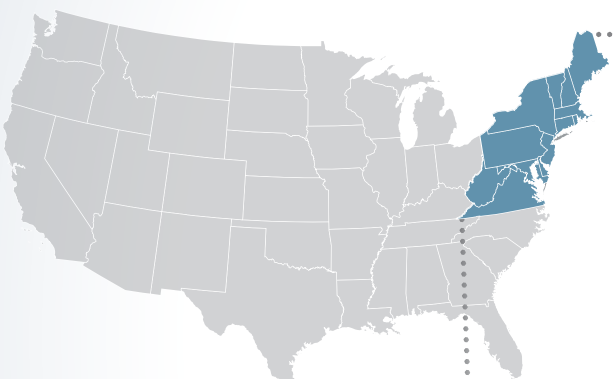
FirstNet®

Nationwide Public Safety Broadband Network

Draft Programmatic Environmental Impact Statement for the Eastern United States

VOLUME 10 - CHAPTER 12



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APRIL 2016

First Responder Network Authority

FirstNet®

Nationwide Public Safety Broadband Network

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VOLUME 10 - CHAPTER 12

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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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12.PENNSYLVANIA

In 1643, Swedish colonists founded the first permanent settlement in Pennsylvania. The settlement was then briefly held by the Dutch, but by 1664 the territory had passed to British hands and was eventually granted to the Quaker William Penn. Philadelphia, Pennsylvania was the United States (U.S.) capital during the Revolutionary War as well as the site of the Constitutional Convention (Pennsylvania Historical and Museum Commission, 2015b). Located in the northeastern U.S., Pennsylvania is bordered by New York to the north, Ohio and West Virginia to the west, New Jersey to the east, and Maryland to the south. This chapter provides details about the existing environment of Pennsylvania as it relates to the Proposed Action.

General facts about Pennsylvania are provided below.

- **State Nickname**: The Keystone State
- **Total Area:** 44,743 square miles; **U.S. Rank**: 33 (U.S. Census Bureau, 2010) (U.S. Census Bureau, 2015s)
- **Capital:** Philadelphia
- **Counties:** 67 (U.S. Census Bureau, 2015a)
- **Estimated Population:** Over 12.7 million people, 2014 estimate; **U.S. Rank:** 6 (U.S. Census Bureau, 2015j)
- **Most Populated Cites:** Philadelphia, Pittsburgh, Allentown, and Harrisburg (U.S. Census Bureau, 2015a)
- **Main Rivers:** Susquehanna River, Allegheny River, and Ohio River
- **Bordering Waterbodies:** Lake Erie
- **Mountain Ranges:** Allegheny Mountains, Pocono Mountains, and a portion of the Appalachian Mountains
- **Highest Point:** Mt. Davis (3,213 ft.) (U.S. Geological Survey, 2015a)

12.1. AFFECTED ENVIRONMENT

12.1.1. Infrastructure

12.1.1.1. Definition of the Resource

This section provides information on key Pennsylvania 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 12.1.1.3 provides an overview of Pennsylvania's traffic and transportation infrastructure, including road and rail networks and waterway facilities. Pennsylvania'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 Pennsylvania are presented in more detail in Section 12.1.1.4. Section 12.1.1.5 describes Pennsylvania's public safety communications infrastructure and commercial telecommunications infrastructure. An overview of Pennsylvania utilities, such as power, water, and sewer, is presented in Section 12.1.1.6.

12.1.1.2. Specific Regulatory Considerations

Multiple Pennsylvania laws and regulations pertain to the state's public utility and transportation infrastructure and its public safety community. Table 12.1.1-1 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 12.1.1-1: Relevant Pennsylvania Infrastructure Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Pennsylvania Consolidated Statutes: Title 58 Oil and Gas; Title 66 Public Utilities—Pennsylvania Code: Title 52 Public Utilities	Department of Environmental Protection (DEP); Pennsylvania Public Utility Commission (PUC)	Issues permits to drill oil or gas wells; collects necessary fees when issuing licenses; develops and conserves oil, gas, minerals and water; finances alternative energy solutions and sources; constructs electric generating units fueled by nuclear energy, oil or natural gas; establishes energy efficiency and conservation

[1] "The term 'public safety entity' means an entity that provides public safety services" (7 U.S. Code [U.S.C.] § 140126)).

State Law/Regulation	Regulatory Agency	Applicability
		programs; ensures safe and responsible supply of electricity to public.
Pennsylvania Consolidated Statutes: Title 35 Health and Safety—Pennsylvania Code: Title 28 Health and Safety	Pennsylvania Emergency Management Agency (PEMA)	Establishes, receives, reviews and approves or disapproves all 9-1-1 system plans; develops interconnectivity of 9-1-1 systems; develops a comprehensive plan for the implementation of a statewide interoperable Internet protocol network; and prepares, maintains, and keeps current a Pennsylvania Emergency Management Plan.
Pennsylvania Consolidated Statutes: Title 66 Public Utilities—Pennsylvania Code: Title 52 Public Utilities	Pennsylvania PUC	Oversees the following: producing, generating, transmitting, distributing or furnishing natural or artificial gas, electricity, or steam for the production of light, heat, or power to or for the public for compensation; diverting, developing, pumping, impounding, distributing, or furnishing water for the public for compensation; conveying or transmitting messages or communications, by telephone or telegraph or domestic public land mobile radio service including, point-to-point microwave radio service; and collecting, treating, or disposing of sewage.
Pennsylvania Consolidated Statutes: Title 74 Transportation; Title 30 Fish—Pennsylvania Code: Title 67 Transportation	Pennsylvania Department of Transportation (PennDOT)	Acquires and operates public transportation facilities and systems including roads, streets, highways, bridges, or tunnels; establishes operating guidelines and registers trucks, passenger cars, motor homes, buses, vans, and boats; and licenses drivers.

Sources: (Pennsylvania General Assembly, 2015a) (Fry Communications, Inc., 2015)

12.1.1.3. Transportation

This section describes the traffic and transportation infrastructure in Pennsylvania, including specific information related to the road networks, airport facilities, rail networks, and harbors this PEIS defines "harbor" as a body of water deep enough to allow anchorage of a ship or boat). 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 Pennsylvania are based on a review of maps, aerial photography, and federal and state data sources.

The PennDOT 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 PennDOT is divided into five principal divisions:

- The Highway Administration is responsible for the "design, construction, maintenance, materials testing, environmental review, and safety and traffic engineering" for the state's highways;
- Driver and Vehicle Services "manages the issuance of more than 8.8 million driver's licenses and the registration of more than 11.6 million motor vehicles";

- Planning "works with the federal government and local planning organizations to develop the Twelve Year Transportation Program";
- Multimodal Transportation "oversees aviation, rail freight, public transportation, ports and other multimodal programs"; and
- Administration "oversee[s] fiscal management, computer systems, equal opportunity, training, office services personnel, and Pennsylvania Welcome Centers" (PennDOT, 2014).

Pennsylvania has an extensive and complex transportation system across the entire state. The state's transportation network is comprised of:

- 119,847 miles of highways and 25,000 state owned bridges (PennDOT, 2014);
- Over 6,000 miles of rail network that includes passenger rail and freight (PennDOT, 2010);
- 806 aviation facilities that includes both public and private airports (USDOT, 2015); and
- 2 major ports that includes both public and private facilities.

Road Networks

As identified in Figure 12.1.1-1, the major urban centers of the state are Pittsburgh, Erie, Altoona, Scranton, Allentown, Bethlehem, Allentown, Reading, Lancaster, Philadelphia, and Levittown. Pennsylvania has 12 major interstates connecting its major metropolitan areas to one another, as well as to other states. Travel to local towns is conducted mainly via state and county routes. Table 12.1.1-2 lists the interstates and their start/end points in Pennsylvania. Per the national standard, even numbered interstates run from west to east with the lowest numbers beginning in the south; odd numbered interstates run from north to south with the lowest numbers beginning in the west (FHWA, 2015a).

Table 12.1.1-2: Pennsylvania Interstates

Interstate	Southern or Western Terminus in PA	Northern or Eastern Terminus in PA
I-70	WV line at West Alexander	MD line at Warfordsburg
I-76	OH line at Enon Valley	NJ line at Philadelphia
I-78	I-81 in Union	NJ line at Easton
I-79	WV line at Mount Morris	PA 5 in Erie
I-80	OH line at West Middlesex	NJ line at Stroudsburg
I-81	MD line at State Line	NY line at Great Bend
I-83	MD line at Shrewsbury	I-81 in Harrisburg
I-84	I-81 in Roaring Brook	NY line at Matamoras
I-86	I-90 in Greenfield	NY line at North East
I-90	OH line at Springfield	NY line at North East
I-95	DE line at Marcus Hook	NJ line at Yardley
I-99	I-76 in Bedford	I-80 in Bellefonte

In addition to the Interstate System, Pennsylvania 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 12.1.1-1 illustrates the major transportation networks, including roadways, in Pennsylvania. Section

12.1.8, Visual Resources, describes the National and State Scenic Byways found in Pennsylvania from an aesthetic perspective.

