPA, 2012d). 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). There are no Federal Class I areas within 100 kilometers of Delaware and therefore, Class I areas will not be of concern for any actions conducted within the state.

4.1.13. Noise

This section presents a discussion of a basic understanding of environmental noise, background/ambient noise levels, noise standards, and guidelines.

4.1.13.1. Definition of the Resource

Noise is caused by pressure variations that the human ear can detect and is often defined as unwanted sound (USEPA, 2012e). 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.

[105] The memorandum and associated guidance use kilometers. 100 kilometers is equal to about 62 miles.
[106] The memorandum and associated guidance use kilometers. 50 kilometers is equal to about 31 miles.

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"). The normal audible frequency range is approximately 20 Hz to 20 kHz. (FAA, 2015h) 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, 2013).

Measurements and descriptions of noise (i.e., sounds) are based on various combinations of the following factors (Federal Transit Authority, 2006):

- The vibration frequency characteristics of the sound, measured as sound wave cycles per second [Hertz (Hz)], determines the pitch of the sound.
- 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.
- The changes in frequency characteristics or pressure levels through time.

Figure 4.1.13-1 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.

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 (Federal Transit Authority, 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). The ambient noise levels can differ considerably depending on whether the environment is urban, suburban, or rural.

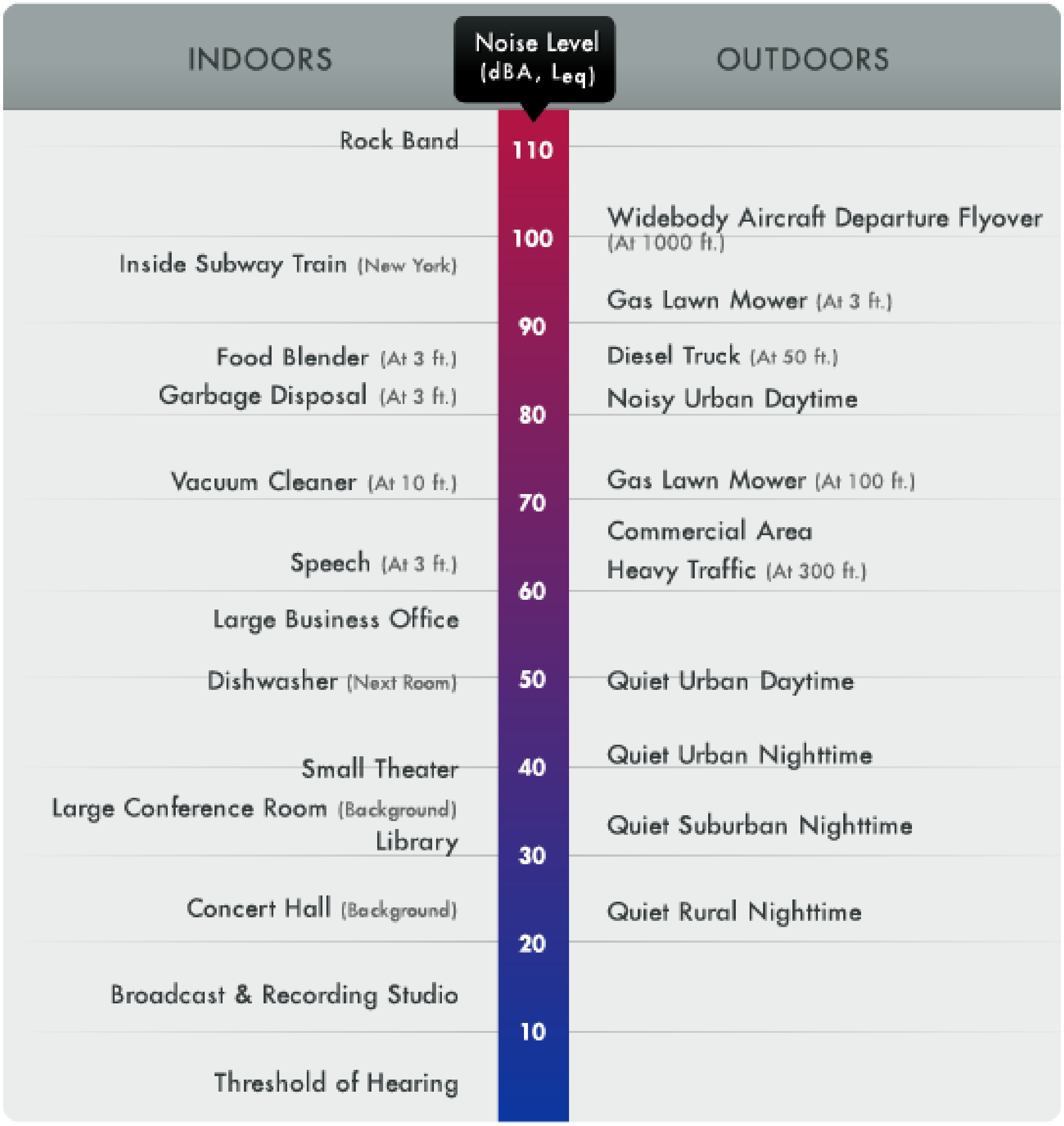


Figure 4.1.13-1: Sound Levels of Typical Sounds

Source: (Sacramento County Airport System, 2015)
Prepared by: Booz Allen Hamilton, 2005.

4.1.13.2. Specific Regulatory Considerations

As identified in Appendix C, 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.

Delaware has applicable statewide noise laws that outline the various restrictions placed on noise emitting sources within the state (Table 4.1.13-1). For instance, Title 7, Chapter 71 § 7104 states that noise and noise disturbance are prohibited as follows:

> "(a) No person shall, without first having obtained a variance or a temporary emergency variance from the Department of Natural Resources and Environmental Control, undertake any activity which in any way may cause or contribute to the creation of noise or a noise disturbance.
>
> (b) No person shall, without having first obtained a variance or a temporary emergency variance from the Department of Natural Resources and Environmental Control, construct, install, replace, modify or use any equipment, machinery, motor vehicle, device or other article which in any way may cause or contribute to the creation of noise or a noise disturbance." (Delaware State Regulations, 1982)

Where noise is defined as "any sound which annoys or disturbs humans or which causes or tends to cause an adverse psychological or physiological effect on humans, excluding all aspects of noise regulated by the federal Occupational Safety and Health Act (OSHA)" and noise disturbance is defined as "any sound which:

(1) Endangers or injures the safety or health of humans or animals; or
(2) Annoys or disturbs a reasonable person of normal sensitivities; or
(3) Jeopardizes the value of property and erodes the integrity of the environment. (Delaware State Regulations, 1982).

Many cities and towns may have additional, local noise ordinances 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 Wilmington, are likely to have different regulations than rural or suburban communities largely due to the population density and difference in ambient noise levels (FHWA, 2011a). Table 4.1.13-1 provides an overview of Delaware state laws relating to noise.

Table 4.1.13-1: Relevant Delaware Noise Laws and Regulations

State Law/ Regulation	Regulatory Agency	Applicability
Delaware Code, Title 7 Chapter 71	Legislative Council, General Assembly. State of Delaware	Provides instructions to ensure an environment free from unwanted noise that would endanger safety
§ 7104	Legislative Council, General Assembly. State of Delaware	Informs of the obligation to acquire a variance prior to producing a noise disturbance
§ 7110	Legislative Council, General Assembly. State of Delaware	Defines the exception that may allow the acquisition of a temporary emergency variance
§ 7121	Legislative Council, General Assembly. State of Delaware	All vehicles must be in compliance with federal and state standards
§ 4306	Legislative Council, General Assembly. State of Delaware	Defines the noise requirements for vehicle horns
§ 4307	Legislative Council, General Assembly. State of Delaware	Authorizes emergency vehicles to be equipped with a warning device

Source*:* (State of Delaware, 2015b)

4.1.13.3. Environmental Setting: Ambient Noise

The range and level of ambient noise in Delaware varies widely based on the area and environment of the area. The population of Delaware can choose to live and interact in areas that are large cities, rural communities and National and State parks. Figure 4.1.13-1 illustrates noise values for typical community settings and events that are representative of what the population of Delaware may experience on a day-to-day basis. These noise levels represent a wide range and are not specific to Delaware. As such, this section describes the areas where the population of Delaware 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) (U.S. Department of Interior, 2008). The areas that are likely to have the highest ambient noise levels in the state are: Wilmington, Dover, Newark, Milford, and Seaford.

- **Airports:** Areas surrounding airports tend to be more sensitive to noise 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, 2012). 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 are in the proximity of urban communities; therefore, aircraft operations (arrivals/departures) can result in noise exposure in the surrounding areas to be at higher levels 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 Delaware, New Castle Airport (ILG) has more than 57,000 annual operations combined (FAA, 2015i). These operations result in increased ambient noise levels in the surrounding communities. See Section 4.1.1, Public Safety Infrastructure, and Figure 4.1.1-1 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, 2015b). There are a number of major highways within the state that may contribute to higher ambient noise levels for residents living in those areas. 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, 2015b). See Section 4.1.1, Public Safety Infrastructure, and Figure 4.1.1-1 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 (Federal Transit Authority, 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 (Federal Railroad Administration, 2015). Delaware has multiple rail corridors with high levels of commercial and commuter rail traffic. These major rail corridors extend from Frankford to Wilmington through Dover, Harrington, and Newark. There are also a number of other rail corridors that join these major rail lines and connect with other cities (DelDOT 2011b). See Section 4.1.1, Public Safety Infrastructure, and Figure 4.1.1-1 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. These areas typically have lower noise levels, as low as 30 to 40 dBA (NPS, 2014c). Delaware has 1 national park and 13 Natural Historic Landmarks (National Parks Conservation Association, 2015) (NPS, 2015l). Visitors to these areas expect lower ambient noise conditions than the surrounding urban areas. See Section 4.1.8, Visual Resources, for more information about national and state parks for Delaware.

4.1.13.4. 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, towns, and villages in Delaware 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 in the Delaware.

4.1.14. Climate Change

4.1.14.1. 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 in increase atmospheric concentrations of greenhouse gas (GHG) caused by emissions from human activities such as burning fossil fuels to generate electricity (USEPA, 2012f). 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[107] (MT CO_2e), which equalizes for the different global warming potential of each type of GHG. Where this document references emissions of CO_2 only, the units will be in million metric tons (MMT) CO_2. Where the document references emissions of multiple GHGs, the units will be 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 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 Section 4.2.14, 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).

4.1.14.2. Specific Regulatory Considerations

The pertinent federal laws relevant to the protection and management of climate change are summarized in Appendix C. Delaware has established goals and regulations to reduce GHG emissions to combat climate change. As shown in Table 4.1.14-1, three key state laws/regulations are the primary policy drivers on climate change preparedness and GHG emissions.

In conjunction with executive orders that address climate change, the state developed a report titled "Delaware Climate Change Impact Assessment" to summarize the best available science on the impacts of climate change on Delaware's population, infrastructure, and natural resources. The state also wanted to increase awareness and understanding of both on-going and future climate change, and support preparedness and adaptation at the state, local, community, and individual level (DNREC, Division of Climate and Energy, 2015c). Delaware is also one of nine states participating in the Regional Greenhouse Gas Initiative (RGGI). RGGI is a CO_2 emissions trading scheme, launched in 2008, which sets an annual cap on CO_2 emissions from power plants over 25 MW capacity within those nine states. The cap for 2015 was set at 88.7 million short tons of CO_2, with an annual reduction of 2.5 percent per year until 2020 (RGGI, 2015).

[107] 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, 2015o)

Table 4.1.14-1: Relevant Delaware Climate Change Laws and Regulations

State Laws/Regulations	Regulatory Agency	Applicability
EO 41: Preparing Delaware for Emerging Climate Impacts and Seizing Economic Opportunities from Reducing Emissions	Delaware Division of Climate and Energy	"Directs agencies to address both the causes and consequences of climate change by developing actionable recommendations to reduce GHG emissions that contribute to climate change, increase resilience to climate impacts, and avoid and minimize flood risks due to sea level rise." (DNREC, Division of Climate and Energy, 2015a)
Executive Order 41: Working Groups Climate Framework for Delaware	State of Delaware: Division of Climate and Energy	The Climate Framework for Delaware summarizes the work to date and recommendations from the three workgroups formed under Executive Order 41: Mitigation, Adaptation, and Flood Avoidance. 1. The Mitigation Workgroup has recommended a mitigation target of 30 percent greenhouse gas reduction from a 2008 baseline by 2030. 2. The Adaptation Workgroup has proposed more than 150 recommendations for a wide range of actions that address public health and safety needs, impacts to facilities and infrastructure, and capacity to deliver services to constituents in Delaware. 3. The Flood Avoidance Workgroup is developing technical guidance and tools for use by state agencies for the siting and design of structures and infrastructure, with an emphasis on avoidance of current and future flood risk. These tools include a Flood Risk Adaptation Map that depicts flood exposure from a combination of sea level rise and coastal storms. (DNREC, Division of Climate and Energy, 2015a)
EO 18: Leading by Example Towards a Clean Energy Economy and Sustainable Natural Environment	Delaware Division of Climate and Energy	"Requires state agencies to take actions to address energy conservation and efficiency, use of renewable energy, environmentally responsible construction, recycling, clean transportation, and environmentally sensitive procurement. EO 18 also directs each executive agency to designate an Agency Sustainability Manager." (DNREC, Division of Climate and Energy, 2015b)

4.1.14.3. Delaware Greenhouse Gas Emissions

Estimates of Delaware's total GHG emissions vary. The Department of Energy's Energy Information Agency (EIA) collects and disseminates data on national-level emissions of CO_2 from fossil fuels by state. In addition, EIA maintains data on other GHGs such as CH_4 and nitrous oxide (NOx), but these are not broken down by state (EIA, 2011). The USEPA also collects and disseminates national-level GHG emissions data, but by economic sector, not by state (USEPA 2015g). Individual states have developed their own GHG inventories and these are updated with different frequencies and trace GHG in different ways.

According to the EIS, energy-related activities in Delaware emitted a total of 13.4 MMT of CO_2 in 2013, with electric power as the largest emitter (see Table 4.1.14-2) (EIA, 2015f). Annual emissions from 1980-2013 are presented in Figure 4.1.14-1 (EIA, 2015f). Between 1980 and 2008, Delaware's GHG emissions declined slowly but in 2009 underwent an abrupt decline as emissions from both coal and natural gas declined in the electric power sector. Delaware was ranked 48th among the states the states for total CO_2 emissions in 2013 y stable since 1980 although they have experienced recent declines beginning in 2009, but is 30th in the U.S. per capita CO_2 emissions (EIA, 2015d).

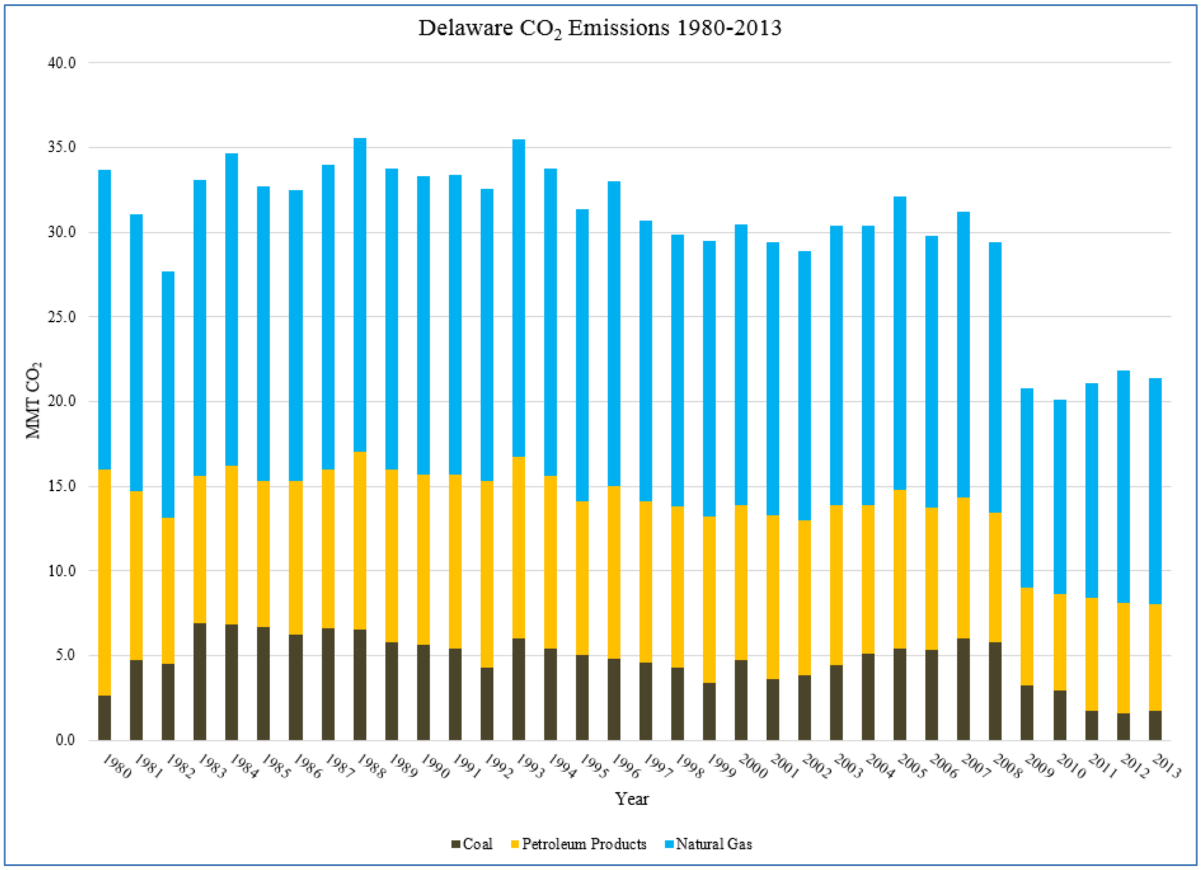
Table 4.1.14-2: Delaware CO_2 Emissions from Fossil Fuels by Fuel Type and Source, 2013

Fuel Type (MMT)		**Source (MMT)**	
Coal	1.7	Residential	0.9
Petroleum Products	6.3	Commercial	0.8
Natural Gas	5.3	Industrial	3.7
		Transportation	3.9
		Electric Power	4.1
TOTAL	**13.4**	**TOTAL**	**13.3**

Source: (EIA, 2015f)

The majority of Delaware's GHG emissions (93 percent) is CO_2 (DNREC, Division of Air Quality, 2012a). CO_2 emissions are the result of fossil fuel combustion (FFC) associated with space heating, transportation and, power. The remaining 7 percent comes from methane (1 percent), nitrous oxide (4 percent), and hydrofluorocarbons, sulfur hexafluoride, and perfluorocarbons; averaging 2 percent as a combined total (DNREC, Division of Air Quality, 2012a). Total U.S. GHG greenhouse were 6,673 million metric tons (14.7 trillion pounds) in 2013 (EIA, 2014). Overall, Delaware has lower (13.0 metric tons per-capita) energy-related GHG emissions in the U.S. (EIA, 2014).

Delaware completed its own GHG inventory in 2008. It divides CO_2 emissions into four main source categories: energy-related activities (93 percent), industrial processes (3 percent), agriculture activities (3 percent), and waste management (< 1 percent). Overall, energy related activities such as electric power generation, transportation, industrial, commercial, and residential had the greatest impact on GHG emissions in Delaware in 2008 (DNREC, Division of Air Quality, 2012a).



Source: (EIA, 2015f)

Figure 4.1.14-1: Delaware CO_2 Emissions from Fossil Fuels by Fuel Type 1980-2013

Because there were 15 different electric generation plants in Delaware, electric power generation accounted for the majority of GHG emissions in 2008 at 35 percent. Transportation accounted for 29 percent of FFC, which includes on-road and non-road vehicles such as "boats and other marine vessels, aviation, locomotive, construction and farm equipment" (DNREC, Division of Air Quality, 2012b). On-road gasoline vehicles emitted the largest amount of CO_2 totaling 89 percent. "Emissions from non-road vehicles were approximately 8 percent, while emissions from on-road diesel vehicles and alternative fuels vehicles were 2% and 1% respectively" (DNREC, Division of Air Quality, 2012a). Emissions growth coincided with an increase in Delaware's vehicle miles traveled (VMT) however, N_2O and CH_4 emissions declined. This could be due to improvements in engine technology and more efficient engine design (DNREC, Division of Air Quality, 2012a).