National Scenic Byways are roads with nationwide interest; these byways are designated and managed by the U.S. Department of Transportation (USDOT), Federal Highway Administration. Pennsylvania has three National Scenic Byways: Historic National Road, Journey Through Hallowed Ground Byway, and Great Lakes Seaway Trail (FHWA, 2015a).

State Scenic Byways are roads with statewide interest; State Scenic Byways are designated and managed by PennDOT. Pennsylvania has 19 State Scenic Byways that crisscross the entire state (Visit PA, 2015):

- Blue Route
- Brandywine Valley
- Bucktail Trail
- Conestoga Ridge Road
- Crawford Lakelands
- Delaware River Valley
- Exton Bypass
- Gateway to the Endless Mountains
- Governor Casey
- Grand View
- High Plateau
- Kinzua
- Lake Wilhelm
- Laurel Highlands
- Lebanon Cornwall
- Longhouse National
- U.S. Route 202 Parkway
- Viaduct Valley Way
- West Branch Susquehanna River

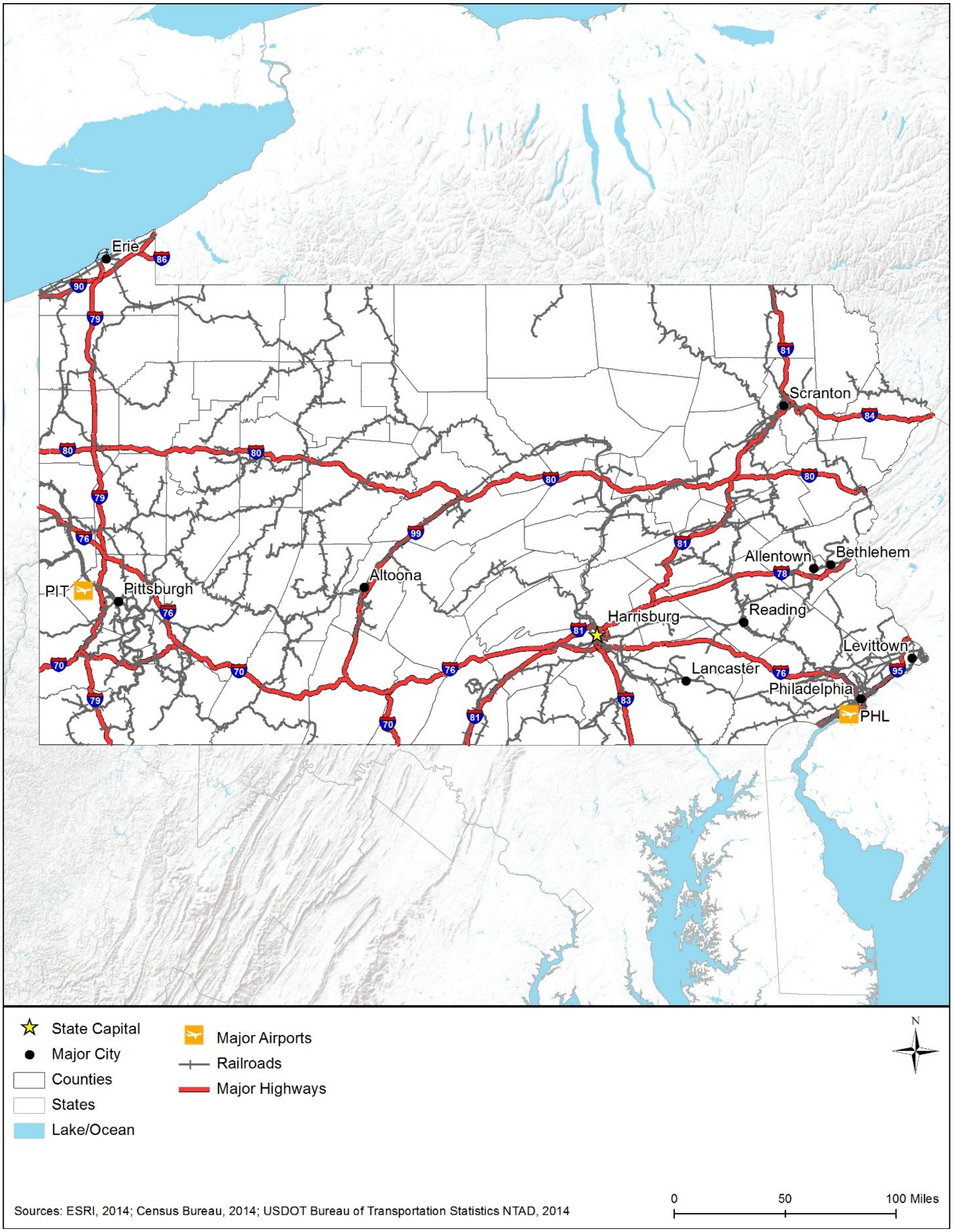


Figure 12.1.1-1: Pennsylvania Transportation Networks

Airports

Air service to the state is provided by a number of major international airports. Philadelphia International Airport serves the City of Philadelphia and points east; Pittsburgh International Airport serves the City of Pittsburgh and points west.

Philadelphia International Airport (PHL) is owned and operated by the City of Philadelphia. The airport served over 30.7 million passengers in 2014 and handled 419,253 aircraft takeoffs and landings (Philadelphia International Airport, 2015a). That same year, the airport moved 43,752 tons of cargo and mail (Philadelphia International Airport, 2015a). In 2013, Philadelphia International Airport ranked 18th for the number of total passengers among all U.S. airports and 17th for cargo, which includes freight and mail; the airport was 10th in the U.S. for the total number of airplane takeoffs and landings (Philadelphia International Airport, 2015b).

Pittsburgh International Airport (PIT) is owned and operated by the Allegheny County Airport Authority under an initial 25 year lease (Pittsburgh International Airport, 2015). In 2014, the airport served 7,998,970 passengers and handled 135,840,169 pounds of cargo (Pittsburgh International Airport, 2014).

Figure 12.1.1-1 illustrates the major transportation networks, including airports, in the state. Section 12.1.7, Airspace, provides greater detail on airports and airspace in Pennsylvania.

Rail Networks

Pennsylvania is connected by a large rail network of passenger rail (Amtrak), public transportation (commuter rail), and freight rail. Pennsylvania maintains the fifth largest rail system in the nation (PennDOT, 2010). Figure 12.1.1-1 illustrates the major transportation networks, including rail lines, in Pennsylvania.

Amtrak runs six lines throughout Pennsylvania, 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. Table 12.1.1-3 provides a complete list of Amtrak lines that run through Pennsylvania.

Table 12.1.1-3: Amtrak Train Routes Serving Pennsylvania

Route	Starting Point	Ending Point	Length of Trip	Major Cities Served in Pennsylvania
Acela Express	Boston, MA	Washington, DC	7 hours	Philadelphia
Capitol Limited	Washington, DC	Chicago, IL	18 hours	Pittsburgh
Keystone	New York, NY	Harrisburg, PA	3 hours 50 minutes	Philadelphia, Harrisburg
Lake Shore Limited	New York, NY or Boston, MA	Chicago, IL	19 hours	Erie
Northeast Regional	Boston, MA	Virginia Beach, VA	12 hours 30 minutes	Philadelphia
Pennsylvanian	New York, NY	Pittsburgh, PA	9 hours 20 minutes	Philadelphia, Pittsburgh

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

Pennsylvania has 37 fixed route transit agencies in the state (PennDOT, 2014). The largest of those is the Southeastern Pennsylvania Transportation Authority (SEPTA): the sixth largest transit system in the nation, it is a regional rail service serving the Philadelphia metropolitan area (PennDOT, 2014). SEPTA runs a total of 13 lines into Center City Philadelphia, maintains 154 stations, and operates on 280 miles of tracks (SEPTA, 2014). In fiscal year 2014, riders made 36,657,700 trips on SEPTA trains (SEPTA, 2014).

Pittsburgh's light rail service, known as the "T," is the 25th largest commuter rail service in the nation (PennDOT, 2014). The "T" is owned and operated by the Port Authority of Allegheny County. The system is both a subway in Pittsburgh and a commuter rail serving the southern suburbs of Pittsburgh. In 2014, the "T" served 28,053 passengers on a typical weekday across the two lines of its 26.2-mile light rail system (Port Authority of Allegheny County, 2013).

In 2011, Pennsylvania ranked first in the U.S. for the number of freight railroads operating in the state, seventh in the number of freight carloads terminating in the state, and eighth in the number of carloads originating in the state. The state has four large freight railroad companies operating within its borders (PennDOT, 2015a).

Harbors and Ports

Pennsylvania is largely landlocked, with the exception of Lake Erie in the north, and the Delaware River to the southeast. The Delaware River separates southeastern Pennsylvania from New Jersey. Sitting on the river is the state capitol and the accompanying Port of Philadelphia. Just south of Philadelphia lies the Port of Chester, also on the Delaware River. Far west of these, in Pennsylvania's interior, lies the Port of Pittsburgh, found at the junction of the Alleghany, Ohio, and Monongahela Rivers. In the extreme northeast corner of Pennsylvania lies the Port of Erie, found on Lake Erie near the state line.

The Philadelphia Regional Port Authority (PRPA) was created in 1989 by the state legislature as an independent agency to oversee the Port of Philadelphia and its trade (PRPA, 2015a). The port it oversees has facilities up and down the coast of the Delaware River, which can be reached via I-95. This is presented in Figure 12.1.1-1. The Port of Philadelphia is served by rail lines from CSX, Norfolk Southern, and Canadian Pacific rail companies (PRPA, 2015b). In order to accommodate larger vessels, the Port is in the process of deepening the main channel of the Delaware from 40 feet to 45 feet. Scheduled to be finished in 2017, this effort will benefit port terminals in Pennsylvania and New Jersey (PRPA, 2015c). The Port of Pennsylvania imported 15,545 million kg worth of goods in 2013, worth $17.2 billion. That year, the port also exported 3,644 million kg of goods worth $4,508 million (U.S. Census Bureau, 2015b).

Just south of the Port of Philadelphia on the Delaware River lies the Port of Chester. Known as Penn Terminals, the port is privately owned in Chester, PA (Figure 12.1.1-1). This port is also served by rail lines from CSX, Conrail, and Norfolk Southern (Penn Terminal, 2015a). The grounds of the port were originally a Naval Shipyard converted in 1986 for use as a multiuse terminal (Penn Terminal, 2015b). In 2013, $7,066 million of cargo, weighing 4,790 million kg, was imported through the Port of Chester. That same year, the port exported 385 million kg in cargo, worth $1,920 million (U.S. Census Bureau, 2015b).

Found at the juncture of the Alleghany, Ohio, and Monongahela Rivers in inland Pennsylvania, the Port of Pittsburgh was the third busiest inland U.S. port in 2013 (Figure 12.1.1-1). Cargo can be moved from the Port of Pittsburgh as far inland as Tulsa, OK or the Gulf of Mexico. The port, the surrounding districts, and rivers include 17 locks and dams which allow vessels to move down the river. The Port District contains approximately 200 miles of waterways in the western and southwestern part of the state (Port of Pittsburgh, 2015a). The Port District also contains 23 river terminals, designed to handle a number of commodities (Port of Pittsburgh, 2015b). A number of rails also run to and from the port, including the Class I Railroads of CSX Transportation, Inc., Norfolk Southern, and Canadian National Railways. The port also has rail connections with Class II Railroads, including the Buffalo & Pittsburgh Railroad, Inc. Kiski Junction Railroad, Mountain Laurel Railroad Company, the Pittsburgh (sic) & Shawmut Railroad, and the Wheeling & Lake Erie Railway Company (Port of Pittsburgh, 2015c). "Based on 2013 data from the U.S. Army Corps of Engineers (USACE), Pittsburgh is the third busiest inland port in the nation and the 20th busiest port, of any kind, in the nation, handling 33 million tons of cargo in 2013" (Port of Pittsburgh, 2015a).

The Port of Erie is found on the edge of Lake Erie in the northeast corner of Pennsylvania (Figure 12.1.1-1). The port's harbor is 29 feet deep in a "natural bay formed and sheltered by Presque Isle." (Port of Erie, 2015a). Its location makes the port a hub for vessels moving through the Great Lakes and the St. Lawrence Seaway (Port of Erie, 2015a). In addition to offering marinas and camping, the port is home to Donjon Shipbuilding and Repair. Donjon has "one of only two dry docks on the Great Lakes capable of dry docking 1,000 foot Great Lakes Self-Unloading vessels" (Port of Erie, 2015b). In 2013, U.S. Census data indicated that approximately $2.3 million in cargo was imported through the Port of Erie, weighing 56.7 thousand tons (U.S. Census Bureau, 2015b).

12.1.1.4. Public Safety Services

Pennsylvania 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 12.1.4-1 presents Pennsylvania'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 12.1.9, Socioeconomics.

Table 12.1.1-4: Key Pennsylvania Indicators

Pennsylvania Indicators	
Estimated Population (2014)	12,787,209
Land Area (square miles) (2010)	44,742.70
Population Density (persons per sq. mile) (2010)	283.9
Municipal Governments (2013)	1,016

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

Table 12.1.1-5 presents Pennsylvania's public safety infrastructure, including fire and police stations. Table 12.1.1-6 identifies first responder personnel including dispatch, fire and rescue, law enforcement, and emergency medical personnel in the state.

Table 12.1.1-5: Public Safety Infrastructure in Pennsylvania by Type

Infrastructure Type	Number
Fire and Rescue Stations	4,147
Law Enforcement Agencies	1,030
Fire Departments	2,373

Source: (National Fire Department Census, 2015)

Table 12.1.1-6: First Responder Personnel in Pennsylvania by Type

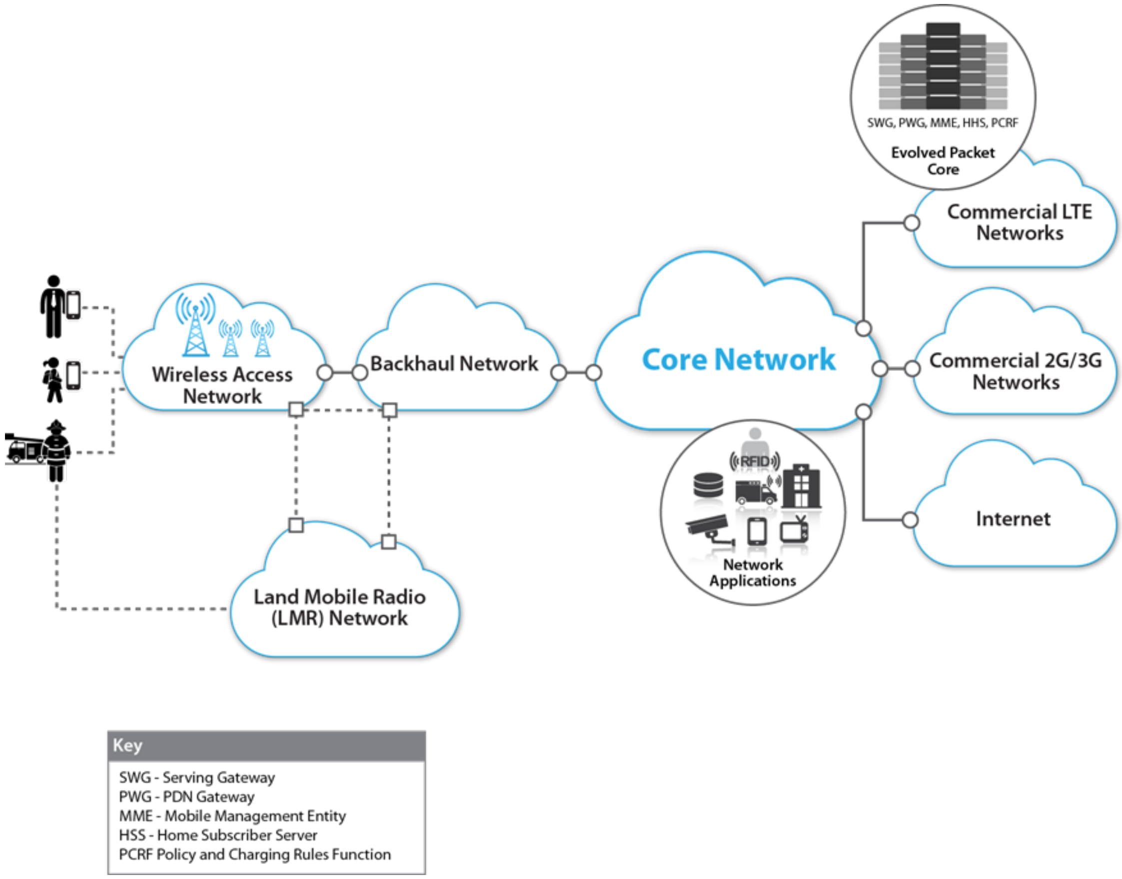
Dispatch Personnel	
First Responder Personnel	**Number**
Police, Fire and Ambulance Dispatchers	3,180
Fire and Rescue Personnel	63,955
Law Enforcement Personnel	68,383
Emergency Medical Technicians and Paramedics	13,070

Sources: (National Fire Department Census, 2015) (BLS, 2015b) (Reaves, 2011)

12.1.1.5. Telecommunications Resources

Telecommunication resources in Pennsylvania 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 Pennsylvania 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 12.1.1-2 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 an 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 12.1.1-2: 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 (NTFI, 2005). This has caused a fragmented approach to communications implementation across the U.S. and at the state level, including in Pennsylvania.