The industrial sector generated 27 percent of GHG emissions due to the consumption of petroleum, coal, and natural gas. GHG's emitted from industrial processes include: ozone depleting substances (61 percent), titanium dioxide Production (23 percent), electric power transmission and distribution systems (1 percent), iron and steel production (6 percent), crude oil refining (1 percent) and soda ash consumption (1 percent). Petroleum usage decreased in Delaware between 1990 and 2008, which resulted in a slight reduction in emissions from the industrial sector. CO_2 emissions decreased between 2004 and 2008 but this is likely from the economic downturn at the time. The commercial and residential section totaled 9 percent from petroleum and natural gas consumption from space heating. This sector often has shifting emission levels from year to year from weather patterns and the fluctuating price of fossil fuel and electricity (DNREC, Division of Air Quality, 2012a).

One of the main contributors to Delaware's reduction in GHG emissions has been the land use, land use change, and commercial forestry (LULUCF) sector. Between 1990 and 2008, the LULUCF sector sequestered (removed from the atmosphere) an annual average of 1.5 MMT of CO_2 from the atmosphere due to Delaware's agricultural base and improved practices that minimize emissions (DNREC, Division of Air Quality, 2012a).

4.1.14.4. 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).

Delaware lies along the Atlantic Ocean, with much of the state considered coastal. Delaware is also adjacent to the Delaware Bay and the Chesapeake Bay. The Köppen-Geiger climate classification system classifies Delaware as (Cfa) (See Figure 4.1.14-2). Climates classified as (Cfa) are "moist subtropical mid-latitude climates" (NWS, 2011a) (NWS, 2011b). In (C) climate groups, temperatures are generally warm, with humid summers and mild winters (NWS, 2011a) (NWS, 2011b). Delaware's secondary classification indicates year-round rainfall, but it is highly variable; convective thunderstorms are dominant during summer months (NWS, 2011a) (NWS, 2011b). During winter months, "the main weather feature is the mid-latitude cyclone" (NWS, 2011a) (NWS, 2011b). The tertiary classification is indicative of mild, hot summers. In Cfa climates, temperatures are commonly mild, with hot summers and no dry season. Temperatures of warmer months are typically over 72 °F and temperatures of colder months are typically under 64 °F. Rainfall in Cfa climates is year round, but "highly variable" (NWS, 2011a) (NWS, 2011b).

This section discusses the current state of Delaware's climate with regard to temperature, precipitation, sea level, stream flow, and extreme weather events (e.g., tropical storms, tropical cyclones, and hurricanes) in Delaware's climate region, Cfa.

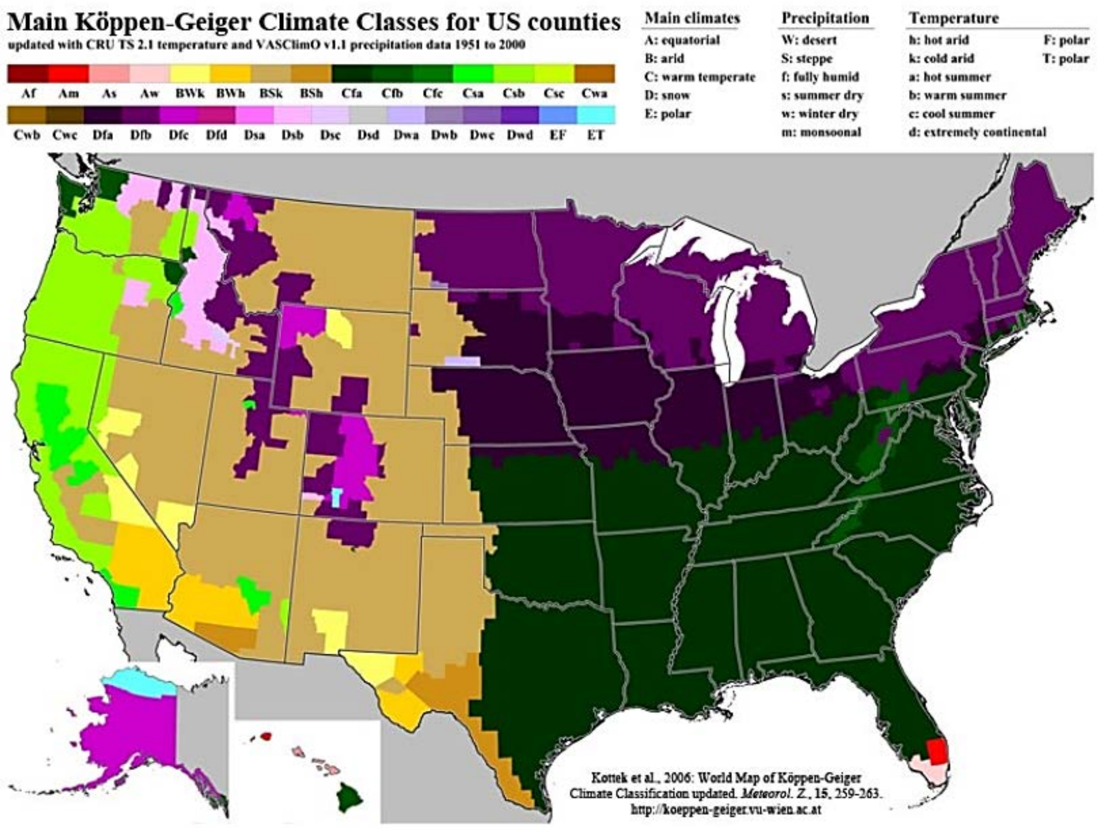


Figure 4.1.14-2: Köppen-Geiger Climate Classes for U.S. Counties

Source: (Kottek, 2006)

Air Temperature

Cities in close proximity to the Delaware River, Chesapeake Bay, or Atlantic Ocean have fewer temperature extremes than cities located in the interior of the state. The mean annual temperature within the interior portion of the state, such as New Castle, is 54 °F (NOAA, 2015g). In comparison, the mean annual temperature along the coast of Delaware is 58.1 °F (NOAA, 2015g). The average temperature for the entire state of Delaware is 54.2 °F (NOAA, 2015h). The highest temperature to occur in Delaware was on July 21, 1930 with a record high of 110 °F (SCEC, 2015). The coldest temperature to occur in Delaware was on January 17, 1893 with a record low of negative 17 °F (SCEC, 2015) (ODSC, 2015) (NOAA, 2015h) (NOAA, 2015g).

Dover, the capital of Delaware, is located in central part of the state. The average annual mean temperature in Dover is approximately 56.9 °F (NOAA, 2015g). The average temperature in Dover during winter months is 37.5 °F; the average temperature during summer months is 75.7 °F; the average temperature during spring months is 54.8 °F; and the average temperature during autumn months is 59.2 °F (NOAA, 2015g). Since 1901, the temperature in Dover has increased by 1.7 °F (USEPA, 1997) (NOAA, 2015h) (NOAA, 2015g) (USEPA, 1997).

Precipitation

Delaware is classified as a continental Cfa climate, with "ample precipitation throughout the year." Weather systems from the Gulf of Mexico and the Atlantic Ocean are primarily responsible for transporting precipitation into Delaware through circulation patterns and storm systems. On average, the state receives an annual precipitation amount of 45 inches, with rainfall spread evenly across the state (ODSC, 2015). However, Wilmington receives an average of 41.62 inches of precipitation per year (NOAA, 2015g). The greatest 24-hour snowfall accumulation occurred in Dover, in July 1975, with 8.5 inches of rainfall (ODSC, 2015). In addition to rainfall, Delaware can also experience abundant snowfall, with an average annual snowfall accumulation of 16 inches. The greatest 24-hour snowfall accumulation also occurred in Dover in February 1979, with 35.9 inches of snowfall (ODSC, 2015). Since 1901, mean annual precipitation has increased "by up to 10 percent in some parts of the state" (ODSC, 2015) (USEPA, 1997) (NOAA, 2015h) (NOAA, 2015g) (NWS, 2011a) (NWS, 2011b).

Sea Level

Delaware has approximately 381 miles of shoreline (USEPA, 1997). This shoreline includes "barrier beaches, inland bays and productive estuaries, freshwater and saltwater marshes, tidal flats, and several islands" (USEPA, 1997). Rising sea levels could lead to extensive flooding of these low-lying areas, as well as "loss of coastal wetlands, erosion of beaches, saltwater contamination of drinking water, and decreased longevity of low-lying roads, causeways, and bridges" (USEPA, 1997). In addition, sea level rise will "increase the vulnerability of coastal areas to storms and associated flooding" (USEPA, 1997). Since 1900, sea level in Lewes has risen approximately one foot (mostly due to thermal expansion and land subsidence) (USEPA, 1997). As sea level continues to rise, the risks associated with living along the coast also rise. Superstorm Sandy highlighted the risks and vulnerabilities of living near unprotected tidal shoreline (USEPA, 1997) (DNREC, 2009b).

Severe Weather Events

Due to Delaware's close proximity to the Atlantic Ocean, the Delaware River, and the Chesapeake Bay, the state regularly experiences flooding. Delaware is also affected by seasonally occurring severe weather, including "winter and spring nor'easters that can drop heavy snow and cause coastal flooding" (ODSC, 2015). During autumn months, Delaware frequently experiences "tropical systems with high winds, coastal flooding, and heavy rainfall" (ODSC, 2015). Severe thunderstorms are common during spring and summer months (ODSC, 2015).

Delaware is located directly adjacent to the Atlantic Ocean, the Delaware River, and the Chesapeake Bay, making the state highly vulnerable to coastal storms and tidal flooding. However, flooding in Delaware is most commonly caused by high intensity storms that lead to flash flooding. Additionally, Delaware is susceptible to riverine flooding, which can occur due to excessive or rapid snowmelt, ice flows, and heavy rainfall (NWS, 2015a). One of the most costly, widespread, and damaging floods to occur was in March 1962 (NWS, 2015a). This historic flood was caused by merging low-pressure systems along the East Coast, which resulted in waves over 40 feet off Rehoboth beach (NWS, 2015a). In the Rehoboth Beach surf zone, waves exceeded 30 feet and destroyed the boardwalk and homes along the beach (NWS, 2015a). Winds reached 80 mph (NWS, 2015a). Ultimately, the storm was responsible for seven deaths in Delaware and more than $500 million dollars in damage (NWS, 2015a). Although it is uncommon for hurricanes to travel inshore once they make landfall, storms can re-intensify if they come into contact and combine with pre-existing low-pressure storms (Ho, Su, Hanevich, Smith, & Richards, 1987) (NWS, 2015a).

4.1.15. Human Health and Safety

4.1.15.1. Definition of the Resource

The existing environment for health and safety is defined by occupational and environmental hazards likely to be encountered during the deployment, 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 deployment 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 4.1.1, Infrastructure.

4.1.15.2. Specific Regulatory Considerations

Federal organizations, such as OSHA, USEPA, the U.S. Department of Health and Human Services, and others protect human health and the environment. In Delaware, occupational safety is regulated by the Delaware Department of Labor (DEDOL), Delaware Department of Health and Social Services (DEDHSS), and DNREC regulates environmental pollution.

Federal laws relevant to protecting occupational and public health and safety are summarized in Appendix C. Table 4.1.15-1 below summarizes the major Delaware laws relevant to the state’s occupational health and safety, hazardous materials, and hazardous waste management programs.

Table 4.1.15-1: Relevant Delaware Human Health and Safety Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Delaware Code, Title 19, Labor; Title 16, Health and Safety	Delaware Department of Labor (DEDOL); Delaware Department of Health and Social Services (DEDHSS)	Specifies requirements for occupational health and safety and labor management in Delaware.
Delaware Code, Title 7, Chapter 60, Regulations Governing Solid Waste	DNREC, Division of Waste and Hazardous Substances	Specifies requirements for solid waste storage, collection, transportation, processing, transfer, and disposal management.
7 Delaware Code, Part VII, Chapters 63 and 74	DNREC, Division of Waste and Hazardous Substances	Specifies requirements for storage, transportation, treatment, and disposal of hazardous waste and underground storage tanks.
7 Delaware Code Part IX, Hazardous Substance Cleanups	DNREC, Division of Waste and Hazardous Substances, Site Investigation and Restoration Section	Specifies requirements for hazardous substance cleanups in order to protect public health and environment.
Appalachian States Low-Level Radioactive Waste Compact	Governor of Delaware	Specifies that Low-Level Radioactive waste disposal must be regionally managed and coordinated.
29 Delaware Code Chapter 82	Delaware Department of Safety and Homeland Security	Specifies responsibilities for all divisions within the Department of Safety and Homeland security, including emergency management.
16 Delaware Code 66, “Fire Prevention”	Office of the State Fire Marshal	Specifies requirements for fire prevention and control, including permitting and notification system for hazardous processes.

4.1.15.3. 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 are often performed at dangerous heights, inside trenches 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, 2016). 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, 2015). 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.

Trenches and confined spaces – Installation of underground utilities, building foundations, and work in utility manholes[108] 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 movement is restricted and may prevent a rapid escape or interfere with proper work posture and ergonomics.

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.

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.

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 (International Finance Corporation, 2007). Additionally, fusion splicing (to join optical fibers) in confined spaces or other environments with the potential for flammable gas accumulation (e.g., manholes) 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 4.1.13, Noise) (OSHA, 2002). Fugitive noise

[108] 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.

may emanate beyond the telecommunication work site and affect the public living in the vicinity, observing the work, or transiting through the area.

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 treatments, such as pesticide application. Secondary hazardous materials, like exhaust fumes, may be a greater health risk than the primary hazardous material (i.e., 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 general 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.

Aquatic environments – Installation of telecommunication lines may include laying, burying, or boring lines under waterways and wetlands, such as lakes, rivers, ponds, or 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.

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), and 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, Delaware employed an estimated 690 telecommunication equipment installers and repairers, and 420 telecommunication line installers and repairers (Figure 4.1.15-1) (BLS, 2015c). In 2013, the most recent year that data are available, Delaware had no nonfatal occupational injuries or illnesses in the telecommunications industry (BLS, 2015d). By comparison, there were 2.1 nonfatal occupational injuries or illnesses reported nationwide per 100 full-time workers in the telecommunications industry (BLS, 2014a).

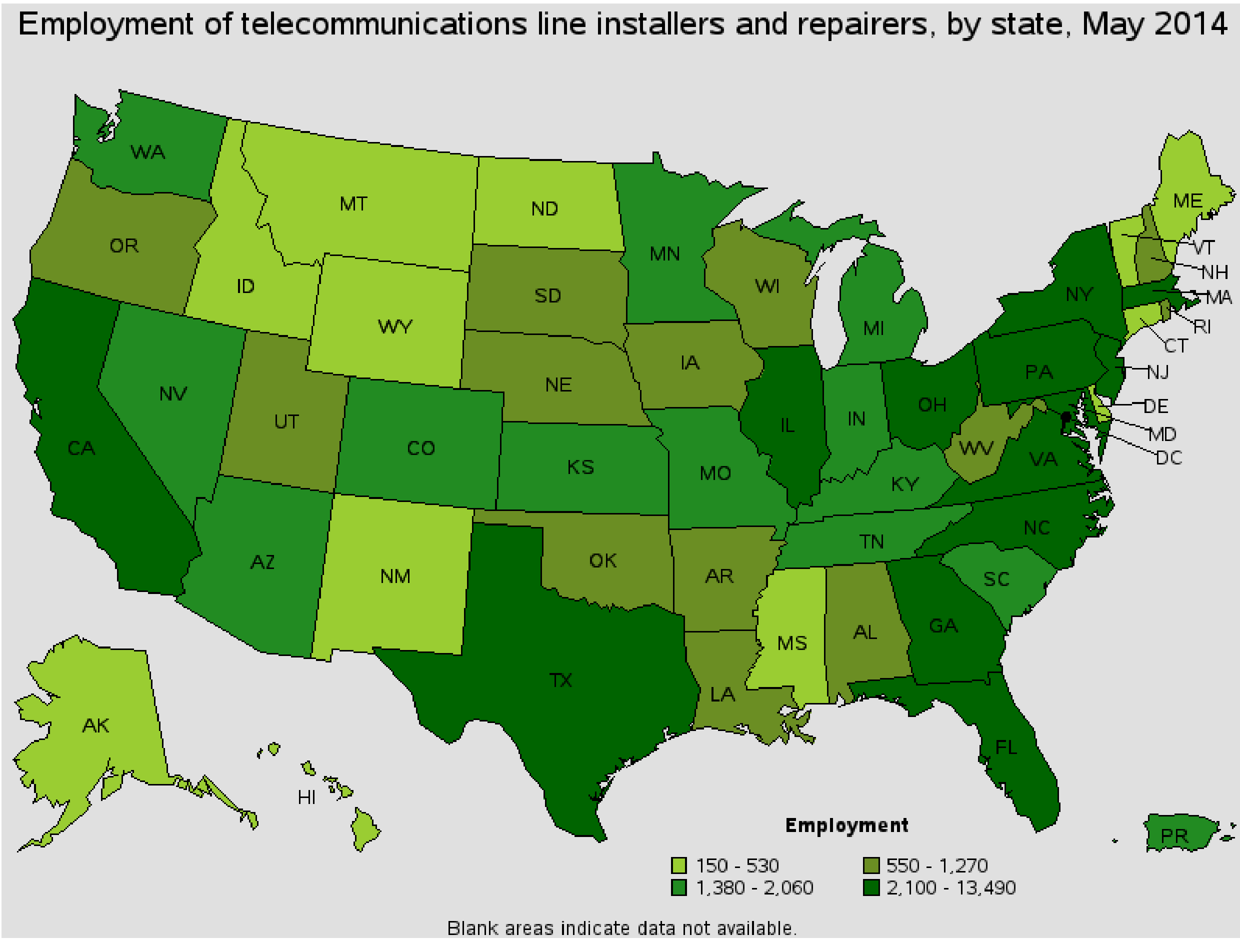


Figure 4.1.15-1: Number of Telecommunication Line Installers and Repairers Employed per State, May 2014

Source: (BLS, 2015e)

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, 2013). This represents 45 percent of the broader information industry fatalities (40 total), and less than 1 percent of total occupational fatalities (4,585 total). Delaware had no fatalities in the telecommunications industry or telecommunications occupations since 2003, when data are first available (BLS, 2015f).

Public Health and Safety

The general public are not likely to encounter occupational hazards at telecommunication sites, due to limited access. Delaware has not recorded incidents of injuries from the public to these sites. Among the general public, trespassers entering telecommunication sites would be at the greatest risk for exposure to the anticipated health and safety hazards.

4.1.15.4. 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 site occupants at telecommunication sites, prior to creation of 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[109] 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.

In Delaware, the Hazardous Substance Cleanup Program (also known as the State Superfund Program) is used to identify, investigate, and remediate sites with a release or imminent threat of hazardous substance release. Delaware has identified approximately 874 potentially hazardous substance release sites. Sites are ranked as High, Intermediate, or Low according to Delaware Hazard Ranking model, with High indicating an imminent threat to public health or environment and has the highest priority to receive state cleanup funding. Brownfields in Delaware are managed through the Brownfield Development Program (DNREC, 2013c). Delaware's Regulations Governing Hazardous Substance Cleanup describe standards which must be met to achieve safe reuse of a contaminated site (DNREC, 2012b).

As of August 2015, Delaware has 16 RCRA Corrective Action sites[110] and an estimated 115 brownfield sites (USEPA, 2013c), as well as 15 proposed or final Superfund/NPL sites (National Institute of Health, 2015a). Based on a September 2015 search of USEPA's Cleanups in My Community (CIMC) database, there is one Superfund site in Delaware where contamination has

[109] 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, Environmental Laws and Regulations (USEPA, 2011b).

[110] Data gathered using USEPA's CIMC search on July 21, 2015, for all sites in Delaware State, 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)

been detected at an unsafe level, or a reasonable human exposure risk still exists (Koppers Co, Inc.) (USEPA, 2015i).

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 August 2015, Delaware has 628 TRI reporting facilities (National Institute of Health, 2015a). According to the USEPA, in 2013, the most recent data available, Delaware released 5,520,713 pounds of toxic chemicals through onsite and offsite disposal, transfer, or other releases, largely from petroleum refineries. This accounted for 0.13 percent of total nationwide TRI releases, ranking Delaware 7 of 56 states and territories (USEPA, 2014c).