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

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

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

Pennsylvania Public Safety and state government agencies are served by the 800 Megahertz (MHz) Pennsylvania Statewide Radio Network (PA-STARNET). According to the Pennsylvania State Police's (PSP) Statewide Radio Network Division's Factsheet summarizing PA-STARNET's history, the objectives of the system's development, authorized by the Pennsylvania Legislature in 1996, were to: " Replace multiple incompatible, aging mobile radio systems in use by the commonwealth with a single, highly flexible, centrally managed statewide system…Implement a statewide wireless transport for mobile, handheld, and fixed position radios that supports data applications in addition to voice communications…Provide system coverage of at least 95 percent by county throughout Pennsylvania for mobile radio communication; Create a framework for interoperable communications among any state agencies, Regional Taskforces (RTFs) and county 9-1-1 centers" (PSP, 2015a).

PA-STARNET provides mobile coverage of 96.9 percent of the state's territory via its communications infrastructure consisting of 253 standard wireless towers, complemented by 759 microcells[2] (PSP, 2015a). PA-STARNET currently supports 22 state agencies including the PSP, (which runs the network), county and municipal agencies, and both houses of the state legislature (PSP, 2015a).

Like many states Pennsylvania has invested in upgrading its Public Safety networks to take advantage of digital[3] and IP technologies; PA-STARNET is based on Harris' OpenSky platform, a time division multiple access (TDMA) digital system.[4] Pennsylvania's public safety wireless

[2] A microcell is a supplemental lower-profile and smaller coverage wireless site used to either enhance capacity or extend wireless coverage.

[3] Digital networks are those that allow for simultaneous digital transmission of voice, data, video, and other network services over the traditional public-switched telephone network, or over new 3G, 4G, or LTE wireless networks.

[4] TDMA is a multiplexing channel access technology.

networks continue to use older analog[5] Very High Frequency (VHF)[6] and Ultra High Frequency (UHF)[7] radio technologies including hybrid digital/analog communications, remote location communications, mutual aid, and supplemental dispatch and tactical communications.

Operational responsibility for PA-STARNET resides with the PSP in its Radio Network Division which, "provides management, and administration for the design, development, and operation of PA-STARNet, including support for agency adoption, use, and fleet management..." (PSP, 2015b). In addition, there is a PA-STARNET Operations committee comprised of multiple agency representatives which "provides a forum to discuss PA-STARNET status, development, policy, interoperability, and other key issues, resulting in guidance for PA-STARNET management and administration as well as information sharing among system users" (PSP, 2015b).

In 2010, the Commonwealth of Pennsylvania received a Broadband Technology Opportunities Program (BTOP) infrastructure grant to enhance broadband connectivity and speeds in Pennsylvania and to improve the capacity, coverage, and resiliency of its public safety and government agency microwave and wireless network. The BTOP project resulted in the addition of five new wireless towers and 71 new microwave links which strengthened PA-STARNET, improving its capacity, coverage, and resiliency (Executive Office of the State of Pennsylvania, 2013).

Statewide Networks

As referenced above, PA-STARNET is Pennsylvania's statewide radio network providing near ubiquitous geographical coverage of the state through its combination traditional wireless tower and low profile microcell network sites, as presented in Figure 12.1.1-3 below.

[5] Analog networks are those based on circuit-switching, which establishes a connection and then maintains it through the whole communication. Although now digitized, the nation's original telephone system is an example of an analog network.
[6] VHF band covers frequencies ranging from 30 MHz to 300 MHz. (NTIA, 2005)
[7] UHF band covers frequencies ranging from 300 MHz to 3000 MHz. (NTIA, 2005)

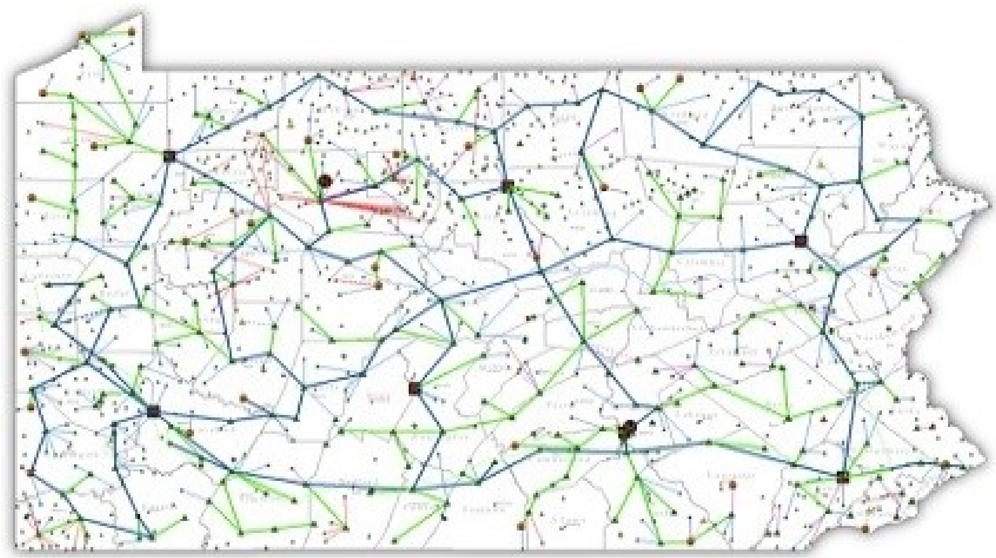


Figure 12.1.1-3: PA-STARNET Tower Location Overview Map

Source: (PSP, 2015a)

The PSP Statewide Radio Division Factsheet summarizes the statewide network technical highlights as including:

- "…a robust Internet Protocol (IP) throughout the state
- System network backbone link sites through a high-availability microwave network using Multi-protocol Label Switching (MPLS)[8]…
- 800 Megahertz (MHz) trunked digital technology…
- Vehicular Tactical Networking (V-TAC) with a mobile radio used as a repeater to extend system coverage…
- Interoperability technology, including external radio system gateways, Internetworking[9], frequency band overlays, and wireless broadband…" (PSP, 2015a)

PA-STARNET also leverages older VHF and UHF overlay networks to its digital 800 MHz core statewide network and technology to facilitate interoperability. Figure 12.1.1-4 (Alleghany county example) and Figure 12.1.1-5 (Berks county example) depict VHF and UHF overlay network coverage examples, respectively for each frequency type.[10]

[8] MPLS is a mechanism in high-performance telecommunications networks that directs data from one network node to the next based on short path labels rather than long network addresses (avoiding complex lookups in a routing table).

[9] The practice of connecting a computer network with other networks through the use of gateways that provide a common method of routing information packets between the networks.

[10] The PSP through its Radio Network Division provides maps of multiple VHF and UHF sites to facilitate interoperability planning and the full set of maps are available at the PSP source cited for future reference if required.