Another USEPA program is the National Pollutant Discharge Elimination System (NPDES), which regulates the quality of stormwater 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.

The National Institute of Health, 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" (National Institute of Health, 2015b). Figure 4.1.15 2 provides an overview of potentially hazardous sites in Delaware.

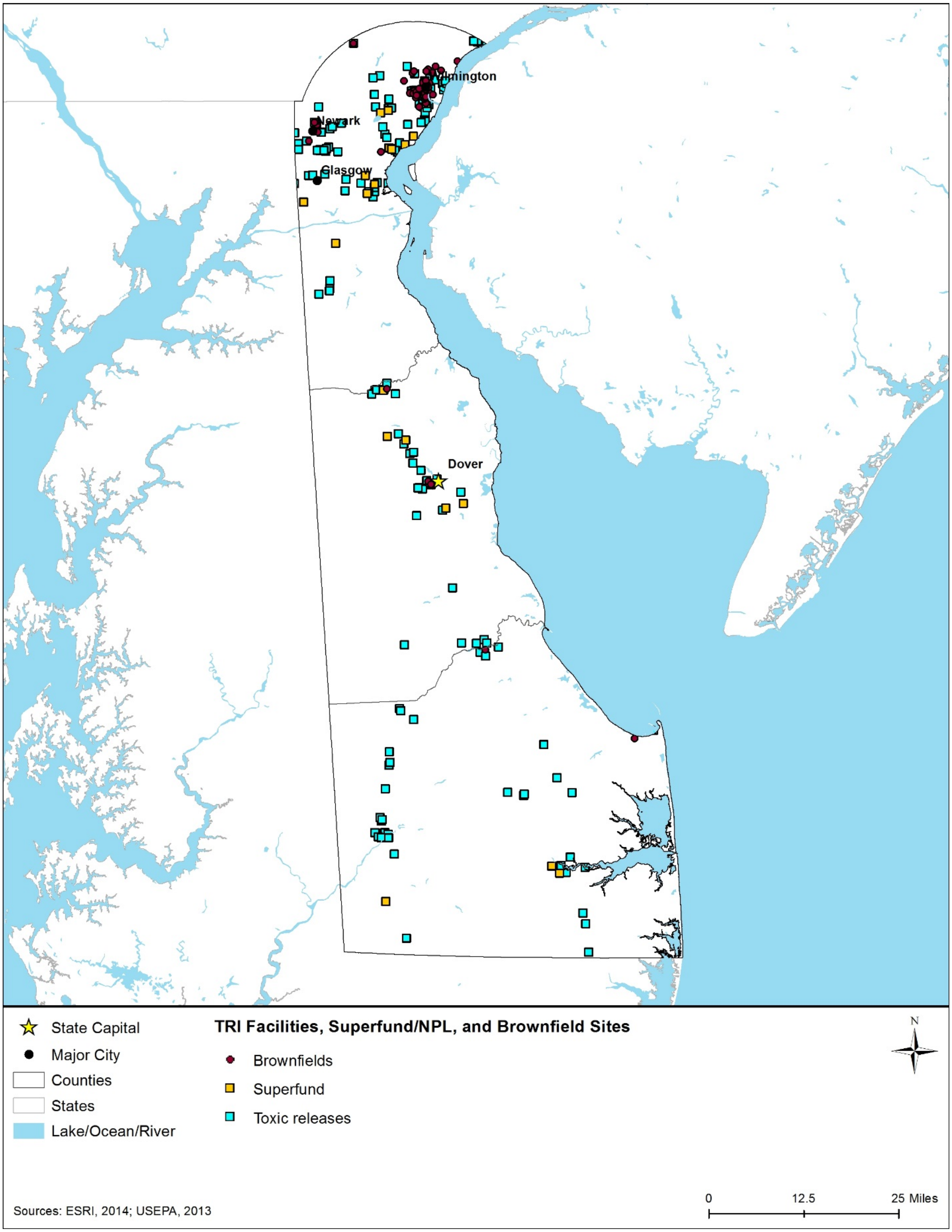


Figure 4.1.15-2: TOXMAP Superfund/NPL and TRI Facilities in Delaware (2013)

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 be impacted from vapor intrusion infiltrating indoors from contaminated soil or groundwater that are present beneath a building's foundation. DEDHSS has not reported any statistics relating to occupational exposure to environmental contamination (DEDHSS, 2015). According to BLS data, Delaware has not reported fatalities in the telecommunications industry or telecommunications occupations since 2003, when data are first available (BLS, 2015f). In 2013, there were 11 total fatal occupational injuries in Delaware across all industries, however, none of these resulted from exposure to harmful substances or environments (BLS, 2015g). By comparison, BLS reported three fatalities in 2011 and three preliminary fatalities in 2014 nationwide within the telecommunications industry (NAICS code 517), due to exposure to harmful substances or environments (BLS, 2015f). In 2014, BLS also reported four "preliminary" fatalities 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, 2014b).

In addition to hazardous waste contamination, another health and safety hazard includes surface and subterranean mines. Health and safety hazards known to be present 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). Gradual settling or sudden sinking of the Earth's surface, also known as subsidence, presents additional risks and is further discussed in Section 4.4.4.3, Geology. As of May 2015, there were no high priority AMLs in Delaware (U.S. Department of the Interior, Office of Surface Mining Reclamation and Enforcement, 2015), therefore hazards relating to mines will not be discussed further.

Public Health and Safety

As described earlier, access to telecommunication sites is nearly always restricted to occupational workers. Although site access control is one of the major reasons telecommunication 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 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 DEDHSS, Division of Public Health (DPH) is responsible for collecting public health data resulting from exposure to environmental contamination. No data are available from DPH (DEDHSS, 2015) or federal sources (CDC, 2015) that indicate public exposure to environmental hazards at contaminated sites, including telecom sites, resulted in public illnesses or fatalities.

4.1.15.5. Environmental Setting: Natural and Manmade Disaster Sites

Spotlight on Delaware Superfund Sites: Standard Chlorine of Delaware, Inc. (Metachem)
Standard Chlorine of Delaware, Inc. (also known as Metachem), manufactured chlorinated benzene compounds from 1966 to 2002, and is the largest Superfund site in Delaware. The facility has numerous historical environmental compliance violations, including a major chemical spill in 1981 while filling a railroad tank car that spilled 5,000 gallons of chlorobenzene, followed by a second incident in 1986 where more than 560,000 gallons of toxic chemicals spilled due to a tank collapse (Agency for Toxic Substance & Release Registry, 2003). The site was placed on the NPL in 1987 when 40 million pounds of chlorobenzenes were found in soil, sediments, groundwater, surface water, and wetlands near Red Lion Creek. Additional chemical contamination is present in deteriorating tanks, pipelines, process vessels and treatment systems" (DNREC, Division of Waste and Hazardous Substances, 2016).

Figure 4.1.15-3*:* Photo of Standard Chlorine/Metachem Superfund Site, New Castle, DE (2006)

Source: (USEPA, 2015l)

In 2002, the facility declared bankruptcy. Since then, the USEPA and partnering agencies have conducted multiple investigations and implemented interim remediation measures, including a groundwater cleanup system (subsurface barrier wall around the site and pump and treat system) in 2008, as well as dismantling and disposing of the facility. The USEPA is currently determining remediation options for the wetland area, groundwater, soil, and sediments, including a solar feasibility study (DNREC, Division of Waste and Hazardous Substances, 2016).

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.). Floodwaters are often contaminated by hazardous chemicals and sanitary wastes, which can cause headaches, skin rashes, dizziness, nausea, excitability, weakness, fatigue, and disease to exposed workers (OSHA, 2003).

Physical hazards may also be present at disaster sites, such as downed utility lines, debris blockage or road washout conditions, which increases exposure risks to telecommunication workers. Climbing and working from tower structures damaged by wind increases the risk of slips, trips, or falls. During natural and manmade disasters, access to the telecommunication sites can be obstructed by debris.

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. 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, the DEDOL 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, 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 63 NRC-reported incidents for Delaware in 2015 with known causes, 3 incidents were attributed to natural disaster (e.g., earthquake, flood, hurricane, tornado, or other natural phenomenon), while 60 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 (U.S. Coast Guard, 2015).

Public Health and Safety

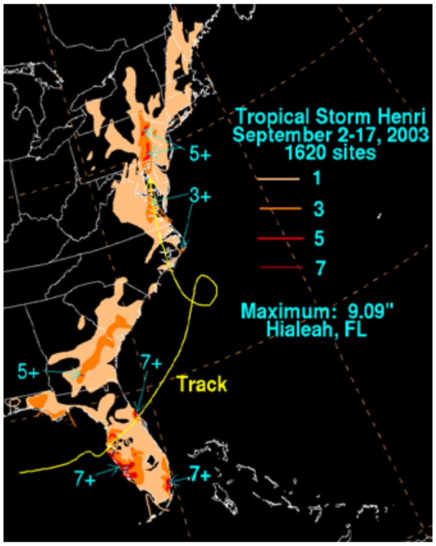
Hazards present during natural and manmade disasters are often ubiquitous, affecting large geographic areas and affecting all populations living within the area. Similar to telecommunication workers, the general public faces risks during these types of disasters, such as compromised transportation infrastructure and utilities, potential for exposure to unknown chemical and biologic hazards, and inadequate medical support.

In 2003, Delaware was impacted by Tropical Storm Henri, which caused extensive flooding in the area. Only days later, Delaware was hit again by Hurricane Isabel, the most powerful hurricane in 2003. Delaware experienced massive wave and wind surge, causing approximately $20 million in economic losses (NOAA, 2004). The storm caused trees to fall on the power lines and caused significant power outages for over 6.5 million customers (NOAA, 2004) (National Energy Technology Laboratory, 2003). In 2014, Delaware experienced one weather-related fatality and three injuries (NWS, 2015b).

Spotlight on Delaware Natural Disaster Sites: 2003 Tropical Storm Henri Flooding

In September 2003, the Red Clay Creek watershed and Northern New Castle County areas experienced a record 500-year flood following Tropical Storm Henri (NWS, 2015c). Thunderstorms with torrential downpour generated 1 to 10 inches of heavy rain, setting record crest levels for the Red Clay Creek area (Figure 4.1.15-4) (NOAA, 2003). The flood damaged more than 100 houses, trapped people in cars and homes, and destroyed several bridges, creating hazards to both the public and workers restoring weather-damaged infrastructure. Total flood damages were estimated at $20 million (NWS, 2015c).

Figure 4.1.15-4: Tropical Storm Henri Rainfall



Source: (NOAA, 2015l)

4.2. 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 categories of impacts are 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, include the No Action Alternative. The No Action 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.

4.2.1. Infrastructure

4.2.1.1. Introduction

This section describes potential impacts to infrastructure in Delaware associated with construction, deployment, and operation of the Proposed Action and alternatives. See Chapter 17, BMPs and Mitigation Measures, for 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.

4.2.1.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on infrastructure were evaluated using the significance criteria presented in Table 4.1.2-1. 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 infrastructure addressed in this section are presented as a range of possible impacts.

Table 4.2.1-1: 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

4.2.1.3. 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., departments of transportation, airport authorities, railway companies, and harbormasters) to ensure proper coordination during deployment. Based on the impact significance criteria presented in Table 4.1.2-1, such impacts would be less than significant due to the temporary nature of the deployment activities, even if such impacts would be realized at one or more isolated locations. Such 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

The capacity of local health, public safety, and emergency response services would experience less than significant impacts during deployment 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 – and that is 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 first responders 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 4.1.2-1, such potential negative and positive impacts would be less than significant.

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 4.1.2-1, 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 compliment such practices and SOPs in a positive manner; therefore, only beneficial or complimentary impacts would be anticipated. Public safety communication capabilities and response times would be expected to also experience such beneficial impacts through enhance communications abilities. It is possible that FirstNet would be upgrading physical telecommunications infrastructure, thus such 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.

Effects to Commercial Telecommunication Systems, Communications, or Level of Service

Commercial telecommunication systems, communications, or level of service would experience no impacts, as such commercial assets would 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.[111] 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 4.1.2-1.

Effects to Utilities, including Electric Power Transmission Facilities, and Water and Sewer Facilities

The activities proposed by FirstNet would have less than significant impacts on utilities, including electric power transmission facilities, and water and sewer facilities. 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. Also, 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.

4.2.1.4. Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment, and operation activities.

[111] 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.

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 to 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 (POPs),[112] 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 limited nearshore or inland 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, there 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

[112] Points of Presence are connections or access points between two different networks, or different components of one network.

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 can 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 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 COWs, COLTs, and 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 launched or recovered on 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 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. See Chapter 17, BMPs and Mitigation Measures, for 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.

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 also 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 also minimize disruptions and misinformation resulting from limited or disrupted service.

4.2.1.5. Alternatives Impact Assessment

The following section assesses potential impacts to infrastructure associated with the Deployable Technologies Alternative and the No Action Alternative.[113]

[113] As mentioned above and in Section 2.1.2, Proposed Action Infrastructure, the Preferred Alternative includes implementation of deployable technologies.

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 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.

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 roads or utility ROWs, or if additional maintenance-related construction activities occur within public road and utility ROWs, less than significant impacts would likely still occur to transportation systems or utility services due to the limited amount of new infrastructure needed to accommodate the deployables.

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 4.1.1, Infrastructure. The state also would not realize positive, beneficial impacts to infrastructure resources described above.

4.2.2. Soils

4.2.2.1. Introduction

This section describes potential impacts to soil resources in Delaware associated with deployment and operation of the Proposed Action and alternatives. See Chapter 17, BMPs and Mitigation Measures, for 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.

4.2.2.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on soil resources were evaluated using the significance criteria presented in Table 4.2.2-1. 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.

4.2.2.3. Description of Environmental Concerns

Soil Erosion

Soil erosion is an environmental concern of 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 Delaware and other states with similar geography and weather patterns is the erosion of construction site soils to natural waterways, where the sediment can impair water and habitat quality, and potentially affect aquatic plants and animals (NRCS, 2000). Areas exist in Delaware that have steep slopes (i.e., greater than 20 percent) or where the erosion potential is medium to high, including locations with Aquepts, Aquults, Hemists, Orthents, Udalfs, Udepts, and Udults (see Section 4.1.2.4, Soil Suborders and Figure 4.1.2-2).

Based on the impact significance criteria presented in Table 4.2.2-1, 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 given the short-term and temporary duration of the activities.

Table 4.2.2-1: Impact Significance Rating Criteria for Soils

Type of Effect	Effect Characteristic	Impact Level: Potentially Significant	Impact Level: Less than Significant with BMPs and Mitigation Measures Incorporated	Impact Level: Less than Significant	Impact Level: 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

For the majority of projects, impacts to soils would be expected to be less than significant 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 to avoid or minimize impacts, and minimize the periods when exposed soil is open to precipitation and wind (see Chapter 17).

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 4.2.2-1, and due to the relatively small-scale (less than 1 acre) of most FirstNet project sites, as well as the implementation of BMPs and mitigation measures (Chapter 17), minimal topsoil mixing is anticipated.

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. Heavy equipment can cause perceptible compaction and rutting of susceptible soils, particularly if BMPs and mitigation measures are not implemented.

Soils with the highest potential for compaction or rutting were identified by using the STATSGO2 database (see Section 4.1.2.3, Soil Suborders). The most compaction susceptible soils in Delaware are hydric soils with poor drainage conditions, which include Aquepts, Aquults, and Hemists. These suborders constitute approximately 24 percent of Delaware's land area,[114] and are found across the state, particularly along coastal areas (see Figure 4.1.2-2). 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 4.2.2-1, the risk of soil compaction and rutting resulting from FirstNet deployment activities would be less than significant due to the extent of susceptible soils in the state.

4.2.2.4. Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operation activities.

[114] 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.

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 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 is required to light dark fiber, it would be through existing hand holes, pulling vaults, junction boxes, huts, and similar existing structures.
- 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.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the nationwide public safety broadband network (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 soil resources, it is anticipated that this activity would have no impact to soil resources.

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 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 limited nearshore and inland bodies of water could potentially impact soil resources at and near the landings or facilities on shore to accept 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 less than significant, given the relative small-scale and short-term duration.

- 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 the on-site delivery of 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, 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 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 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. See Chapter 17, BMPs and Mitigation Measures, for 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 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. 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. These impacts are expected to be less than significant due to the temporary nature and small-scale of operations activities with the potential to create impacts. See Chapter 17, BMPs and Mitigation Measures, for 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.

4.2.2.5. 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 if deployment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. In addition, 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. See Chapter 17, BMPs and Mitigation Measures, for 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 soil resources associated with routine inspections of deployable assets, 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 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 as described above. See Chapter 17, BMPs and Mitigation Measures, for 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 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 4.1.2, Soils.

4.2.3. Geology

4.2.3.1. Introduction

This section describes potential impacts to Delaware geology resources associated with deployment and operation of the Proposed Action and alternatives. See Chapter 17, BMPs and Mitigation Measures, for 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.

4.2.3.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on geology resources were evaluated using the significance criteria presented in Table 4.2.3-1. 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 4.2.3-1: Impact Significance Rating Criteria for Geology

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs 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 BMPs 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
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
Paleontological Resources impacts	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 BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
	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

4.2.3.3. 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, 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

As discussed in Section 4.1.3.8, Delaware is not at risk to significant earthquake events. Based on the impact significance criteria presented in Table 4.2.3-1, 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 or active fault zones. Given the potential for minor earthquakes in or near Delaware, some amount of infrastructure could be subject to earthquake hazards, in which case BMPs and mitigation measures (see Chapter 17) could help avoid or minimize the potential impacts.

Volcanic Activity

Volcanoes were considered but not analyzed for Delaware, as they do not occur in Delaware; therefore, volcanoes do not present a hazard to the state.

Landslides

As discussed in Section 4.1.3.8, the majority of Delaware is at low risk of experiencing landslide events. Based on the impact significance criteria presented in Table 4.2.3-1, 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. 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. The highest potential for landslides in Delaware is in the Piedmont Province along the Delaware River. To the extent practicable, FirstNet would avoid deployment in areas that are susceptible to landslide events. However, given that several of Delaware's major cities, including Wilmington, Newark, and Glasgow, are in areas that experience landslides with moderate frequency, some amount of infrastructure could be subject to landslide hazards, in which case BMPs and mitigation measures (see Chapter 17) could help avoid or minimize the potential impacts.

Land Subsidence

As discussed in Section 4.1.3.8, portions of Delaware are vulnerable to land subsidence due to karst topography. Based on the impact significance criteria presented in Table 4.2.3-1, 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 to the Proposed Action if FirstNet's deployment locations were within areas at high risk to karst topography or inundation due to long-term land subsidence. Equipment that is exposed to land subsidence, such as sinkholes created by karst topography 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[115] and inundation of equipment. All of these activities could result in connectivity loss. To the extent practicable, FirstNet would avoid deployment in known areas of karst topography or in areas that are subject to sea level rise. However, where infrastructure is subject to landslide hazards, BMPs and mitigation measures, as discussed in Chapter 17, could help avoid or minimize the potential impacts.

Mineral and Fossil Fuel Resource Impacts

Equipment deployment near mineral and fossil fuel resources are 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 4.2.3-1 impacts to mineral and fossil fuel resources are unlikely as the Proposed Action could only be potentially significant if FirstNet's deployment locations were to cause severe, widespread, observable impacts to mineral and/or fossil fuel resources.

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 4.2.3-1, impacts to paleontological resources could be potentially significant if FirstNet's buildout/deployment locations uncovered paleontological resources during construction activities. As discussed in Section 4.1.3.8, fossils are abundant in parts of Delaware especially near the Chesapeake and Delaware Canal, and in Kent County. 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 fossil resources should be considered on a site-by-site basis, and BMPs and mitigation measures (see Chapter 17) may be required help avoid or minimize the 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 4.2.3-1, impacts could be potentially significant if FirstNet's deployment were to cause substantial and measurable degradation or alteration of surface

[115] 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)

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 (see Chapter 17) could be implemented to help avoid or minimize the potential impacts.

4.2.3.4. 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 to 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 limited nearshore or inland 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 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 perturbation 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 the on-site delivery of 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, 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. 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. However, where equipment is permanently 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 include minimal removal of bedrock or mineral resources, or adverse impacts to installed equipment resulting from geologic hazards (e.g., seismic hazards, landslides, and land subsidence). Specific FirstNet projects 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. These potential impacts are expected to be less than significant. See Chapter 17, BMPs and Mitigation Measures, for 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 geology associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections.

The operation of the Preferred 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 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. See Chapter 17, BMPs and Mitigation Measures, for 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.

4.2.3.5. 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 due to the minor amount of paving or new infrastructure needed to accommodate the deployables. See Chapter 17, BMPs and Mitigation Measures, for 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 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 Alternative.

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 as the deployment would be temporary and likely would attempt to avoid locations that was subject to increased seismic activity, landslides, and land subsidence. See Chapter 17, BMPs and Mitigation Measures, for 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 geologic resources (or from geologic hazards) as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 4.1.3, Geology.

4.2.4. Water Resources

4.2.4.1. Introduction

This section describes potential impacts to water resources in Delaware associated with deployment and operation of the Proposed Action and alternatives. See Chapter 17, BMPs and Mitigation Measures, for 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.

4.2.4.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on water resources were evaluated using the significance criteria presented in Table 4.2.4-1. 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.

4.2.4.3. 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 303(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.

All of the surface waters in the state have been degraded to some extent. According to DNREC's 2012 statewide waters assessment, most of Delaware's rivers and streams (86 percent) and almost half of the state's freshwater ponds and lakes (44 percent) do not fully support swimming or fishing due to nonpoint source pollution[116] impacts and "bacteria concentrations above the levels considered acceptable for primary contact recreation (swimming, bathing, and water skiing)" (DNREC, 2013a) (see Figure 4.1.4-4). In addition, high bacteria levels (above levels considered safe for shellfish harvesting and consumption) have affected Delaware's estuarine and tidal waters, including the Delaware Bay's tidal tributaries and portions of Delaware's Inland Bays Estuary. (DNREC, 2013a) Groundwater quality within the state is generally suitable for daily uses. Within the state, groundwater is predominantly soft or moderately hard, and slightly acidic (DNREC, 2013a).

[116] Nonpoint source pollution: a source of pollution that does not have an identifiable, specific physical location or a defined discharge point. Non-point source pollution includes nutrients that run off croplands, lawns, parking lots, streets and other land uses. It also includes nutrients that enter waterways via air pollution groundwater, or septic systems (USEPA, 2015b).

Table 4.2.4-1: Impact Significance Rating Criteria for Water Resources

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**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 subwatershed level.	NA
	Duration or Frequency	Chronic and long term changes not likely to be reversed over several years or seasons		The impact is temporary, lasting no more than six months.	NA
Floodplain degradation*	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 subwatershed level.	NA
	Duration or Frequency	Chronic and long term changes not likely to be reversed over several years or seasons		The 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 subwatershed level.	NA
	Duration or Frequency	Impact occurs in perennial streams, and is ongoing and permanent		The 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
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed 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 subwatershed level.	NA
	Duration or Frequency	Impact is ongoing and permanent		Potential impact is temporary, not lasting more than six months.	NA

* - 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).
NA = Not Applicable

Deployment activities can contribute pollutants in a number of ways but the primary manner is increased sediment in surface waters. Vegetation removal on site exposes soils to rain and wind that can 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 can 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 stormwater 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 could reduce potential impacts to surface water quality.

Expected deployment activities would not violate applicable state, federal (e.g., CWA, and Safe Drinking Water Act), and 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 4.2.4-1, 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[117] 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

[117] 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).

Delaware dewatering requirements. Any groundwater extracted during dewatering activities or as required by a dewatering permit would be treated prior to discharge or disposed of at a wastewater treatment facility.

Due to average thickness of most Delaware aquifers, there is potential for groundwater contamination within a watershed or multiple watersheds. Thus, it is unlikely that the majority of FirstNet's deployment locations would result in a drinking quality violation, or otherwise substantially degrade groundwater quality or aquifer, and based on the impact significance criteria presented in Table 4.2.4-1, there would likely be less than significant impacts on groundwater quality within most of the state. In areas where groundwater is close to the surface, then 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 humans, 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 flood. 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 4.2.4-1, floodplain degradation impacts would be potentially less than significant since the majority of FirstNet's likely deployment activities, on the watershed or subwatershed 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 be temporary, lasting no more than one season or water year,[118] or occur only during an emergency.

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.
- Limited clearing or grading activities.

Implementation of BMPs and mitigation measures would reduce the risk of additional impacts to floodplain degradation (see Chapter 17).

[118] 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, 2014j)

Drainage Pattern Alteration

Flooding and erosion from land disturbance can changes drainage patterns. Stormwater runoff causes erosion while construction activities and land clearing can change drainage patterns. Clearing or grading activities, or the creation of walls or berms, can alter water flow in an area or cause changes to drainage patterns. Drainage can be directed to stormwater drains, storage, and retention areas designed to slow water and allow sediments to settle out. Improperly handled drainage can cause increased erosion, changes in stormwater runoff, flooding, and damage to water quality. Existing drainage patterns can be modified by channeling (straightening or restructuring natural watercourses); creation of impoundments (detention basins, retention basins, and dams); stormwater increases; or altered flow patterns.

According to the significance criteria in Table 4.2.4-1, any temporary (lasting less than six months) alterations to drainage patterns that are minor and mimic natural processes or variations within the watershed or subwatershed 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 stormwater runoff.
- Where stormwater is contained on site and does not flow to or impact surface waterbodies off-site on other properties.
- Activities designed so that the amount of stormwater generated before construction is the same as afterwards.
- Activities designed using low impact development techniques for stormwater.

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, mitigation measures, and avoidance 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 can 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 can 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 4.2.4-1. 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 subwatershed 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 off site or into surface water bodies that have not received that volume of stormwater before, and
- Minor clearing or grading activities.

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, mitigation measures, and avoidance could be implemented to further reduce any impacts.

Changes in Groundwater or Aquifer Characteristics

As described in Section 4.1.4.7, 75 percent of drinking water used in New Castle County comes from streams in the Delaware River basin, and the remainder of the drinking water used in New Castle County is provided by groundwater. Kent and Sussex Counties rely solely on groundwater for drinking 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 Delaware's aquifers is suitable for daily water needs. Within the state, groundwater is predominantly soft or moderately hard, and slightly acidic (DNREC, 2013a). 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 unlikely cause any impacts to water quality. Activities that may cause changes is groundwater or aquifer characteristics include:

- Excavation or dredging during or after construction.
- Any liquid waste, including but not limited to wastewater, generation.
- 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 should be less than significant 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 4.2.4-1, 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.

4.2.4.4. 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, 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 to 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 limited nearshore and inland 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. See Chapter 17, BMPs and Mitigation Measures, for 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.

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 due to the limited geographic scale of individual activities and would likely return to baseline conditions once revegetation of disturbed areas is complete. BMPs to help mitigate or reduce any potential impacts are described in Chapter 17.

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.

4.2.4.5. 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 if the deployment occurred paved surfaces if there is any runoff into the surface water. 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. The amount of impact depends on the land area affected, installation technique, and location. Implementing the BMPs and mitigation measures identified in Chapter 17 could further avoid or reduce potential impacts. The activities could also result in indirect impacts on water quality if fuels leak into surface or groundwater.

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 less than significant 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 of established access roads or corridors and near waterbodies, the resulting ground disturbance could increase sedimentation in 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. 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 of time, 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. 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, depending on the 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.

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 4.1.4, Water Resources.

4.2.5. Wetlands

4.2.5.1. Introduction

This section describes potential impacts to wetlands in Delaware associated with deployment and operation of the Proposed Action and alternatives. See Chapter 17, BMPs and Mitigation Measures, for 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.

4.2.5.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on wetlands were evaluated using the significance criteria presented in Table 4.2.5-1. 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.

4.2.5.3. 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 project 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. Potential wetlands impacts can be further reduced by implementing BMPs and mitigation measures (see Chapter 17).

Table 4.2.5-1: Impact Significance Rating Criteria for Wetlands

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Direct wetland loss (fill or conversion to non-wetland)	Magnitude 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 404 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 subwatershed 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 subwatershed 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: [2] Change in Function(s)[3] 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 subwatershed 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

[1] "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.
[2] 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.
[3] 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

There are approximately 260,000 acres of wetlands throughout Delaware (USFWS, 2014a). Palustrine (freshwater) wetlands are found on river and lake floodplains across the state, and estuarine (tidal) wetlands are found around large coastal rivers, such as the Indian and Leipsic Rivers, Delaware Bay, and the inland bays of Rehoboth Bay, Indian River Bay, and Little Assawoman Bay (Tiner, Biddle, Jacobs, & Rogers, 2011).

Based on the impact significance criteria presented in Table 4.2.5-1, and given the temporary nature of most proposed activities, the deployment activities would most likely have less than significant direct impacts on wetlands. Additionally, most of the deployment activities would not violate applicable federal (e.g., CWA Section 404), state, and local regulations.

In Delaware, as discussed in Section 4.1.5.4, Wetlands, regulated high quality wetlands include palustrine tidal marshes, Atlantic white cedar swamps, coastal plain ponds, and interdunal swales,[119] as well the Delaware Bay Estuary, Inland Bays Estuary, and wetlands associated with critical resource waters (Delaware Estuary National Estuary Research Reserve).

- Palustrine tidal marshes provide habitat for a number of threatened plant species and are found primarily along the Christina River in northern Delaware and near the Nanticoke River in Southern Delaware (Tiner, R., 2001; DNREC, 2015j).
- Atlantic white cedar swamps are a type of PFO wetland characterized by acidic, highly organic, and poorly drained soils near floodplains. These swamps support unique species such as sundews and pitcher plants. Historically these swamps were extensive across the state but due to drainage and the timber industry, they are now limited to small stands in Sussex County along the floodplains of Cedar Creek and the Mispillion and Nanticoke Rivers. (Tiner, R., 2001; DNREC, 2015j).
- Coastal plain ponds, also known as Delmarva bays or potholes, are small, shallow, isolated, seasonally inundated, freshwater depressional wetlands located primarily in the inland region of the state in New Castle and Kent Counties. There are more than a thousand coastal plain ponds in Delaware, which provide critical habitat to numerous threatened and rare species of plants and animals and offer essential breeding areas for many amphibians. (DNREC, 2013c) (Tiner, R., 2001) (DNREC, 2015j)
- Bald cypress swamps are forested, permanently flooded wetlands (Figure 4.1.5-2). Dominated by bald cypress, these swamps occur primarily in southern Delaware within forested floodplains of creeks, rivers, and ponds such as Trussum Pond and Trap Pond in Sussex County. (Tiner 1985) (DNREC, 2015j)
- Interdunal swales are wetlands that occur in the low-lying areas between and behind dunes along the coastline. Delaware interdunal swales are found in Sussex County near the Delaware Bay and the Inland Bays. These wetlands provide habitat for many rare species and are important freshwater sources for organisms within the coastal dune systems. (McAvoy, W., 1994)

[119] See below for a description of interdunal swales.

- The Delaware Bay Estuary contains more than 400,000 acres of tidal and nontidal wetlands and was designated a Wetlands of International Significance by the Ramsar Convention on Wetlands in 1992 (Partnership for the Delaware Estuary, 2012).
- The Inland Bays Estuary feature tidal wetlands as well as some of Delaware's most rare nontidal wetlands, such as Atlantic white cedar swamps, sea-level fens, and interdunal swales. Currently, there are approximately 25,000 acres of nontidal wetlands and 9,000 acres of tidal wetlands in the Inland Bays Estuary. (Jacobs, Rogerson, Fillis, & Bason, 2009; Rogerson, Howard, & Jacobs, 2009)
- Under the USACE Nationwide Permit General Condition #22, Delaware provides additional protection for wetlands associated with critical resources waters, which includes the Delaware NERR (USACE, 2012a; NOAA, 2015c). The Delaware NERR consists of palustrine and estuarine wetlands and uplands at two sites, the Blackbird Creek Reserve and the St. Jones Reserve. The Blackbird Creek Reserve, in southern New Castle County features approximately 1,100 acres of palustrine tidal and nontidal wetlands. The St. Jones Reserve, in Kent County, contains approximately 5,100 acres of estuarine vegetated and nonvegetated wetlands and deepwater habitat. (NOAA, 2015c) (DNREC, 2015h)

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 be required, in addition to BMPs and mitigation measures to avoid potentially significant impacts to wetlands.

Potential Other Direct Effects

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, 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 stormwater discharges or water withdrawals that alter the functions of the wetlands.

Based on the impact significance criteria presented in Table 4.2.5-1, 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 project 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. Potential wetlands impacts can be further reduced by implementing BMPs and mitigation measures (see Chapter 17).

Examples of activities that could have other direct effects to wetlands in Delaware 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 stormwater runoff in wetlands can 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 can destroy native plant communities, as can depriving them of their water supply. Hydrologic changes can make a wetland more vulnerable to pollution. Increased water depths or flooding frequency can 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 can lead to degradation of wetlands that have a specific pH range and/or other parameter, such as the acidic conditions of Atlantic white cedar swamps and alkaline conditions of sea-level fens (which are high quality wetlands in Delaware).
- *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) can reduce light penetration, dissolved oxygen, and overall wetland productivity. Toxic materials in runoff can interfere with the biological processes of wetland plants, resulting in impaired growth, mortality, and changes in plant communities.

Indirect Effects:[120] Change in Function(s)[121] 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 can 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 project 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.

[120] 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.
[121] 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.

Potential wetlands impacts can be further reduced by implementing BMPs and mitigation measures (see Chapter 17). Examples of functions related to wetlands in Delaware that could potentially be impacted from construction-related deployment activities include:

- *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 can lower flood peaks by providing detention of storm flows.
- *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 can 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.
- *Wildlife Habitat:* Impacts on wetland hydrology and water quality affect wetland vegetation. While flooding can harm some wetland plant species, it promotes others. Shifts in plant communities because of hydrologic changes can 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 the significance criteria defined in Table 4.2.5-1, 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. Since the majority of the 260,000 acres of wetlands in Delaware are not considered high quality, deployment activities could have less than significant indirect impacts on wetlands in the state. BMPs and mitigation measures could be implemented, as feasible and practicable, to reduce potential impacts to all wetlands.

In areas of the state with high quality wetlands, there could be potentially significant impacts at the project level that would be analyzed on a case-by-case basis. If avoidance were not possible, BMPs and mitigation measures would help to mitigate impacts.

4.2.5.4. 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 satelites 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 to 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 limited nearshore and inland 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 reduce impact intensity.
- 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 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 the on-site delivery of 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, or blimps 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 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. See Chapter 17, BMPs and Mitigation Measures, for 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 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 not expected to be significant expected to be less than significant 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. See Chapter 17, BMPs and Mitigation Measures, for 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.

4.2.5.5. 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. See Chapter 17, BMPs and Mitigation Measures, for 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 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 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.

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 4.1.5, Wetlands.

4.2.6. Biological Resources

4.2.6.1. Introduction

This Chapter describes potential impacts to terrestrial vegetation, wildlife, fisheries and aquatic habitat, and threatened and endangered species in Delaware associated with deployment and operation of the Proposed Action and its alternatives. BMPs and mitigation measures that could be implemented, as appropriate, to avoid or minimize those potential impacts are identified in Chapter 17.

4.2.6.2. 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 4.2.6-1. 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 terrestrial vegetation, wildlife, and fisheries and aquatic habitat addressed in Sections 4.2.6.3, 4.2.6.4, and 4.6.2.5, respectively, are presented as a range of possible impacts.

Refer to Section 4.2.6.6 for impact assessment methodology and significance criterial associated with threatened and endangered species in Delaware.

4.2.6.3. Terrestrial Vegetation

Impacts to terrestrial vegetation occurring in Delaware 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 4.2.6-1, 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, these events are expected to be relatively small in scale. The implementation of BMPs and 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 perturbations that result in alterations in the amount or quality of a habitat. 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 loss or breaking down of continuous and connected habitat.

Construction of new infrastructure and long-term facility maintenance would result in the alteration of the type of vegetative communities in these localized areas, and in some instances the permanent loss of vegetation. Further, some limited amount of infrastructure may be built in sensitive or rare regional vegetative communities, in which case BMPs and mitigation measures would be recommended to minimize or avoid potential impacts.

Table 4.2.6-1: Impact Significance Rating Criteria for Terrestrial Vegetation, Wildlife, Fisheries, and Aquatic Habitats

Type of Effect	Effect Characteristic	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 mitigation 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 Delaware 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 Characteristic	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 mitigation 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 Delaware 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 Characteristic	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**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 mitigation 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 disturbancesare 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.

Type of Effect	Effect Characteristic	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
	Geographic Extent	Regional or site specific effects observed within Delaware 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
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 mitigation 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.

Type of Effect	Effect Characteristic	Impact Level: Potentially Significant	Impact Level: Less than Significant with BMPs and Mitigation Measures Incorporated	Impact Level: Less than Significant	Impact Level: No Impact
	Geographic Extent	Regional effects observed Delaware 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
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 mitigation 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.

Type of Effect	Effect Characteristic	Impact Level: Potentially Significant	Impact Level: Less than Significant with BMPs and Mitigation Measures Incorporated	Impact Level: Less than Significant	Impact Level: No Impact
	Geographic Extent	Regional effects observed within Delaware for at least one species. Anthropogenic disturbances that lead to exclusion from prey or habitat resources required for breeding/spawning, or anthropogenic disturbances, that lead to 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
Invasive Species Effects	Magnitude or Intensity	Extensive increase in invasive species populations over several seasons.	Effect that is potentially significant, but with mitigation 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.

Type of Effect	Effect Characteristic	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
	Geographic Extent	Regional impacts observed throughout Delaware.		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

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 can include stress related to disturbance. The alteration of soils or hydrology within a localized area can 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. Increasing or decreasing hydrology in an area as an indirect effect, could lead to moisture stress and/or mortality of plant species that are adapted to specific hydrologic regimes. Indirect injury/mortality impacts vary depending on the species, time of year and duration of construction or deployment, though BMPs and mitigation measures could help to minimize or avoid the 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 can have a dramatic effect on natural resources and biodiversity.

When non-native species are introduced into an ecosystem in which they did not evolve, their populations sometimes increase rapidly. Natural or native community species evolve together into an ecosystem with many checks and balances that limit the population growth of any one species. These checks and balances include such things as: predators, herbivores, diseases, parasites, and other organisms competing for the same resources and limiting environmental factors. However, when an organism is introduced into an ecosystem in which it did not evolve naturally, those limits may not exist and its numbers can sometimes dramatically increase. The unnaturally large population numbers can then have severe impacts to the environment, local economy, and human health. Invasive species can out-compete the native species for food and habitats and sometimes even cause their extinction. Even if natives are not completely eliminated, the ecosystem often becomes much less diverse.

The potential to introduce invasive plants within construction zones and during long-term site maintenance can 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 could help to minimize or avoid the potential for introducing invasive plant 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 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[122], and the nature as well as the extent of the habitats affected.

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 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 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 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

[122] Phenology is the seasonal changes in plant and animal lifecycles, such as emergence of insects or migration of birds.

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 to 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 if BMPs and mitigation measures are not implemented.
  - New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public right-of-ways (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 if BMPs and mitigation measures are not implemented.
  - 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 limited nearshore and inland 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 if BMPs and mitigation measures are not implemented.

- 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, the vegetation loss, and invasive species effects.

- Wireless Projects
  - New Wireless Communication Towers or Backhaul Equipment: 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 new 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 launching or recovery 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. These impacts are expected to be less than significant due to the small-scale of expected deployment activities. See Chapter 17, BMPs and Mitigation Measures, for 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, 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 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. 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 affect terrestrial vegetation 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. See Chapter 17, BMPs and Mitigation Measures, for 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.

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 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 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. However, impacts are expected to remain less than significant due to the relatively small-scale of FirstNet activities at individual locations. See Chapter 17, BMPs and Mitigation Measures, for 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. As with the Preferred Alternative, it is anticipated that there would be less than significant impacts to terrestrial vegetation associated with routine operations and maintenance due to the relatively small-scale of likely FirstNet project sites. The impacts can vary greatly among species, vegetative community, and geographic region, but are expected to remain less than significant.

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 4.1.6.3, Terrestrial Vegetation.