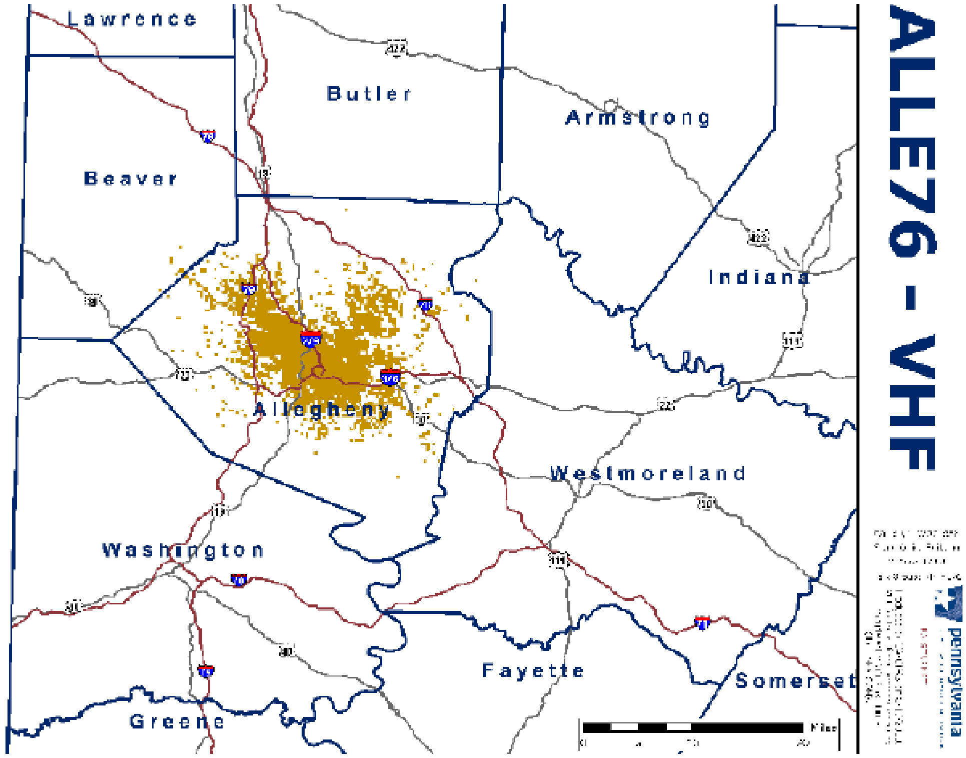


Figure 12.1.1-4: PA-STARNET VHF Overlay Network: Allegheny County Example

Source: (PSP, 2015b)

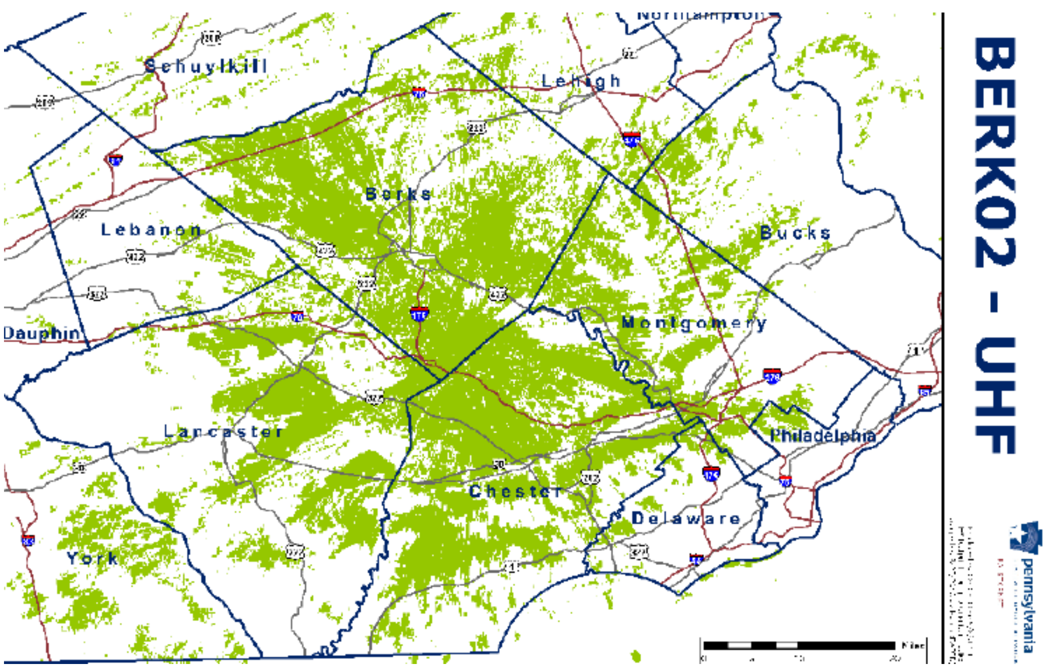


Figure 12.1.1-5: PA-STARNET UHF Overlay Network: Berks County Example

Source: (PSP, 2015b)

County Networks

Many counties in Pennsylvania have elected to upgrade their public safety networks to the Project-25 (P-25) digital standard, including Philadelphia, Bucks, York, Berks, Centre, and Lancaster Counties (Radio Reference.com, 2015a). Other counties including Allentown, Lebanon, and Montgomery County have not upgraded to a digital system and operate older analog networks (Radio Reference.com, 2015a). Allegheny County and Cumberland County have elected the digital OpenSky system (Radio Reference.com, 2015a).

Local City and Town Networks

Pennsylvania's local city and town public safety networks, including local police, fire, and emergency medical services (EMS), continue to rely on a wide variety of VHF and UHF frequencies for dispatch, vehicle-to-vehicle, and tactical communications. In some instances, a MultiNet is used for police/fire/EMS, leveraging both VHF and UHF frequencies. For example, Chester County deployed an analog Logic Trunked Radio (LTR) MultiNet[11] which uses multiple frequencies and allows for local interoperability across first responder users (RadioReference.com, 2015b).

Public Service Answering Points (PSAP)

According to the Federal Communications Commission's (FCC) Master PSAP registry, there are 90 PSAPs in Pennsylvania providing 9-1-1 services in the state (FCC, 2015a).

Commercial Telecommunications Infrastructure

Pennsylvania'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 Pennsylvania'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

Pennsylvania's commercial telecommunications industry provides the full spectrum of telecommunications technologies and networks, including coaxial cable, fiber optics, hybrid fiber optics/coaxial cable, microwave, wireless, and satellite systems. Table 12.1.1-7 presents the number of providers of switched access[12] lines, Internet access[13], and mobile wireless services including coverage.

[11] An LTR MultiNet System is an APCO-16 compliant LTR computer-controlled two-way trunked radio system.
[12] "A service connection between an end user and the local telephone company's switch; the basis of plain old telephone services (POTS)." (FCC, 2014b)
[13] Internet access includes DSL, cable modem, fiber, satellite, and fixed wireless providers.

Table 12.1.1-7: Telecommunications Access Providers and Coverage in Pennsylvania as of December 31, 2013

Commercial Telecommunications Access Providers	Number of Service Providers	Coverage
Switched access lines	197	98% of households
Internet access	94	65% of households
Mobile Wireless	12	96% of population

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

Table 12.1.1-8 shows the wireless providers in Pennsylvania along with their geographic coverage. The following four maps, Figure 12.1.1-6, Figure 12.1.1-7, Figure 12.1.1-8, and Figure 12.1.1-9, show: i) the combined coverage for the top two providers, AT&T and Verizon Wireless; ii) Sprint's and Toast.net's coverage; iii) T-Mobile's and Cricket Wireless' coverage; and iv) the coverage of all other providers with less than 5 percent coverage area, respectively.

Table 12.1.1-8: Wireless Telecommunications Coverage by Major Providers

Wireless Telecommunications Providers	Coverage
AT&T Mobility	94.42%
Verizon Wireless	83.57%
Sprint	47.32%
TOAST.net	47.32%
T-Mobile	18.26%
Cricket Wireless	8.94%
Other[a]	8.51%

Source: (NTIA, 2014)

[a]Other: Provider with less than 5% coverage area. Providers include: In the Stix Broadband, Getwireless.net, NTELOS, Evenlink, Noroc Broadband, Nittany Media, NCN Data Networks, CAWinet, ChiliTech Internet Solutions, Wavecrazy, WestPAnet, Innernet, UNSI, BackWoods Wireless, KCnet, Netlinx Internet, Lanteck, Clarity Connect, USA Choice Internet, Conterra Ultra Broadband, Double Dog, Interlync Internet Services, Navpoint Internet, and StarLinX Technical Services.