4.2.6.4. Wildlife

Impacts to amphibians and reptiles, terrestrial mammals, marine mammals, birds, and terrestrial invertebrates occurring in Delaware and Delaware's near offshore environment (i.e., less than two miles from the edge of the coast) 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 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 4.2.6-1, less than significant impacts would be anticipated given the anticipated small size and nature of the majority of the proposed deployment activities. Although anthropogenic disturbances may be measurable (although minimal) for some FirstNet projects, 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.

Terrestrial Mammals

Vehicle strikes are common sources of direct mortality or injury to both small and large mammals in Delaware. Mammals use roads to access mating or nesting sites, as preferred habitat in right-of-ways, for vegetation sources along roadways, or as a means of travel (FHWA, 2011b). 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.

If 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 the amount of 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 man-made cables and wires are environmental concerns for avian species and violate MBTA and BGEPA. Generally, collision events occur to “poor” fliers (e.g., ducks), night-migrating birds, 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 (Gehring, Kerlinger, & Manville, 2011).

Avian mortalities or injuries can also result from vehicle strikes, although typically occur as isolated events.

Direct injury and mortality of birds can 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 nesting 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 as these areas provide them with essential habitat that supports various life stages (Hill, D. et al., 1997). Direct injury/mortality are not anticipated to be widespread or affect bird populations due to the small-scale of likely FirstNet actions.

Direct mortality and injury to birds of Delaware are not likely to be widespread or affect populations of species as a whole; individual species impacts may be realized depending on the nature of the deployment activity. If siting considerations and BMPs and mitigation measures are implemented (Chapter 17), potential impacts could be minimized. Additionally, potential impacts under MBTA and BGEPA can be addressed through BMPs and mitigation measures developed in consultation with USFWS.

Reptiles and Amphibians

The majority of Delaware's amphibian and reptile species are widely distributed throughout Delaware. Direct mortality to amphibians or reptiles could occur in construction zones either by excavation activities or by vehicle strikes; however, these events are expected to be temporary and isolated, affecting only individual animals.

Four species of marine turtles – all listed as threatened or endangered under the ESA – occur in Delaware's offshore environment. Environmental consequences pertaining to these reptiles are discussed in Section 4.2.6.6, Threatened and Endangered Species and Species of Conservation Concern.

Terrestrial Invertebrates

The terrestrial invertebrate populations of Delaware 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

Habitat impacts are primarily physical perturbations that result in alterations in the amount or quality of a habitat. 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 loss or breaking down of continuous and connected habitat, and impeding access to resources and mates. There are areas in Delaware that have experienced extensive land use changes from urbanization and agriculture. However, there are portions of the state are forested and remain relatively unfragmented.

Additionally, habitat loss can 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.

Potential effects of vegetation and habitat loss, alteration, or fragmentation are described for Delaware's wildlife species below.

Terrestrial Mammals

Mammals occupy a wide range of habitats throughout Delaware and may experience localized effects of habitat loss or fragmentation. Removal or loss of vegetation may impact large mammals 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 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.

Marine Mammals

A number of seal species may occur in the offshore areas of Delaware. Harbor seals tend to be non-migratory; they can be found in open waters and also using rocks, beaches or other coastal habitats as haulouts and pupping sites in Delaware, particularly in Long Island Sound. Seals could be temporarily excluded from a resource or abandon their haulout locations due to the presence of humans, noise, or vessel traffic during deployment activities. For example, the seals would need to find a new haulout, likely at a less favorable location. Effects on seals from exclusion from resources would be low magnitude and temporary in duration.

Further, whales may be temporarily excluded from a resource if they avoid it due to the increased presence of boats, humans, and associated noise. Depending on the duration of response activities, whales could be excluded from their environment temporarily or could abandon the habitat entirely. Loss of habitat or exclusions from these areas for seals and whales could be avoided or minimized by BMPs and mitigation measures (see Chapter 17).

Birds

The direct removal of most bird nests are prohibited under the MBTA. The USFWS and DNREC (Hill, D. et al., 1997). The majority of FirstNet deployment activities would be short-term in nature, therefore repeated disturbances would not occur. Depending on the project type and location, individual species may be disturbed resulting in less than significant impacts.

Reptiles and Amphibians

Changes in water quality and quantity, especially during the breeding seasons, can cause stress resulting in lower productivity. The majority of FirstNet deployment activities would be short-term in nature, therefore repeated disturbances would not occur. Depending on the project type and location, individual species may be disturbed resulting in less than significant impacts.

Terrestrial Invertebrates

Terrestrial invertebrates can 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 the state, and given the short-term nature of most of the deployment activities, this impact would likely be less than significant.

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. Potential effects to migration patterns of Delaware amphibians and reptiles, terrestrial mammals, marine mammals, birds, and terrestrial invertebrates are described below.

<u>Terrestrial Mammals</u>

Large game animals have well-defined migratory routes. Route knowledge is passed on from one generation to the next and includes important feeding and calving areas. Small mammals also have migratory routes that include spring and fall roosting areas between their summer maternity roosts and hibernacula[123]. 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 can vary depending on the species, time of year of construction/operation, and duration, but are generally expected to be less than significant. BMPs and mitigation measures could help to further avoid or minimize the potential impacts.

<u>Marine Mammals</u>

Noise associated with the installation of cables in the near/offshore waters of coastal Delaware 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[124]. It is clear that behavioral responses are strongly affected by the context of exposure and by the animal's experience, motivation, and conditioning. Marine mammals have the capacity to divert from sound sources during migration, and impacts are expected to be less than significant. BMPs and mitigation measures could help to further avoid or minimize the potential impacts.

<u>Birds</u>

Because many birds have extremely long migrations, protection efforts for critical sites along migratory routes must be coordinated over vast distances often involving many different countries. For example, as a group shorebirds undertake some of the longest-distance migrations of all animals. Delaware is located within the Atlantic Flyway, which spans more than 3,000 miles from the Arctic tundra to the Caribbean. Delaware has 27 IBAs spread throughout the state that serve as important stopover areas for migratory birds (National Audubon Society, 2015). Many migratory routes are passed from one generation to the next. Impacts can vary (e.g.,

[123] A location chosen by an animal for hibernation

[124] 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*).

mortality of individuals or abandonment of stopover sites by whole flocks) depending on the species, time of year of construction/operation, and duration, and impacts are expected to be less than significant. BMPs and mitigation measures could help to further avoid or minimize effects to migratory pathways.

Reptiles and Amphibians

Several species of mole salamanders and the wood frog are known to seasonally migrate in Delaware. These amphibians often travel by the hundreds on their migration pathway that often crosses roadways. Mole salamanders are typically found in burrows in the forest floor. Frogs use diverse vegetation types from grassy meadows to open forests. Mortality and barriers to movement could occur as result of the Proposed Action (Calhoun & DeMaynadier, 2007).

Species that use streams as dispersal or migratory corridors may be impacted if these waterways are restricted or altered, but and 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 to migratory patterns of Delaware's terrestrial invertebrates are expected as a result of the Proposed Action.

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, which can affect the overall population of individuals.

Terrestrial Mammals

Restricted access to important winter hibernacula or summer maternity roosts for bats and calving grounds for large mammals, such as the moose, has the potential to negatively affect body condition and reproductive success of mammals in Delaware.

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 and impacts are expected to be less than significant. Reproductive effects as a result of displacement and disturbance could be minimized through the use of BMPs and mitigation measures.

Marine Mammals

Restricted access to important calving grounds has the potential to negatively affect body condition and reproductive success of marine mammals. For example, the displacement of female seals from preferred pupping habitats due to deployment and operations may reduce fitness and survival of pups potentially affecting overall productivity, though activities are likely to be small-scale in nature and contribute only minimally to minor, short-term displacement, and BMPs and mitigation measures could help to avoid or minimize the potential impacts.

Disturbance to hauled out seals from activities associated with the Proposed Action could result in the abandonment, or death of offspring, though BMPs and mitigation measures would 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 if birds temporarily avoid those areas, since they provide essential habitat for various life stages (Hill, D. et al., 1997). The majority of FirstNet deployment or operation activities are likely to be small-scale in nature. BMPs and mitigation measures as defined through consultation with USFWS, if required, could help to avoid or minimize any potential impacts.

Reptiles and Amphibians

Reproductive effects to reptile nests may occur through direct loss or disturbance of nests. For example, the spotted turtle (*Clemmys guttata*) leaves its breeding pool in May and travels to its nesting site.

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, alter water quality through sediment infiltration, or obstruction of natural water flow to pools, though BMPs and mitigation measures would 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; no reproductive effects to terrestrial invertebrates are expected 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 can have a dramatic effect on natural resources.

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.

Potential invasive species effects to Delaware’s wildlife are described below.

Terrestrial Mammals

In Delaware, nutria destroy wetland habitats by overgrazing and burrowing into flood control structures (USDA APHIS, 2010). This, in turn, can seriously reduce native populations of animals and lead to the degradation of their habitat.

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. Invasive species effects to terrestrial mammals could by minimized following BMPs in Chapter 17 to reduce the introduction potential from heavy equipment or laborers.

Marine Mammals

Invasive species displace native fauna and flora communities and/or radically change the nature of the habitats they invade. They also compete for the same natural resources and life requirements (i.e., food, space, and shelter) as native species and degrade local ecologies by disrupting the food chain, thereby causing the extinction of native species. Proposed FirstNet deployment activities near water would likely occur onshore with limited activities in the water; therefore, the introduction of non-native species would not occur.

Birds

Invasive plant and pest species directly alter the landscape or habitat to a condition that is more favorable for an invasive species, and less favorable for native species and their habitats. For example, in Delaware, mute swans (*Cygnus olor*) can impact native waterfowl and wetland birds causing nest abandonment or impacts to rearing young due to their aggressive behavior. Further, this invasive bird can lead to declines in water quality from increased fecal coliform loading in the water, and declines in submerged aquatic vegetation that support native fish and other wildlife (Swift, Clarke, Holevinski, & Cooper, 2013). FirstNet 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 bird species are not expected to be introduced at project sites as part of the deployment activities.

Reptiles and Amphibians

No invasive reptiles or amphibians are regulated in Delaware; although non-native reptiles and amphibians are known to occur there (DNREC, Division of Fish and Wildlife, 2014). Non-native reptiles and amphibians tend to be highly adaptable and can threaten native wildlife by competing with them for food sources and also spread disease. Proposed FirstNet deployment activities near water would likely occur onshore with limited activities in the water; therefore, the introduction of non-native species would be limited. Invasive terrestrial reptile or amphibian species are not expected to be introduced at project sites from machinery or laborers.

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 (USDA Forest Service, 2015). The potential to introduce invasive invertebrates within construction zones and during long-term site maintenance can 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 would help to avoid or minimize the potential for introducing invasive plant species during implementation of the Proposed Action. Invasive species effects related to terrestrial invertebrates could be minimized with the implementation of BMPs and mitigation measures.

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 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.

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 to 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 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 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 wildlife resources, it is anticipated that this activity would have no impact to 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 development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to wildlife resources 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 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 if BMPs and mitigation measures are not implemented.
  - 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 individual species 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 limited nearshore and inland bodies of water and construction of landings and/or facilities on the shore to accept submarine cables could potentially impact wildlife, marine mammals in particular (see Section 4.2.4, 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 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 which would not result in impacts to wildlife. However, if new power units, replacement towers, or structural hardening are required, impacts would be similar to new wireless construction. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.
  - Deployable Technologies: Implementation of deployable technologies including COWs, COLTs, and SOWs could result in direct injury/mortalities to wildlife on roadways. 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 radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.

Deployment of drones, balloons, blimps, and 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. However, deployment activities are expected to be temporary and isolated, and likely affecting only a small number of wildlife.

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 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. See Chapter 17, BMPs and Mitigation Measures, for 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, 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 associated 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.

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 individual wildlife species and unlikely to cause population-level impacts, and therefore would likely than less than significant. See Chapter 17, BMPs and Mitigation Measures, for 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.

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.

Deployment Impacts

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 the state. However, impacts are expected to remain less than significant because deployment activities are expected to be temporary, likely affecting only a small number of wildlife. See Chapter 17, BMPs and Mitigation Measures, for 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. As with the Preferred

Alternative, it is anticipated that there would be less than significant impacts because deployable activities are expected to be temporary and likely affecting only a small number of wildlife. The impacts can vary greatly among species and geographic region. See Chapter 17, BMPs and Mitigation Measures, for 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 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 4.1.6.4, Terrestrial Wildlife.

4.2.6.5. Fisheries and Aquatic Habitats

Impacts to fisheries and aquatic habitats occurring in Delaware and Delaware's near offshore environment 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 entanglement, vessel strike, problems associated with accidental ingestion, and injuries incurred by sensitive animals from disturbance events (NOAA, 2015i).

Based on the impact significance criteria presented in Table 4.2.6-1, less than significant impacts would be anticipated given the size and nature of the majority of proposed deployment activities. Although anthropogenic disturbances may be measurable (although minimal) for some FirstNet projects, individual behavior of fish species would be short-term and direct injury or mortality impacts at the population-level or sub-population effects would not likely be observed. BMPs and mitigation measures could help to avoid or minimize potential impacts to fisheries and aquatic invertebrate population survival.

Vegetation and Habitat Loss, Alteration, or Fragmentation

Habitat impacts are primarily physical perturbations that result in alterations in the amount or quality of a habitat. 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, 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. Additionally, deployment activities with the potential for impacts under the MSFCMA or other sensitive aquatic habitats can be addressed through BMPs and mitigation measures.

Indirect Injury/Mortality

Water quality impacts from exposure to contaminants from accidental spills from vehicles and equipment, and erosion or sedimentation from land clearing and excavation activities near or within riparian areas, floodplains, wetlands, streams, and other aquatic habitats 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. These impacts are expected to be less than significant, and BMPs and mitigation measures to protect water resources (see Section 4.2.4, 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 are expected to be less than significant, and are anticipated to be localized and at a small-scale, and would vary depending on the species, time of year, and duration of deployment. BMPs and mitigation measures could help to further avoid or minimize the potential impacts.

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, which can 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 expected to be less than significant, though BMPs and mitigation measures could help to further avoid or minimize the potential impacts.

Invasive Species Effects

The potential to introduce invasive plants within construction zones can occur from vehicles and equipment being transported from one region to another, or when conducting revegetation of a site after deployment activities are complete. FirstNet 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. BMPs and mitigation measures could 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 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.

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 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 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 to 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 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 fisheries, it is anticipated that this activity would have no impact on the aquatic environment.

Activities with the Potential to Have Impacts

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 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 if BMPs and mitigation measures are not implemented.
  - 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, if conducted near water resources that support fish, could 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 limited nearshore and inland 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 effects.
  - 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 could result in impacts to fisheries and aquatic habitats, if such actions were deployed near water 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, particularly if they occur near waterbodies, 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, or structural hardening are required, impacts would be similar to new wireless construction. For a discussion of radio frequency 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 radio frequency 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 due to the small-scale of deployment activities and the limited number of aquatic species expected to be impacted. See Chapter 17, BMPs and Mitigation Measures, for 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, 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 that there would be less than significant impacts to fisheries and aquatic habitats associated with routine inspections of the Preferred Alternative. Site maintenance, if conducted near water resources that support fish, including application of herbicides, may result in less than significant effects to fisheries and aquatic habitats including exposure to contaminants from accidental spills from maintenance equipment or release of pesticides.

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 that support fish 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 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.

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 the state. However, impacts are expected to remain less than significant due to the limited nature of expected deployment activities. See Chapter 17, BMPs and Mitigation Measures, for 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

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 impacts to fisheries and aquatic habitats associated with routine operations and maintenance due to the limited nature of expected deployment activities. The impacts can vary greatly among species and geographic region. See Chapter 17, BMPs and Mitigation Measures, for 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 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 4.1.6.5, Fisheries and Aquatic Habitats.

4.2.6.6. Threatened and Endangered Species and Species of Conservation Concern

This section describes potential impacts to threatened and endangered species in Delaware and Delaware'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. See Chapter 17, BMPs and Mitigation Measures, for 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 threatened and endangered species and their habitat were evaluated using the significance criteria presented in Table 4.2.6-2. 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.

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 4.2.6-2, any direct injury or mortality of a listed species at the individual-level could be potentially significant as well as any impact that has more than a negligible potential to result in unpermitted take of an individual species at any geographic extent, duration, or frequency. Direct injury/mortality environmental concerns pertaining to federally listed terrestrial mammals, birds, reptiles and amphibians, invertebrates, and plants with known occurrence in Delaware are described below.

Terrestrial Mammals

Northern long-eared bats (*Myotis septentrionalis*) are found throughout the state. Direct mortality or injury to the northern long-eared bat could occur from collisions or electrocutions with man-made cables and wires, vehicle strikes, or when nests are either disturbed or destroyed. Impacts would likely be isolated, individual events. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. See Chapter 17, BMPs and Mitigation Measures, for 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.

Table 4.2.6-2: Impact Significance Rating Criteria for Threatened and Endangered Species

Type of Effect	Effect Characteristic	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.	
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.

Type of Effect	Effect Characteristic	Impact Level		
		May Affect, Likely to Adversely Affect	**May Affect, Not Likely to Adversely Affect**	**No Effect**
	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.	

Birds

Two federally listed birds, the piping plover and red knot, are known to occur within coastal areas of Delaware. Depending on the project types and location, direct mortality or injury to these birds could occur from collisions or electrocutions with man-made cables and wires, vehicle strikes, or by disturbance or destruction of nests during ground disturbing activities. If proposed project sites are unable to avoid sensitive areas, BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. See Chapter 17, BMPs and Mitigation Measures, for 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.

Reptiles and Amphibians

No federally listed amphibians would be affected by the Proposed Action in Delaware as none occur in the state, therefore impacts to listed amphibians will not be discussed further.

The federally listed threatened bog turtle (*Clemmys muhlenbergii*) occurs within wetland and floodplain areas. Direct mortality to reptiles could occur in construction zones either by excavation activities or by vehicle strikes. Impacts would likely be isolated, individual events.

Three federally listed sea turtle species are also known to occur in the coastal area and offshore environment of Delaware. None of these turtles nest in the Delaware area. Direct mortality or injury could occur from watercraft and vessels strikes are unlikely as the majority of the FirstNet deployment projects would not occur in an aquatic environment. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. See Chapter 17, BMPs and Mitigation Measures, for 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.

Invertebrates

There are no listed invertebrates in Delaware.

Plants

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. Plant species include: Canby's dropwort (*Oxypolis canbyi*), Seabeach amaranth (*Amaranthus pumilus*), swamp pink (*Helonius bullata*), and small-whorled pogonia (*Isotria medeoloides*). In general, distribution of these species is limited throughout the state. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. See Chapter 17, BMPs and Mitigation Measures, for 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.

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 can affect the breeding success. Potential effects to federally listed terrestrial mammals, birds, terrestrial reptiles and marine reptiles, amphibians, invertebrates, and plants with known occurrence in Delaware are described below.

<u>Terrestrial Mammals</u>

Noise, light, and other human disturbances associated with the Proposed Action could adversely 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. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. See Chapter 17, BMPs and Mitigation Measures, for 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.

<u>Birds</u>

The red knot and piping plover are known to nest in Delaware on sandy beaches and coastlines. The majority of FirstNet deployment activities would not occur on beaches; therefore, impacts to these bird species are not anticipated. Noise, light, or human disturbance within nesting areas could cause red knots to abandon their nests, relocate to less desirable locations, or cause stress to individuals reducing survival and reproduction. See Chapter 17, BMPs and Mitigation Measures, for 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.

<u>Reptiles and Amphibians</u>

The federally listed threatened bog turtle (*Clemmys muhlenbergii*) occurs within wetland and floodplain areas. Changes in water quality, especially during the breeding seasons, resulting from ground disturbing activities could cause stress resulting in lower productivity. Land clearing activities, noise, and human disturbance during the critical time periods (e.g., mating, nesting) could lower fitness and productivity. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. See Chapter 17, BMPs and Mitigation Measures, for 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.

The three federally listed sea turtles found in the offshore areas of Delaware are migrants. Consequently, no long-term reproductive effects to federally listed sea turtles are expected as a result of the Proposed Action.

<u>Invertebrates</u>

There are no listed invertebrate species in Delaware.

Plants

No reproductive effects to federally listed plants are expected as a result of the Proposed Action as limited pesticides would be used and avoidance measures could be undertaken.

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 mammals, birds, reptiles and amphibians, invertebrates, and plants with known occurrence in Delaware are described below.

Mammals

Noise, light, and other human disturbances associated with the Proposed Action may disturb roosts or colonies of the Northern long-eared bat. 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. See Chapter 17, BMPs and Mitigation Measures, for 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.

Birds

Because many birds have extremely long migrations, protection efforts for critical sites along migratory routes must be coordinated over vast distances often involving many different countries. Disturbance in stopover, foraging, or breeding areas (visual or noise) or habitat loss/fragmentation can 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 adverse effects to federally listed birds. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. See Chapter 17, BMPs and Mitigation Measures, for 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.

Reptiles and Amphibians

Habitat loss or alteration, particularly from fragmentation or invasive species, could adversely affect nesting and foraging sites of the bog turtle, resulting in reduced survival and productivity; however, disturbances during deployment activities are not anticipated to stress federally listed reptiles. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. See Chapter 17, BMPs and Mitigation Measures, for 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.

Invertebrates

There are no listed invertebrate species in Delaware.

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. FirstNet activities are generally expected to be small-scale in nature, therefore large-scale impacts are not expected; however, it is possible that small-scale changes could lead to potentially significant adverse effects for certain species. For example, impacts to designated critical habitat for a listed species that is only known to occur in one specific location geographically. However, the threatened and endangered species that occur in Delaware do not have critical habitat in the state.

Terrestrial Mammals

No designated critical habitat occurs for terrestrial mammals in Delaware. Therefore, no effect to threatened and endangered species from the loss or degradation of designated critical habitat is expected as a result of the Proposed Action.

Birds

No critical habitat has been designated for federally-listed bird populations that are known to occur in Delaware; therefore, no effect to these federally listed birds from the loss or degradation of designated critical habitat is expected as a result of the Proposed Action.

Reptiles and Amphibians

No designated critical habitat occurs for reptiles in Delaware. Therefore, no effect to threatened and endangered species from the loss or degradation of designated critical habitat is expected as a result of the Proposed Action.

Invertebrates

There are no listed invertebrate species in Delaware.

Plants

No designated critical habitat occurs for plants in Delaware. Therefore, no effect to threatened and endangered species from the loss or degradation of designated critical habitat is expected as a result of the Proposed Action.

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 impacts 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.

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 to 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 to 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 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 protected species, it is anticipated that this activity would have no impact to 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 impacts that could occur, including direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. The types of infrastructure 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. reptiles, mollusks, small mammals, and young), that utilize burrows (e.g., ground squirrels), or that are defending nest sites (e.g., ground-nesting birds). Disturbance, including noise, associated with the above activities could result in direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat if BMPs and mitigation measures are not implemented.
  - 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 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, behavioral changes, and loss/degradation of designated critical habitat.
  - 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, and loss/degradation of designated critical habitat to threatened and endangered species. 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 limited nearshore and inland bodies of water and construction of landings and/or facilities on the shore to accept submarine cables could potentially impact threatened and endangered species and their habitat, particularly aquatic species (see Section 4.2.4, Water Resources, for a discussion of potential impacts to water resources). Effects could include direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. 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, behavioral changes, and loss/degradation of designated critical habitat 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, behavioral changes, and loss/degradation of designated critical habitat. Security lighting and fencing could result in direct injury/mortality, disruption of normal behavior patterns, as well as reproductive effects. 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; 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 radio frequency 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 radio frequency 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, behavioral changes, and loss/degradation of designated critical habitat. 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, and loss/degradation of designated critical habitat depending on the species' phenology and the nature and extent of the habitats affected. These impacts may affect, but are not likely adversely affect protected species; BMPs and mitigation measures identified in Chapter 17 and as defined through consultation with the appropriate resource agency, could help to mitigate or reduce 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 threatened and endangered species that would be affected would depend on the species' phenology and the nature and extent of the habitats affected.

It is anticipated that operational impacts may affect, but are not likely to adversely affect threatened and endangered species due to 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 application of herbicides, may affect, but are not likely to adversely affect threatened and endangered species, 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. 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. See Chapter 17, BMPs and Mitigation Measures, for 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.

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. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. See Chapter 17, BMPs and Mitigation Measures, for 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.

Alternatives Impact Assessment

The following section assesses potential impacts 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 impacts 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 through direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. Greater frequency and duration of deployments could change the magnitude of impacts depending on species, life history, and region of the state. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. See Chapter 17, BMPs and Mitigation Measures, for 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 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. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. See Chapter 17, BMPs and Mitigation Measures, for 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 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 effects 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 4.1.6.6, Threatened and Endangered Species and Species of Conservation Concern.

4.2.7. Land Use, Recreation, and Airspace

4.2.7.1. Introduction

This section describes potential impacts to land use, recreation, and airspace resources in Delaware associated with deployment and operation of the Proposed Action and alternatives. See Chapter 17, BMPs and Mitigation Measures, for 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.

4.2.7.2. 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 4.2.7-1. 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.

4.2.7.3. 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 above-ground 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 rights-of-way 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.

Table 4.2.7-1: 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

Based on the impact significance criteria presented in Table 4.2.7-1, 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 above-ground 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 right-of-way, 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 4.2.7-1, less than significant impacts would be anticipated as any new land use would be small-scale and consistent with the surrounding land uses in the area; only short-term impacts during the construction phase would be expected.

Loss of Access to Public or Private Recreation Land or Activities

Access to public or private recreation land or activities could be influenced by the deployment, operation, and maintenance of facilities and the acquisition of rights-of-way or easement. 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 above ground facilities could alter the types and locations of recreation activities.

Based on the impact significance criteria presented in Table 4.2.7-1, 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 above ground 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 4.2.7-1, 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. 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 4.2.7-1, 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 of time, FirstNet would not impact airspace resources.

4.2.7.4. 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 land use, recreation, and airspace 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 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 Likely to Have Impacts below.
    - Recreation: See Activities Likely 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 4.1.7.5, 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 Likely 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 4.1.7.5, 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 Likely to Have Impacts below.
    - Recreation: See Activities Likely 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 limited nearshore and inland bodies of water and the constructing landings and/or facilities on shore to accept submarine cable.
  - Land Use: See Activities Likely to Have Impacts below.
  - Recreation: See Activities Likely to Have Impacts below.
  - Airspace: The installation of cables in limited nearshore and inland bodies of water and construction of landings/facilities would not impact 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 4.1.7.5 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 Likely to Have Impacts below.
  - Recreation: See Activities Likely 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 4.1.7.5, 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 Likely to Have Impacts* below.
    - Airspace: See *Activities Likely 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 (COW, COLT, and SOW) is not expected to result in impacts to airspace, provided antenna masts do not exceed 200 feet Above Ground Level (AGL) or do not trigger any of the other FAA obstruction to airspace criteria listed in Section 4.1.7.5, 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 to land use, it is anticipated that this activity would have no impact to land use.

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.
    - <u>Land Use:</u> Construction activities could temporarily restrict existing and surrounding land uses at isolated locations.
    - <u>Recreation:</u> 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.
    - <u>Airspace</u>: 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.
    - <u>Land Use:</u> 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.
    - <u>Recreation:</u> 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.
    - <u>Airspace:</u> No impacts are anticipated – see previous section.
  - New Build – Submarine Fiber Optic Plant: Installing cables in limited nearshore and inland bodies of water and the constructing landings and/or facilities on shore to accept submarine cable.
    - <u>Land Use:</u> 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.
    - <u>Recreation:</u> Deployment may temporarily restrict recreation on or within limited nearshore and inland bodies of water and the surrounding area during the deployment phase. Reductions in visitation may result during deployment.
    - <u>Airspace:</u> 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 4.1.7.5 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 Delaware'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 Delaware airports (See obstruction criteria in Section 4.10.5.3 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, including the construction of access roads. Potential impacts to land uses associated with deployment of this infrastructure 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 obstructions to airspace or affect flight profiles and operating parameters of SUAs/MTRs. Potential impacts to airspace 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. See Chapter 17, BMPs and Mitigation Measures, for 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. 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. The degree of change in the visual environment (see Section 4.2.8, 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. See Chapter 17, BMPs and Mitigation Measures, for 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.

4.2.7.5. 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. Also, implementation of deployable technologies could result in less than significant impacts to airspace if deployment does trigger any obstruction criterion or result in changes to flight patterns and airspace restrictions. 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. See Chapter 17, BMPs and Mitigation Measures, for 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 would be less than significant due to the temporary nature of deployment activities. See Chapter 17, BMPs and Mitigation Measures, for 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 4.1.7, Land Use, Recreation, and Airspace.

4.2.8. Visual Resources

4.2.8.1. Introduction

This section describes potential impacts to visual resources in Delaware associated with deployment and operation of the Proposed Action and alternatives. See Chapter 17, BMPs and Mitigation Measures, for 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.

4.2.8.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on visual resources were evaluated using the significance criteria presented in Table 4.2.8-1. 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.

4.2.8.3. 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 Delaware, residents and visitors travel to many historic sites, such as First State National Historic Park to enjoy the forest views and hiking along the Brandywine River and explore the early history of the United States. 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. Delaware regulates impacts to visual resources for historic properties through their SHPO to "avoid or minimize adverse visual effects on historic properties wherever feasible." Historic properties in Delaware are assessed prior to a proposed project to determine if any adverse effects to the integrity or historic significance could occur (Delaware Division of Historic and Cultural Affairs, 2003). 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.

Table 4.2.8-1: 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

Based on the impact significance criteria presented in Table 4.2.8-1, 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.

Based on the impact significance criteria presented in Table 4.2.8-1, lighting that illuminates the night sky on a regional basis, diminishes night sky viewing over long distances, and persists over the long-term would 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.

4.2.8.4. 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 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 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 to 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 project; 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 limited nearshore and inland 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 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 the on-site delivery of 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 due to the temporary and small-scale nature of deployment activities, although certain discrete locations could have potentially greater impacts to night skies or as a result of new towers. See Chapter 17, BMPs and Mitigation Measures, for 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.

4.2.8.5. 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. See Chapter 17, BMPs and Mitigation Measures, for 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. These potential impacts would be similar to the potential impacts described for the Deployable Technologies option of the Preferred Alternative, above, only likely with greater numbers of deployable units.

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 4.1.8, Visual Resources.

4.2.9. Socioeconomics

4.2.9.1. Introduction

This section describes potential impacts to socioeconomics in Delaware associated with deployment and operation of the Proposed Action and alternatives. See Chapter 17, BMPs and Mitigation Measures, for 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.

4.2.9.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on socioeconomics were evaluated using the significance criteria presented in Table 4.2.9-1. 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.

4.2.9.3. 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
- 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 reduced property values below typical market values due to below average public safety communication services. Improved services would reduce response times and improve responses. 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 Existing Environment, property values vary considerably across Delaware. Median values of owner-occupied housing units in the 2009–2013 period ranged from over $360,000 in the Lewes area, to below $170,000 in the Delaware portion of the Salisbury 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.

Table 4.2.9-1: Impact Significance Rating Criteria for Socioeconomics

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and 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 BMPs and 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

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 Pending, 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 is a 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 games 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 Delaware. The average unemployment rate in 2014 was 5.7 percent, lower than the national rate of 6.2 percent. County-level unemployment rates were lower than the national rate in Delaware's northern and southern counties, and above the national rate in its central county.

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 4.2.9-1 because 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 can 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.

4.2.9.4. 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 9.2.2-1.

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 to socioeconmic 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
- 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 limited nearshore and inland 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. 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. See Chapter 17, BMPs and Mitigation Measures, for 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.

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.

Operation Impacts

Activities with the Potential to Have 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. All operational activities would be conducted by public or private sector employees, and therefore support employment and involve payment of wages. Even if these economic effects are a 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 state. These impacts are expected to be less than significant. See Chapter 17, BMPs and Mitigation Measures, for 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.

4.2.9.5. 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. The potential adverse impacts of new wireless communication towers on property values would be avoided under the Deployable Technologies Alternative. See Chapter 17, BMPs and Mitigation Measures, for 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.

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. See Chapter 17, BMPs and Mitigation Measures, for 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 4.1.9, Socioeconomics.

4.2.10. Environmental Justice

4.2.10.1. Introduction

This section describes potential impacts to environmental justice in Delaware associated with deployment and operation of the Proposed Action and alternatives. See Chapter 17, BMPs and Mitigation Measures, for 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.

4.2.10.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on environmental justice were evaluated using the significance criteria presented in Table 4.2.10-1. 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.

4.2.10.3. 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, 1997) 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. Indian tribes are considered environmental justice populations (CEQ, 1997); 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, 1997). 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 4.2.9).

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.

Table 4.2.10-1: Impact Significance Rating Criteria for Environmental Justice

<table>
<tr><th rowspan="2">Type of Effect</th><th rowspan="2">Effect Characteristics</th><th colspan="4">Impact Level</th></tr>
<tr><th>Potentially Significant</th><th>Less than Significant with BMPs and Mitigation Measures Incorporated</th><th>Less than Significant</th><th>No Impact</th></tr>
<tr><td rowspan="3">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</td><td>Magnitude or Intensity</td><td>Direct and disproportionately high and adverse effects on environmental justice communities (as defined by EO 12898) that cannot be fully mitigated</td><td rowspan="3">Effect that is potentially significant, but with mitigation is less than significant</td><td>Direct effects on environmental justice communities (as defined by EO 12898) that are not disproportionately high and adverse, and therefore do not require mitigation</td><td>No direct effects on environmental justice communities, as defined by EO 12898</td></tr>
<tr><td>Geographic Extent</td><td>Effects realized within counties at the Census Block Group level</td><td>Effects realized within counties at the Census Block Group level</td><td>Effects realized within counties at the Census Block Group level</td></tr>
<tr><td>Duration or Frequency</td><td>Persists during the life of the project</td><td>Persists for as long as the entire construction phase or a portion of the operations phase</td><td>NA</td></tr>
</table>

NA = Not Applicable

Before FirstNet deploys projects, 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 Existing Environment (Section 4.1.10) as having Moderate Potential or High Potential for environmental justice populations would particularly warrant further screening. As discussed in Section 4.1.10, Delaware's population has a higher percentage of Black/African American persons than the region or the nation, a lower percentage of persons identifying as Hispanic than the region or nation, and lower rates of poverty than the region or nation. Areas with High Potential for environmental justice populations occur primarily in or near the 10 largest population concentrations. The distribution of areas with Moderate Potential for environmental justice populations is fairly even across the state. Further analysis using the data developed for the screening analysis in Section 4.1.10 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, 2015j; USEPA, 2014d).

A site-specific analysis would also evaluate whether an actual environmental justice impact on those populations would be likely to occur. Analysts can 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.

4.2.10.4. 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 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.

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 is 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 to 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 limited nearshore and inland 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 projects 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. See Chapter 17, BMPs and Mitigation Measures, for 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 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. See Chapter 17, BMPs and Mitigation Measures, for 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.

4.2.10.5. 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. See Chapter 17, BMPs and Mitigation Measures, for 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. See Chapter 17, BMPs and Mitigation Measures, for 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 4.1.10, Environmental Justice.

4.2.11. Cultural Resources

4.2.11.1. Introduction

This section describes potential impacts to cultural resources in Delaware associated with deployment and operation of the Proposed Action and alternatives. See Chapter 17, BMPs and Mitigation Measures, for 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.

4.2.11.2. Impact Assessment Methodology and Significance Criteria

The potential impacts of the Proposed Action on cultural resources were evaluated using the significance criteria presented in Table 4.2.11-1. As described in Section 4.2, 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.

4.2.11.3. 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 4.2.11-1, 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 that archaeological sites and historic properties are present throughout Delaware, some deployment activities may be in these same areas, in which case BMPs (see Chapter 17) would help avoid or minimize the potential impacts.

Table 4.2.11-1: Impact Significance Rating Criteria for Cultural Resources

Type of Effect	Effect Characteristics	Impact Level			
		Adverse Effect	**Mitigated Adverse Effect[1]**	**Effect, but Not Adverse**	**No Effect**
Physical damage to and/or destruction of historic properties[2]	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties	Adverse effect that has been procedurally mitigated through Section 106 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 106 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 106 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[1]	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 106 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

[1] 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 106 of the NHPA (as codified in 36 CFR Part 800.6), would require FirstNet to consult with the SHPO/THPO and other consulting parties, including Indian Tribes and Native Hawaiian Organizations, to develop appropriate mitigation.

[2] 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 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.

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 can be avoided or minimized through BMPs (see Chapter 17).

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 Native Americas. 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.

4.2.11.4. 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, 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.

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 to 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.

- New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water could impact cultural resources, as coastal areas, shorelines and creek banks in Delaware have the potential to contain prehistoric archaeological sites, as well as sites associated with the state's significant maritime history since European colonization, such as shipwrecks. Impacts to cultural resources could also potentially occur as a 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 tend to be located in association with bodies of water, and Delaware has numerous maritime and riverine archaeological sites associated with its 18^{th} and 19^{th} century commercial expansion), 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 impacts to 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 Camden, that have larger numbers of historic 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 as appropriate, FirstNet would engage in consultation as required under Section 106 of the NHPA. See Chapter 17, BMPs and Mitigation Measures, for 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.

4.2.11.5. 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. See Chapter 17, BMPs and Mitigation Measures, for 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 because effects to access or the viewshed 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.

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 4.1.11, Cultural Resources.

4.2.12. Air Quality

4.2.12.1. Introduction

This section describes potential impacts to Delaware's air quality from deployment and operation of the Proposed Action and alternatives. See Chapter 17, BMPs and Mitigation Measures, for 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.

4.2.12.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on Delaware's air quality were evaluated using the significance criteria presented in Table 4.2.12-1. 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 Delaware's air quality addressed in this section are presented as a range of possible impacts.

4.2.12.3. 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 unknown 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 Delaware that are in maintenance or nonattainment for one or more criteria pollutants, particularly, ozone is a state-wide issue (see Section 4.1.12, Air Quality and Figure 4.1.12-1). The majority of the counties in Delaware are designated as maintenance areas for one or more of the following pollutants: PM, SOx, and ozone (Table 4.1.12-5: *De Minimis* Levels); counties located in the northern portion of the state are designated nonattainment or maintenance for two NAAQS pollutants (Figure 4.1.12-1).

Table 4.2.12-1: Impact Significance Rating Criteria for Delaware

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and 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

Based on the significance criteria presented in Table 4.2.12-1, 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 Delaware; however, NAAQS exceedances are not anticipated. Given that nonattainment areas are present throughout Delaware (Figure 4.1.12-1), 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.

4.2.12.4. 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 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.

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 to those resources.

Activities with the Potential to Impact 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 limited nearshore and inland 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 the on-site delivery of 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. See Chapter 17, BMPs and Mitigation Measures, for 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.

4.2.12.5. 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 concentrations and associated impacts would be dictated by the products of combustion from ground support vehicles, as well as the duration of ground support operations and travel between storage and deployment locations. 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.

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.

4.2.13. Noise

4.2.13.1. Introduction

This section describes potential noise impacts from construction, deployment, and operation of the Proposed Action and alternatives in Delaware. See Chapter 17, BMPs and Mitigation Measures, for 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.

4.2.13.2. Impact Assessment Methodology and Significance Criteria

The noise impacts of the Proposed Action were evaluated using the significance criteria presented in Table 4.2.13-1. 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 Delaware addressed in this section are presented as a range of possible impacts.

4.2.13.3. 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.

Based on the significance criteria presented in Table 4.2.13-1, 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 would be followed 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.

4.2.13.4. 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.

Table 4.2.13-1: 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

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 to 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 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 limited nearshore and inland 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). See Chapter 17, BMPs and Mitigation Measures, for 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 and 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.

4.2.13.5. 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. See Chapter 17, BMPs and Mitigation Measures, for 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. See Chapter 17, BMPs and Mitigation Measures, for 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.

4.2.14. Climate Change

4.2.14.1. Introduction

This section describes potential impacts to climate and climate change-vulnerable FirstNet installations and infrastructure in Delaware associated with deployment and operation of the Proposed Action and alternatives. See Chapter 17, BMPs and Mitigation Measures, for 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.

4.2.14.2. 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 4.2.14-1. 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 in 2013 (USEPA, 2015k), 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 can provide useful information to the project planning to ensure these projects are resilient to the impacts of climate change.