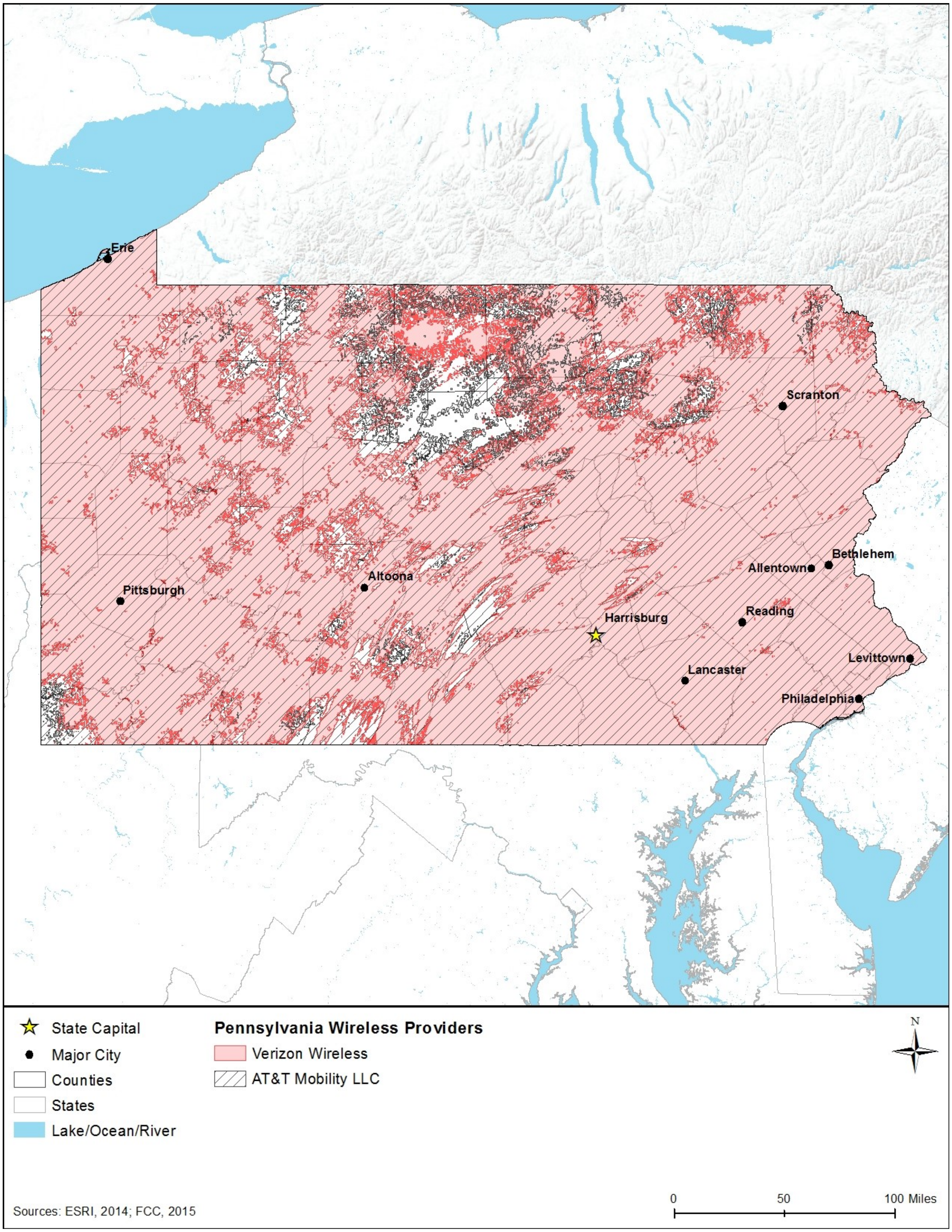


Figure 12.1.1-6: AT&T and Verizon Wireless Availability in Pennsylvania

This figure presents a map of the state and presents AT&T and Verizon Wireless availability in the state.

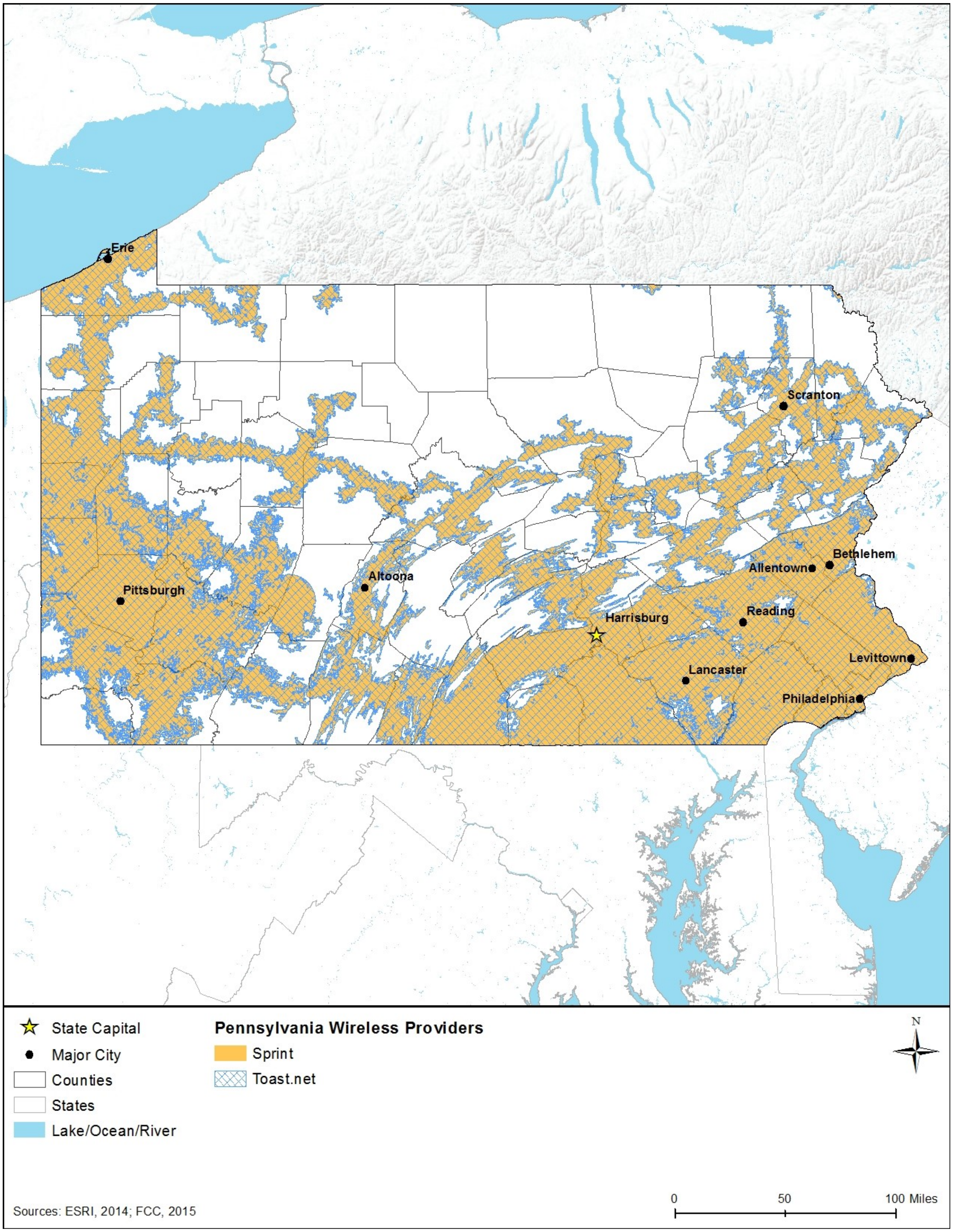


Figure 12.1.1-7: Sprint and Toast.net Wireless Availability in Pennsylvania

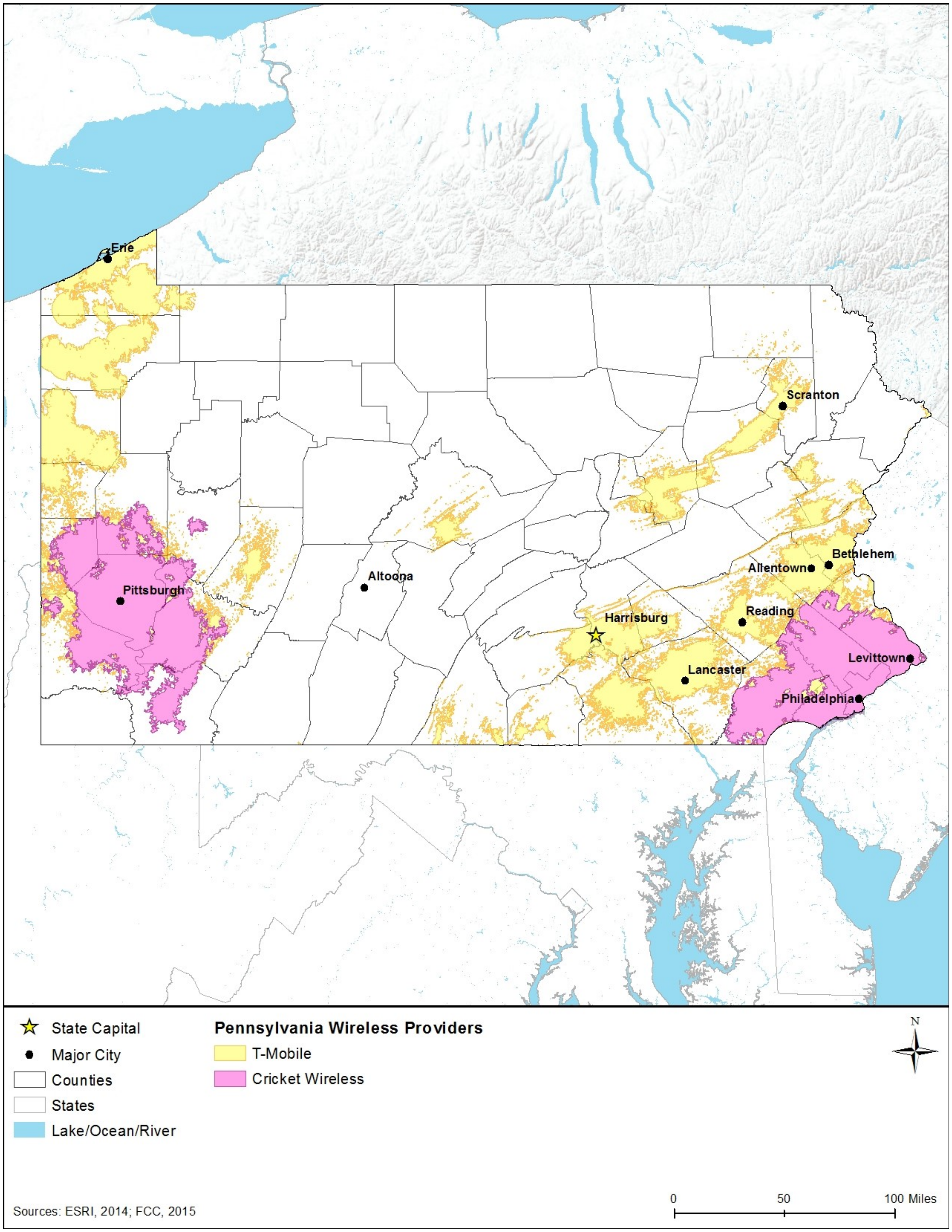


Figure 12.1.1-8: T-Mobile and Cricket Wireless Availability in Pennsylvania

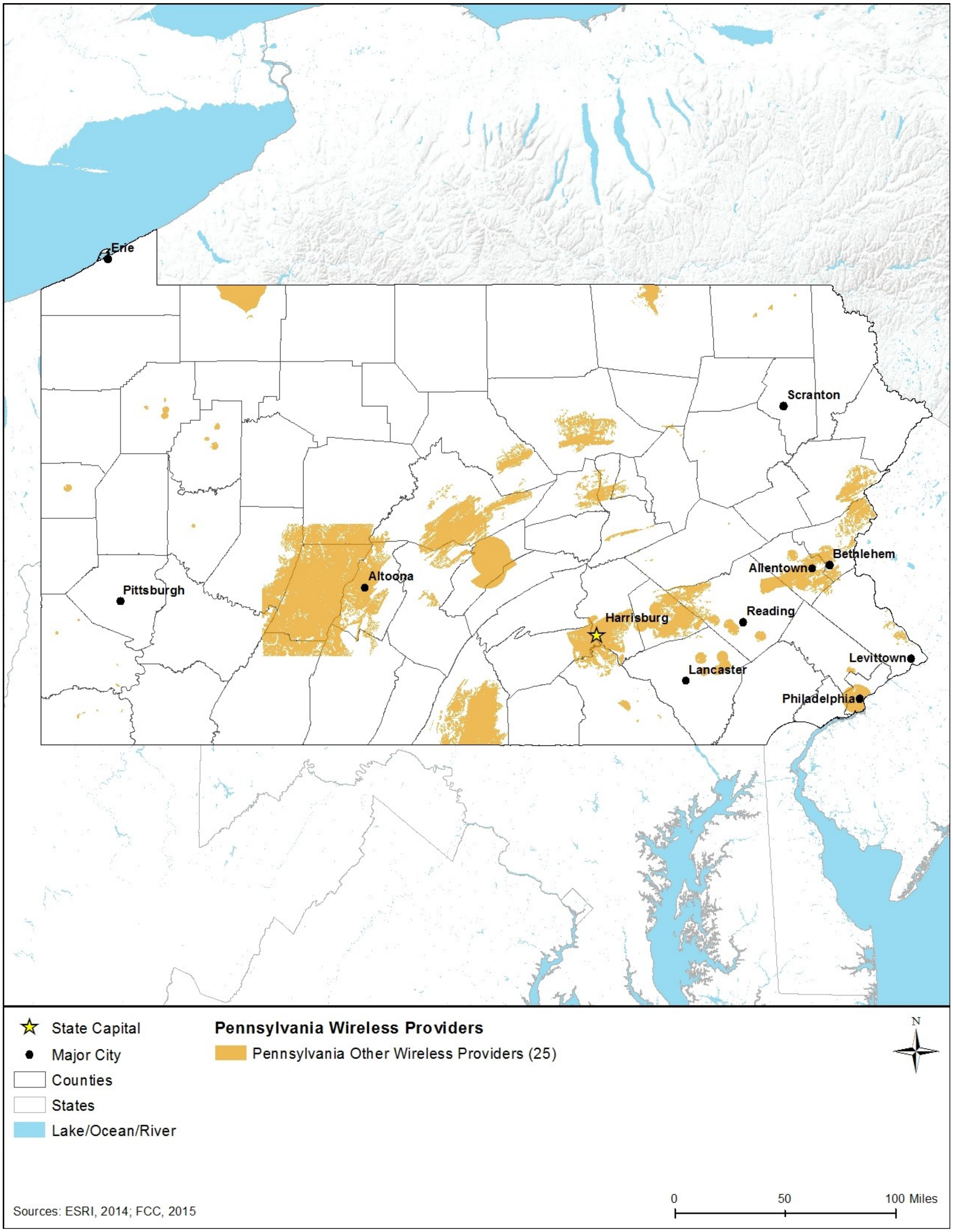


Figure 12.1.1-9: Wireless Availability in Pennsylvania for All Other Coverage Providers

Towers

There are many types of domestic towers employed today by the telecommunications industry, government agencies, and other owners. Towers are designed and used for a variety of purposes, and the height, location, and supporting structures and equipment are all designed, constructed, and operated according to the technical specifications of the spectrum used, the type of equipment mounted on the tower, geographic terrain, need for line-of-sight transmissions to other towers, radio frequency needs, and other technical specifications. There are three general categories of stand-alone towers: monopole, lattice, and guyed. Typically, monopole towers are the smallest, followed by lattice towers at a moderate height, and guyed towers at taller heights (with the guyed wires providing tension support for the taller heights) (CSC, 2007). In general, taller towers can provide communications coverage over larger geographic areas, but require more land for the actual tower site, whereas shorter towers provide less geographic coverage and require less land for the tower site (USFS, 2009a). Figure 12.1.1-10 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 12.1.1-10: Types of Towers

Telecommunications tower infrastructure can be found throughout Pennsylvania, although tower infrastructure is concentrated in the higher and more densely populated areas. Owners of towers and some types of antennas are required to register those infrastructure assets with the FCC (FCC, 2016b).[14] Table 12.1.1-9 shows the number of towers (including broadcast towers)

[14] 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.

registered with the FCC in the state of Pennsylvania. Figure 12.1.1-11 shows the location of those 3,067 structures, as of June 2015.