4.2.14.3. Projected Future Climate

Climate model forecasts of future temperatures are highly dependent on emissions scenarios (low versus high), particularly in projections beyond 2050. By mid-century, the total number of days above 90 ºF is projected to increase in the majority of the Northeastern states especially the southern portion of the region. Under both low and high GHG emissions scenarios, the frequency, intensity, and duration of heat waves (sequential days with temperatures over 90 ºF) is also expected to increase, with the most intense heat waves occurring under higher emissions scenarios. Increases in temperature will also impact precipitation events, sea level rise, and ocean water acidity (USGCRP, 2014a).

Table 4.2.14-1: Impact Significance Rating Criteria for Climate

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and 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

Air Temperature

Figure 4.2.14-1 and Figure 4.2.14-2 illustrate the anticipated temperature changes for low and high GHG emission scenarios for Connecticut from a 1969 to1971 baseline.

Cfa – Figure 4.2.14-1 shows that by mid-century (2040 to 2059) temperatures in the entire state of Delaware under a low emissions scenario will increase by approximately 4 °F, and under a low emissions scenario for the period (2080 to 2099) temperatures in the Cfa region will increase by approximately 5° F (USGCRP, 2009).

Figure 4.2.14-2 shows that by mid-century temperatures will increase by approximately 5° F in the entire state of Delaware under a high emissions scenario. By the end of the century (2080 to 2099) temperatures in the Cfa region of Delaware under a high-emissions scenario will increase by approximately 8 °F (USGCRP, 2009).

Dfa – Temperatures in this region are expected to increase by mid-century (2040 to 2059) and by the end of the century (2080 to 2099) at the same rate as the Cfa region under both low and high emissions scenarios (USGCRP, 2009).

Dfb – Temperatures in this region under a low emissions scenario are expected to increase by mid-century (2040 to 2059) at the same rate as the Cfa and Dfa regions. The majority of the Dfb region's temperature is expected to rise at the same rate as Cfa and Dfa in a low emissions scenario by the end of the century. However, temperatures in the Northwestern most portion of the state may increase up to 6° F by the end of the century (USGCRP, 2009).

Temperatures in the Dfb region under a high emissions scenario for the period (2040 to 2059) temperatures will increase at the same rate as the Cfa and Dfa regions. Temperatures in the Dfb region under a high emissions scenario for the period (2080 – 2099) will increase by approximately 9° F (USGCRP, 2009).

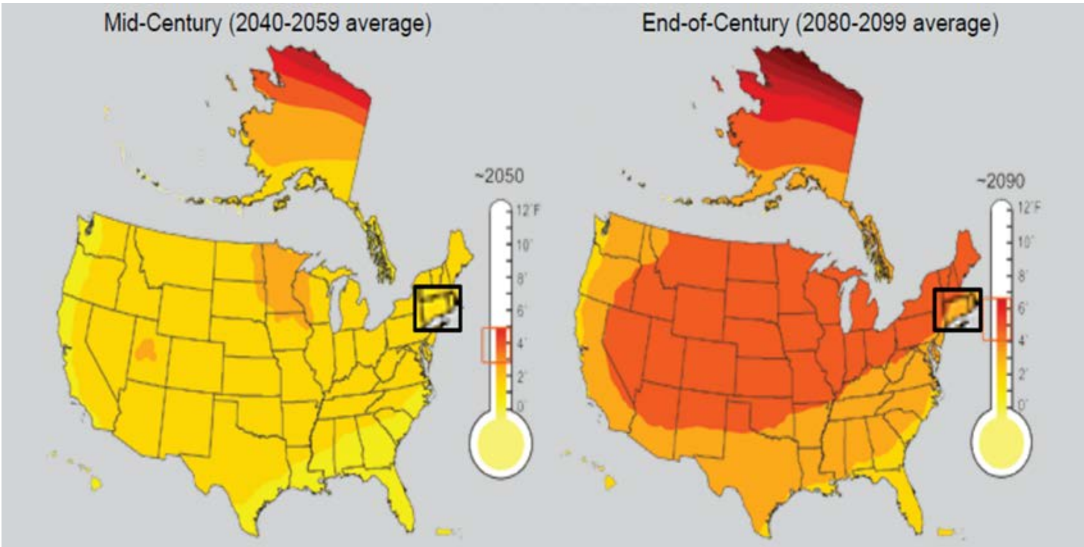


Figure 4.2.14-1: Delaware Low Emission Scenario Projected Temperature Change

Source: (USGCRP, 2009)

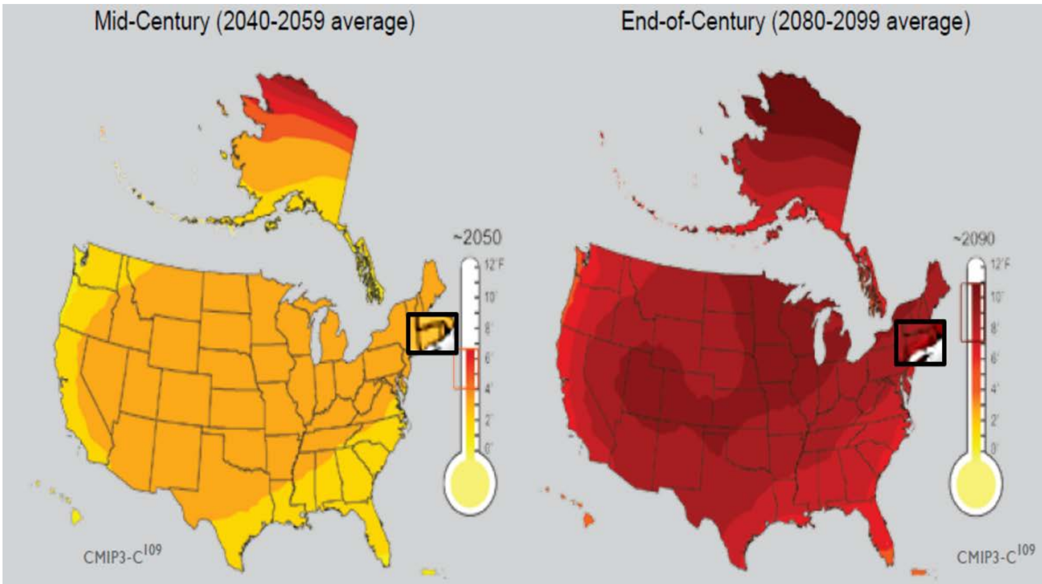


Figure 4.2.14-2: Delaware High Emission Scenario Projected Temperature Change

Source: (USGCRP, 2009)

Precipitation

By late in the century under a high emissions scenario, winters in the Northeast are projected to be much shorter with fewer cold days and more precipitation. Winter and spring precipitation is projected to increase, and the frequency of heavy downpours is projected to continue to increase as the century progresses. Seasonal drought risk is also projected to increase in summer and fall as higher temperatures lead to greater evaporation and earlier winter and spring snowmelt (USGCRP, 2009).

Figure 4.2.14-3 and Figure 4.2.14-4 show predicted seasonal precipitation change for an approximate thirty year period of 2071 to 2099 compared to a 1970 to 1999 approximate thirty year baseline. Figure 4.2.14-3 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 4.2.14-4 shows a high emissions scenario, which assumes continued increases in emissions, with associated large increases in warming and major precipitation changes. Continued increases in emissions would lead to large reductions in spring precipitation in the Northeast. 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 4.2.14-3 shows that in a rapid emissions reduction scenario in the 30-year period for 2071 to 2099, precipitation will increase by 10 percent in winter, spring, and summer for the entire state of Delaware. However, there are no expected increases in precipitation in fall other than fluctuations due to natural variability (USGCRP, 2014b).

Figure 4.2.14-4 shows that if emissions continue to increase, winter and spring precipitation could increase as much as 20 percent over the period 2071 to 2099. In summer, precipitation under this scenario could increase as much as 10 percent. No significant change in fall and summer rainfall is anticipated over the same period (USGCRP, 2014b).

Dfa **–** Precipitation changes for the Dfa region are consistent with projected changes for the Cfa region of Delaware in both low and high GHG emissions scenarios.

Dfb **–** Precipitation changes for the Dfb region are consistent with projected changes for the Cfa and Dfa regions of Delaware in both low and high emissions scenarios.

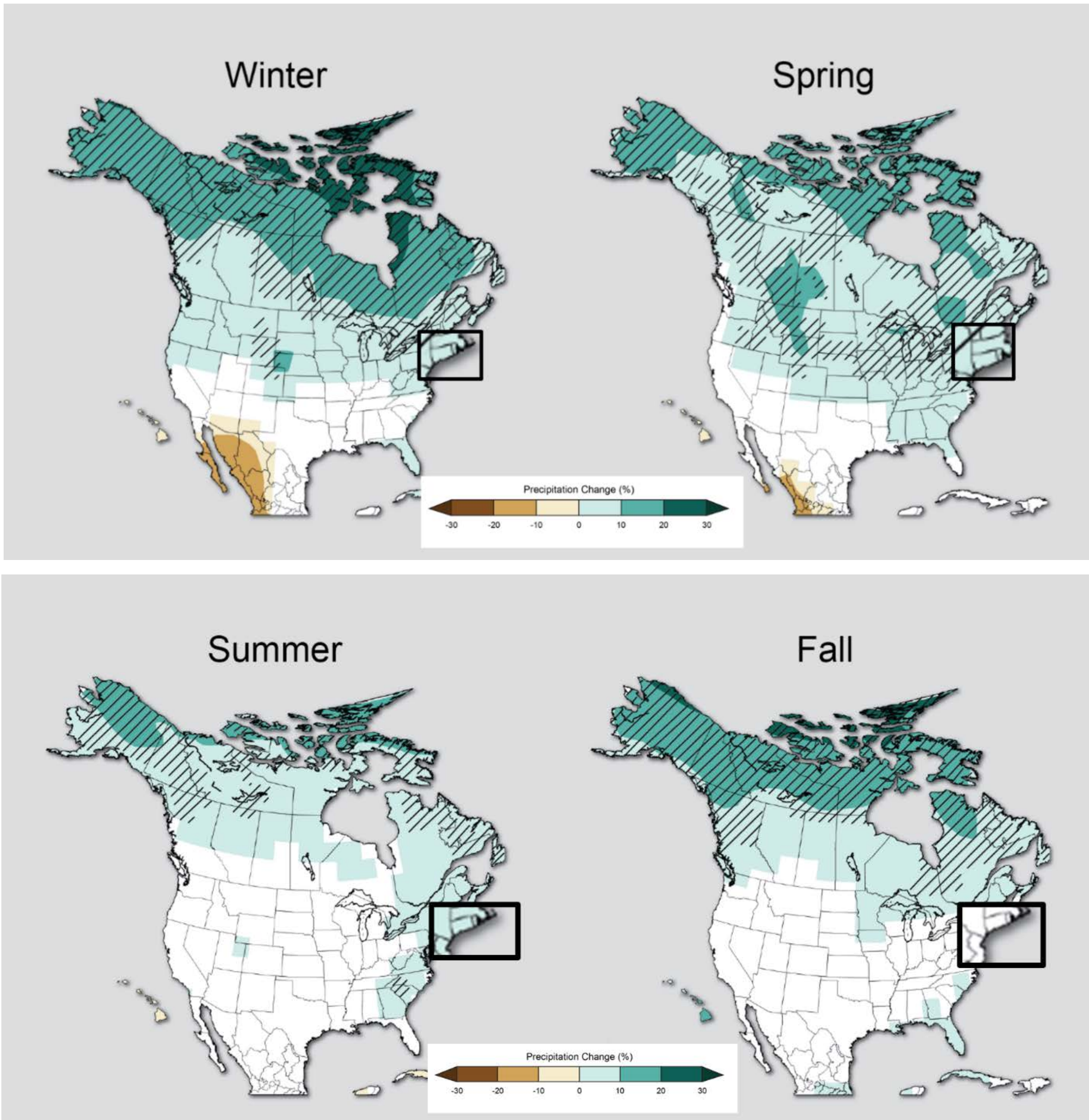


Figure 4.2.14-3: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a Low Emissions Scenario

Source: (USGCRP, 2014b)

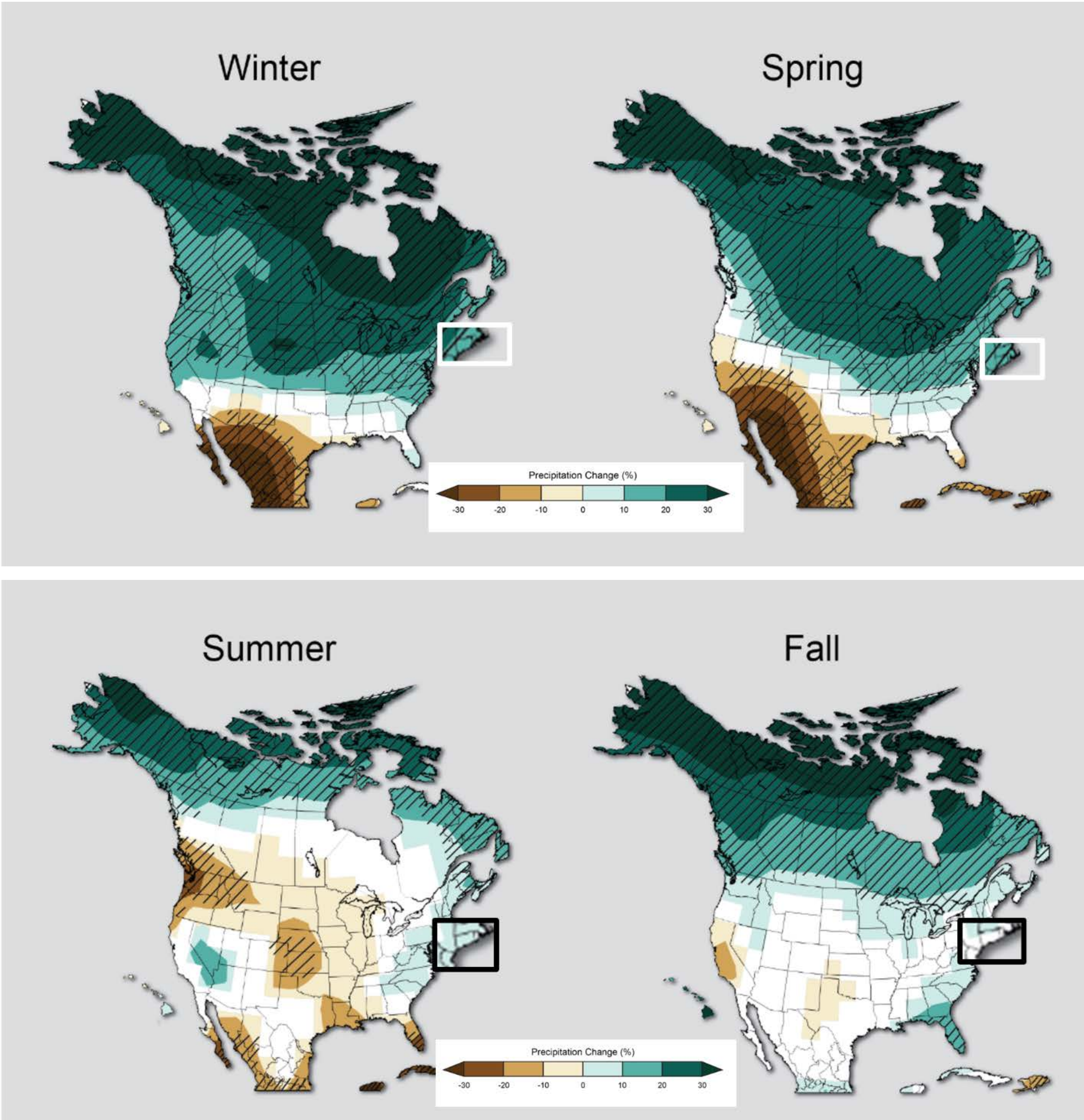


Figure 4.2.14-4: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a High Emissions Scenario

Source: (USGCRP, 2014b)

Sea Level

Several factors will 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, 2012g). 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, 2012g). The higher temperatures of the ocean also influence sea level and currents (USEPA, 2012g).

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, 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 4.2.14-5 and Figure 4.2.14-6 show feet of sea level above 1992 levels at different tide gauge stations. Figure 4.2.14-5 shows an 8 inch global sea level rise above 1992 levels by 2050 and Figure 4.2.14-6 shows a 1.24 foot global sea level rise above 1992 levels by 2050 (USGCRP, 2014c).

Cfa – Figure 4.2.14-5 presents an 8 inch global average sea level rise above 1992 levels resulting in a .7 to 1 foot sea level rise in 2050 along the coast of Delaware. Figure 4.2.14-6 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 of Delaware.

Dfa and Dfb – These Delaware regions are not affected by sea level rise.

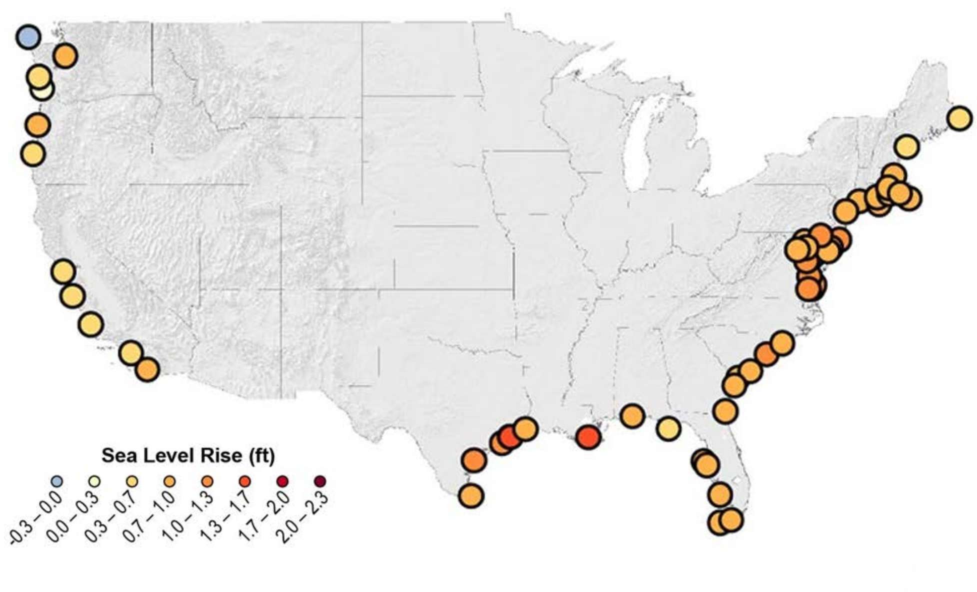


Figure 4.2.14-5: 8-inch Sea Level Rise Above 1992 Levels by 2050

Source: (USGCRP, 2014c)

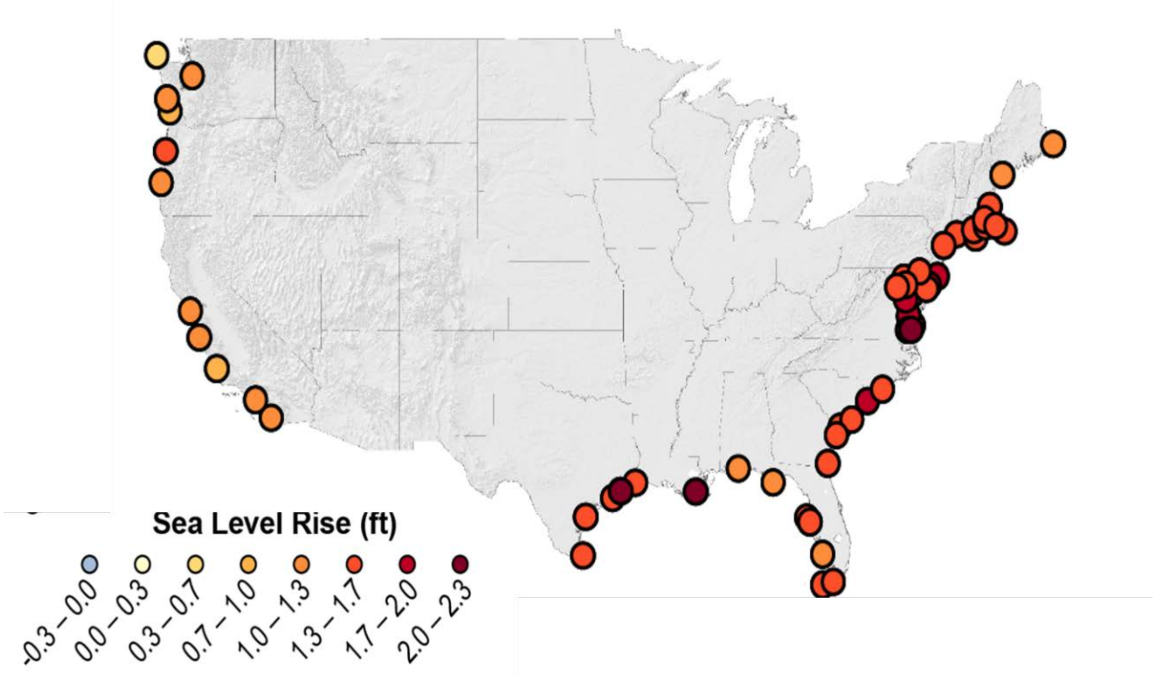


Figure 4.2.14-6: 1.24-foot Sea Level Rise Above 1992 Levels by 2050

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 likely provide greater certainty (USGCRP, 2009).

4.2.14.4. 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 4.2.14-1, 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 on-site 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 (Multiquip, 2015). Diesel fuel combustion emits 22.38 lbs of CO_2 per gallon (EIA, 2015e). 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 is less carbon-intensive, and would generate approximately 240 MT of CO_2 per year for the same equipment, depending on the region of the U.S. where the electricity was generated (USEPA, 2014e). Furthermore, the components of the system would not necessarily all be this large, running all the time, or at full power. 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 (Willem Vereecken, 2011), and would not impact GHG emissions in such a way as to require a quantitative analysis.

Impact of Climate Change on Project-Related Resource Effects

Climate change may impact project-related effects by magnifying or otherwise altering impacts in other resources areas. For example climate change may impact air quality, water resource availability, and recreation. These effects would vary from state to state depending on the resources in question and their relationship to climate change. In Delaware, changes in average temperature and precipitation amounts, coupled with rising sea levels, may potentially shift agricultural production or could change regional water resource levels. Increased storms and rising sea levels may cause coastal erosion to not only Delaware beaches but to associated flora and fauna (DNREC, Division of Climate and Energy, 2015a). In inland areas of Delaware already 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 (DNREC, 2012c).

Impact of Climate Change on FirstNet Installations and Infrastructure

Climate change impacts on FirstNet installations and infrastructure will vary from state to state, depending on the placement and vulnerability of the installations and infrastructure, and the impacts that climate change is anticipated to have in that particular location. Climate-change induced sea level rise combined with land subsidence may increase the height, areal extent, and persistence of coastal flooding and storm surge, and more routine spring tides up Delaware Bay towards Wilmington. Stronger storms may also increase the potential for damage from high winds and wind-borne debris (DNREC, 2012c). Energy sources such as powerlines and stand-by generators would be similarly elevated or otherwise protected. Towers would also be rated for stronger hurricane-force winds and hardened to protect them from strikes by wind-borne debris. Based on the impact significance criteria presented in Table 4.2.14-1, climate change effects on FirstNet installations and infrastructure would be significant if they negatively affected the operation of these facilities.

4.2.14.5. 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 Delaware, 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, 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
  - Satellite Enabled Devices and Equipment: 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.

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:

- Wireless 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 work boats 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 back-up), 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 construction would not take place. 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 back-up), 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 of time (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. See Chapter 17, BMPs and Mitigation Measures, for 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. FirstNet installations should be evaluated in the design and planning phase through tiering to this analysis, in the context of their local geography and anticipated climate hazards to ensure they are properly hardened or there is sufficient redundancy to continue operations in a climate-affected environment. Mitigation measures could minimize or reduce the severity or magnitude of a potential impact resulting from 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.

Climate change's anticipated impact on extreme weather events such as hurricanes or heat waves may increase the severity of the emergencies to which first responders are responding in vulnerable areas, and thus the extent and duration of their dependence on FirstNet resources. FirstNet would likely prepare to sustain these operations in areas experiencing climate and weather extremes through the design and planning process for individual locations and operations.

4.2.14.6. 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.

Operations Impacts

Implementing land-based deployable technologies (COW, COLT, SOW) 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. 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 deployment and 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. The concentrations and associated impacts would be dictated by the products of combustion from ground support vehicles, as well as the duration of ground support operations and travel between storage and deployment locations.

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

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 few GHG emissions associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. Emissions would arise from use of power generators as the main power source. Emissions from the use of one fossil-fuel-powered generator would not be significant based on the defined significance criteria, since activities would be temporary and short-term. These potential impacts could be further reduced through implementation of the required BMPs and mitigation measures. These projects may also consist of deploying aerial vehicles including, but not limited to, drones, balloons, blimps, and piloted aircraft, which could involve fossil fuel combustion. Climate change effects have the most noticeable impacts over a long period of time. 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. If there are no permanent structures, particularly near coastal areas, there would be little to no impacts as a result of sea-level rise. 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.

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 4.1.14, Climate Change.

4.2.15. Human Health and Safety

4.2.15.1. Introduction

This section describes potential impacts to human health and safety in Delaware associated with deployment of the Proposed Action and alternatives. See Chapter 17, BMPs and Mitigation Measures, for 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.

4.2.15.2. 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 4.2.15-1. 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 4.2.15-1: Impact Significance Rating Criteria for Human Health and Safety

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and 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 BMPs and 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 BMPs and 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

4.2.15.3. 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 4.2.15-1, 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. For example, if fuel is spilled from an onsite fuel tank, the spilled fuel could migrate down gradient and infiltrate underground drinking water sources. The general public may then be exposed to hazardous chemicals in their drinking water if they utilize the same groundwater aquifer.

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 n.d.).

1) Engineering controls,
2) Work practice controls,
3) Administrative controls, and then
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, 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.

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 (U.S. Department of Labor, Occupational Safety and Health Administration, n.d.). 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 project sites. In addition to HASPs and SDSs, standard operating procedures (SOP) would be developed and implemented by FirstNet partner(s) for critical and/or repetitive tasks that require attention to detail, specialized knowledge, or clear step-wise 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 (U.S. Department of Labor, Occupational Safety and Health Administration, n.d.). 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 Delaware Department of Labor (DEDOL) is not authorized by OSHA to administer a state program for public or private sector employers. Therefore, DEDOL defers all regulatory authority and enforcement for occupational safety relating to FirstNet site work to the leadership and interpretation of OSHA.

Hazardous Materials, Hazardous Waste, and Mine Lands

The presence of environmental contamination 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 as a result of underground shaft collapses or seismic shifting. Based on the impact significance criteria presented in Table 4.2.15-1, human health impacts could be significant if FirstNet deployment sites are near contaminated properties. Prior to the start of any FirstNet deployment project, 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 DNREC, or through an equivalent commercial resource, such as Environmental Data Resources, Incorporated.

By screening sites for environmental contamination, 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, the more favorable the site will be for FirstNet deployment projects. If sites containing known environmental contamination 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 Delaware 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 DNREC 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

FirstNet is intended to improve connectivity among public safety entities during disasters, thereby improving their ability to respond more safely and effectively during such events. The addition of towers, structures, facilities, equipment, and other deployment activities is expected to allow for expedited responses during 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 4.2.15-1, 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. Therefore, FirstNet partner(s) would develop disaster response plans that outline specific steps employees should take in the event of a natural or manmade disaster.

4.2.15.4. 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.

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. Hazardous materials needed for this work would include fiber optical cable lubricants, mechanical oil/grease, and fuel for 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 to 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 would 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 limited nearshore and inland 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), 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 to 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. See Chapter 17, BMPs and Mitigation Measures, for 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, assuming that the inspections do not require climbing towers or confined space entry. In those instances, 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. See Chapter 17, BMPs and Mitigation Measures, for 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.

4.2.15.5. 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 is 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. See Chapter 17, BMPs and Mitigation Measures, for 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, assuming that the inspections do not require climbing towers or confined space entry. In those instances, 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. See Chapter 17, BMPs and Mitigation Measures, for 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 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 4.1.15, Human Health and Safety.

DE Appendix A – Water Resources

Table A-1: Characteristics of Delaware's Watersheds, as Defined by DNREC

Watershed/Size Land Area within DE (square miles)	Major Surface Waterbodies	Major Water Quality Concerns
Piedmont (116,459)	White Clay Creek Christina River Brandywine Creek Delaware River	• Bacteria • Excess nutrients • Low dissolved oxygen levels • Polychlorinated biphenyls (PCBs) • Zinc • Pesticides
Delaware Bay (814)	Delaware River Smyrna River Leipsic River St. Jones River Murderkill River Mispillion River Lums Pond Chesapeake and Delaware Canal	• PCBs • Arsenic • Dioxin • Mercury • Pesticides • Iron • Low dissolved oxygen • Excess nutrients • High temperature
Chesapeake Bay (769)	Chesapeake and Delaware Canal Nanticoke River	• Bacteria • Excess nutrients • Low dissolved oxygen • High temperature
Inland Bays/Atlantic Ocean (314)	Rehoboth Bay Indian River Bay Assawoman Bay Little Assawoman Bay	• Bacteria • Excess nutrients • Low dissolved oxygen • High temperature • Suspended solids

Source: (DNREC, 2013a) (DNREC, 2015e) (DNREC, 1997) (DNREC, 2015t)

DE Appendix B – Communities of Concern

Table B-1: S1 Ranked Terrestrial Communities of Concern in Delaware

Habitat Type	Sub-Habitats	Description	Distribution
Northern Piedmont and Middle Atlantic Coastal Plain	North Atlantic Fresh Tidal Shrub Swamp	Dominated by smooth alder. Found along the seasonally tidal and flooded rivers and streams in the Christina River floodplain.	New Castle County
	Cattail Brackish Tidal Marsh	Brackish tidal marsh with the dominant species of narrow-leaf cattail.	New Castle and Kent County
	Northeastern Dry Oak-Hickory Forest	Found on well-drained slopes and places where soil moisture is on the dry end of mesic. Dominated by dry acid species and a highly diverse dry oak-hickory forest.	New Castle and Kent County
	Northern Coastal Plain/Piedmont Basic Mesic Hardwood Forest	Rich forest found in sheltered ravines in soils derived from rocks rich in nutrients.	Sporadic through New Castle and Kent County
Northern Piedmont	Central Appalachian Cutgrass Marsh	Prominent community in the northernmost parts of the Brandywine Creek watershed. Found on edges of floodplains dominated by rice cutgrass (*Leersia oryzoides*).	New Castle County
	Golden-saxifrage Forested Seep	Small areas of forested seeps with scattered coverage of golden saxifrage (*Chrysosplenium americanum*) and a canopy of trees or shrubs from the surrounding community.	New Castle County
	Skunk Cabbage-Orange Jewelweed Seep	Wooded seep found in low lying areas of stream headwaters and hillside seepages. Dominated by skunk cabbage (*Symplocarpus foetidus*) and orange jewelweed (*Impatiens capensis*).	New Castle County
	Central Appalachian Dry-Mesic Chestnut Oak-Northern Red Oak	Found on upper slopes and ridgetops that have thin acidic nutrient poor soils. Consists of a closed to partially open canopy that requires occasional fire regeneration.	New Castle County
	Central Appalachian/Northern Piedmont Chestnut Oak Forest	Typical oak forest found in Delaware. Found on dry acidic soils with boulders and cobbles in the substrate. Dominant species include chestnut oak (*Quercus prinus*) and northern red oak (*Quercus rubra*).	New Castle County
	Southern New England Red Maple Seepage Swamp	An acidic seasonally saturated seepage forest community dominated by red maple. Found on slightly sloping hillsides, along small streams and in basins that receive overland flooding and groundwater influence.	New Castle County
	Shrubby St. John's Wort Shrubland	Shrubland dominated by St. John's wort (*Hypericum prolificum*). Found in Brandywine Creek State Park.	New Castle County
	Rice Cutgrass-Fowl Mannagrass Wet Meadow	Herbaceous wetlands located in the headwaters of streams in the Brandywine Creek watershed.	New Castle County

Habitat Type	Sub-Habitats	Description	Distribution
Middle Atlantic Coastal Plain	Woolgrass Marsh	Found in seasonally flooded freshwater marshes or emergent upland depression ponds with inundation in the winter and drying in the summer. The dominant species is woolgrass (*Scirpus cyperinus*).	New Castle County
	Mesohaline Seepage Marsh	Found in meandering streams with freshwater seepage areas with silty mud.	New Castle County
Middle Atlantic Coastal Plain	Blueberry Wetland Thicket	Shrubland found in areas with a fluctuating water table, such as open basins and margins of Coastal Plain ponds. Dominated by highbush blueberry (*Vaccinium corymbosum*).	Kent county, Sussex county
	Maritime Red Cedar Woodland	Maritime woodland found on sand dunes dominated by eastern red cedar (*Juniperus virginiana*). Influenced by onshore winds and salt spray and tidal overwash of the Delaware Bay.	Kent County, Sussex County
	Loblolly Pine/Wax-myrtle/Salt Meadow Cordgrass Tidal Woodland	Found on edges of North Atlantic and Mid Atlantic high salt marshes along the Delaware Bay. Occasionally covered by tidal flooding.	Kent County, Sussex County
	North Atlantic Coastal Oak-Holly Forest	Floodplain found in the Nanticoke River watershed and on flatwoods of the Choptank River watershed.	Kent County, Sussex County
	Oligohaline Mixed Forbs Tidal Marsh	Oligohaline marsh found on tidal shores that range from slightly brackish to fresh water.	New Castle and Kent County
	Freshwater Tidal Mixed High Marsh	Freshwater tidal marsh found in flooded swales and back-marshes.	New Castle and Sussex County
	Inland Dune Ridge Forest	Found on relic sand dunes called xeric sand ridges.	Sussex County
	Atlantic White Cedar/Seaside Alder Swamp	Swamp found in stream floodplains and artificial mill ponds on the Delmarva Peninsula.	Sussex County
	Red Maple-Seaside Alder Woodland	Woodland consisting of stunted red maple in a large inundated impoundment.	Sussex County
	Alluvial Alder Swamp	Found in alluvial floodplains and seepage slopes.	Sussex County
	Needlerush High Marsh	Found in “high” and “low” marshes that are irregularly flooded. Occurs in isolated patches within the North Atlantic low salt marsh or drainage areas. Dominant species is Roemer’s bulrush.	Sussex county
	Twig Rush Peat Mat	Dominated by twig rush (*Cladium mariscoides*) and is associated by numerous rare plant species at the global and state level. One of the rarest in Delaware and on the Delmarva Peninsula.	Sussex County
	Pond Pine Woodland	Woodlands dominated by pond pine (*Pinus serotina*) with a dense shrubby understory. Found along the Delaware Bay.	Sussex County

Habitat Type	Sub-Habitats	Description	Distribution
	Loblolly Pine Dune Woodland	Found on the dunes of barrier islands exposed to actively shifting foredunes, salt spray, wind and storms. Woodlands consist of either dense pine duff accumulation or exposed white sand. Trees have multiple trunks and low spreading branches.	Sussex County
	Pitch Pine Dune Woodland	Pine forest found on back dunes of the Virginia Barrier Islands. Active sand movement from storm activity creates woodland boundaries and allowing for migration overtime. Fire plays an important role in maintaining this community.	Sussex County

ACRONYMS

AGL	Above Ground Level
AML	Abandoned Mine Lands
AQCR	Air Quality Control Region
ARPA	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
BWI	Marshall International Airport
BYA	Billion Years Ago
CAA	Clean Air Act
CCMP	Comprehensive Conservation and Management Plan
CEQ	Council On Environmental Quality
CFR	Code of Federal Regulations
CGP	Construction General Permit
CH4	Dioxide (CO_2), Methane
CIAC	Community Involvement Advisory Council
CIMC	Cleanups In My Community
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COLT	Cell On Light Trucks
COW	Cell On Wheels
CPCN	Certificate of Public Convenience and Necessity
CRS	Community Rating System
CWA	Clean Water Act
DAAQS	Delaware Ambient Air Quality Standards
DAC	Delaware Regulations Administrative Code
DBRC	Delaware Bird Records Committee
DE	Delaware
DEDHSS	Delaware Department of Health and Social Services
DEDOL	Delaware Department of Labor
DELWIN	Networks: (1) the Delaware Interoperable Network
DNHP	Delaware Natural Heritage Program
DNREC	Department of Natural Resources and Environmental Control
DPH	Division of Public Health
DSHS	Department of Safety and Homeland Security
EFH	Essential Fish Habitats

EIA	Energy Information Agency
EMS	Emergency Medical Services
EOP	Emission Offset Provisions
EPCRA	Community Right To Know Act
FAA	Federal Aviation Administration
FAQ	Frequently Asked Questions
FCC	Federal Communications Commission
FEMA	Federal Emergency Management Agency
FFC	Fossil Fuel Combustion
FGDC	Federal Geographic Data Committee
FLM	Federal Land Manager
FSDO	Flight Standards District Offices
FSS	Flight Service Station
GHG	Greenhouse Gas
GWDS	Ground Water Discharges Section
HAP	Hazardous Air Pollutant
HAP	Hazardous Air Pollutants
HASP	Health and Safety Plans
HHRA	Human Health Risk Assessment
IFR	Instrument Flight Rules
ILG	New Castle Airport
IPCC	Intergovernmental Panel On Climate Change
LBS	Locations-Based Services
LRR	Land Resource Regions
LTE	Long Term Evolution
LULUCF	Land Use Change, and Commercial Forestry
MACINAC	Mid-Atlantic Consortium For Interoperable Nationwide Advanced Communications
MBTA	Migratory Bird Treaty Act
MD/DE	Salisbury
MHI	Median Household Income
MLRA	Major Land Resource Areas
MMPA	Marine Mammal Protection Act
MMT	Million Metric Tons
MSFCMA	Magnuson Stevens Fishery Conservation and Management Act
MSL	Mean Sea Level
MYA	Million Years Ago
N2O	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

NEP	National Estuary Program
NEPA	National Environmental Policy Act
NERR	National Estuarine Research Reserve
NFIP	National Flood Insurance Program
NHA	National Heritage Areas
NHL	National Historic Landmarks
NHPA	National Historic Preservation Act of 1966, As Amended
NM	Nautical Miles
NOAA	National Ocean and Atmospheric Administration
NOTAM	Disseminated Via Notices To Airmen
NOX	Ozone
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NPS	National Park Service
NRCS	National Resources Conservation Service
NRHP	National Register of Historic Places
NSA	National Security Areas
NWI	National Wetlands Inventory
OE/AAA	Obstruction Evaluation/Airport Airspace Analysis
OSHA	Occupational Safety and Health Act
OTR	Ozone Transport Region
PEM	Palustrine Emergent Wetlands
PFO	Palustrine Forested Wetlands
PGA	Peak Ground Acceleration
PHL	Philadelphia International Airport
PLUS	Preliminary Land Use Service
PPE	Personal Protective Equipment
PSAP	Public Safety Answering Point
PSC	Public Service Commission
PSCR	Public Safety Communications Research
PSD	Prevention of Significant Deterioration
PSS	Scrub-Shrub Wetlands
RCRA	Resource Conservation and Recovery Act
RF	Radio Frequency
RFI	Request For Information
RGGI	Regional Greenhouse Gas Initiative
SAA	Sense and Avoid
SAIPE	Small Area Income and Poverty Estimates
SASP	State Aviation System Plan
SDS	Safety Data Sheets
SEPTA	Southeastern Pennsylvania Transportation Authority

SGCN	Species of Greatest Conservation Need
SHPO	State Historic Preservation Office
SIP	State Implementation Plan
SO2	PM2.5 (Direct Emissions)
SOC	Standard Occupational Classification
SOP	Standard Operating Procedures
SOW	System On Wheels
SOX	Oxides of Sulfur
SPL	Sound Pressure Level
SSA	Sole Source Aquifer
SUA	Special Use Airspace
SWAP	State Wildlife Action Plan
SWPPP	Stormwater Pollution Prevention Plan
TMDL	Total Maximum Daily Load
TRI	Toxics Release Inventory
TWA	Time Weighted Average
UA	Unmanned Aircraft
UAS	Unmanned Aircraft Systems
UHF	Ultra High Frequency
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service'S
USGS	U.S. Geological Survey
VFR	Visual Flight Rules
VHF	Very High Frequency
VMT	Vehicle Miles Traveled
VOC	Ozone
VR	Visual Route
WCS	Wetlands Classification Standard
WSLS	Wetlands and Subaqueous Lands Section
WWI	World War I
WWII	World War II

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