Table 12.1.1-9: Number of Commercial Towers in Pennsylvania by Type

Constructed[a] Towers[b]		Constructed Monopole Towers	
100ft and over	265	100ft and over	0
75ft – 100ft	869	75ft – 100ft	2
50ft – 75ft	775	50ft – 75ft	30
25ft – 50ft	570	25ft – 50ft	89
25ft and below	71	25ft and below	8
Subtotal	**2,550**	**Subtotal**	**129**
Constructed Guyed Towers		**Buildings with Constructed Towers**	
100ft and over	12	100ft and over	3
75ft – 100ft	28	75ft – 100ft	1
50ft – 75ft	9	50ft – 75ft	2
25ft – 50ft	4	25ft – 50ft	3
25ft and below	1	25ft and below	5
Subtotal	**54**	**Subtotal**	**14**
Constructed Lattice Towers		**Multiple Constructed Structures[c]**	
100ft and over	18	100ft and over	6
75ft – 100ft	158	75ft – 100ft	4
50ft – 75ft	82	50ft – 75ft	4
25ft – 50ft	28	25ft – 50ft	4
25ft and below	3	25ft and below	0
Subtotal	**289**	**Subtotal**	**18**
Constructed Tanks[d]			
Tanks	13		
Subtotal	**13**		
Total All Tower Structures		**3,067**	

Source: (FCC, 2015b)

[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)

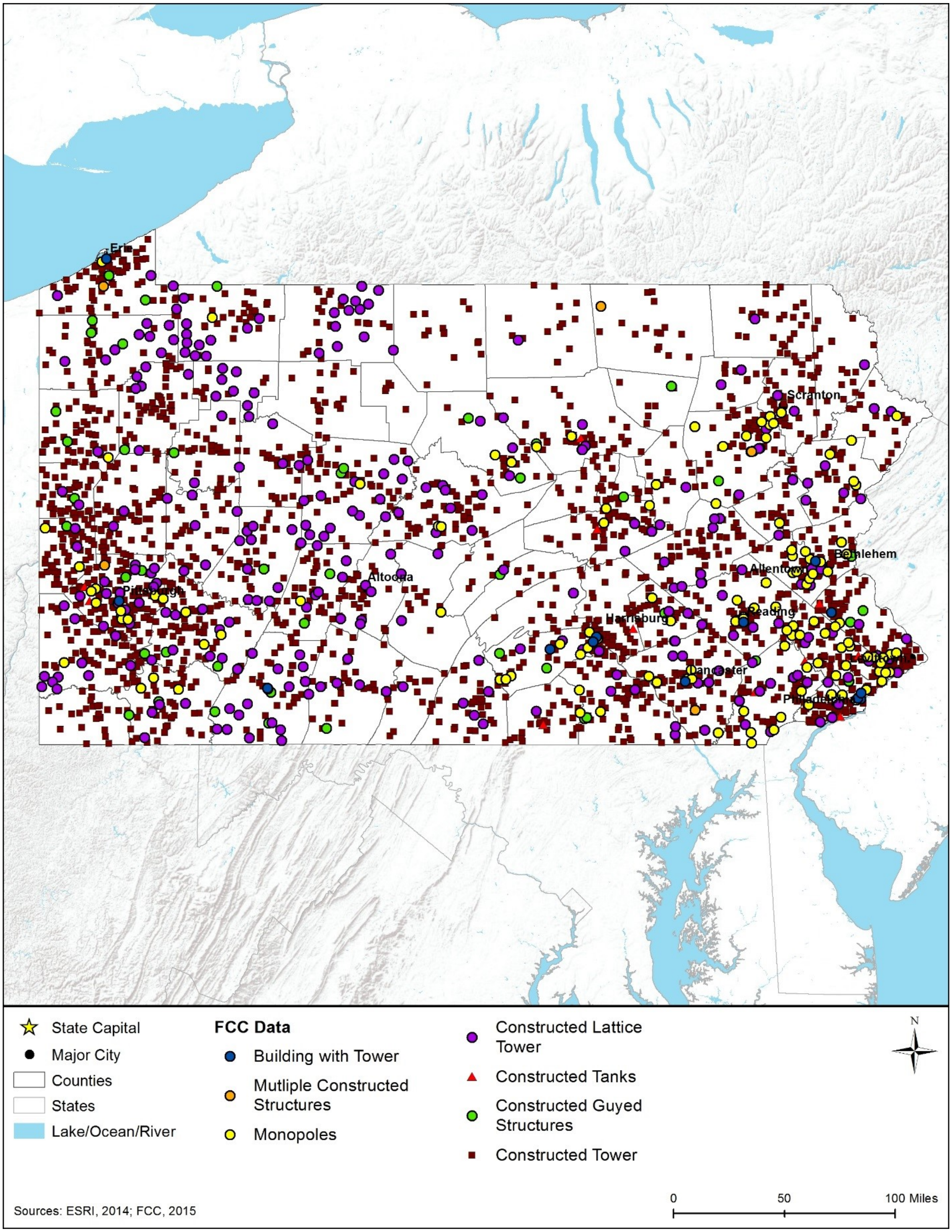
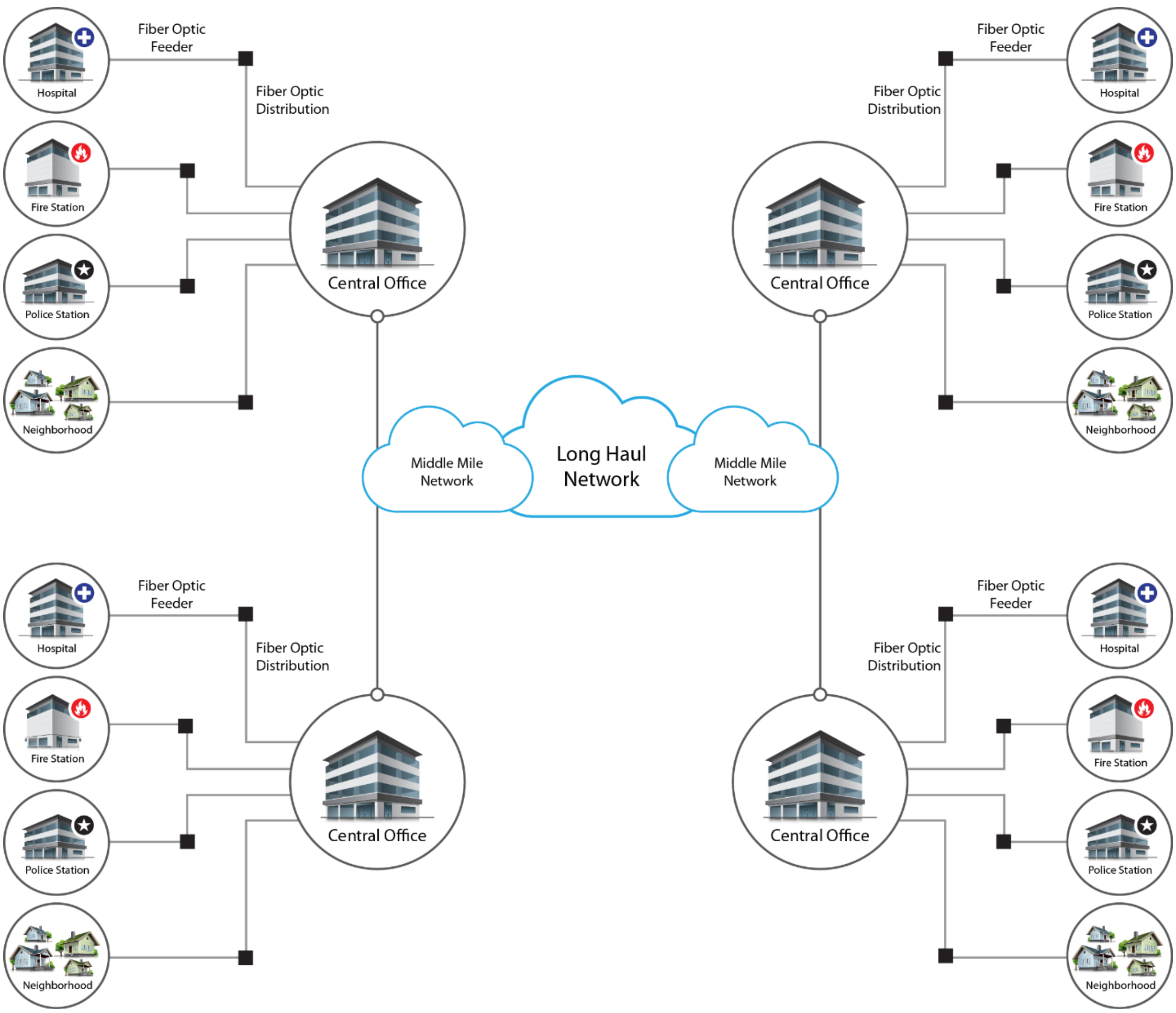


Figure 12.1.1-11: FCC Tower Structure Locations in Pennsylvania

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 (ROW). 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 12.1.1-12. The network also may include a middle mile component (shorter distance cables linking the core network between central offices or network nodes across a region) and a long haul network component (longer distance cables linking central offices across regions) (FCC, 2000).



Prepared by: Booz Allen Hamilton

Figure 12.1.1-12: Typical Fiber Optic Network in Pennsylvania

Last Mile Fiber Assets

In Pennsylvania, fiber access networks are concentrated in the highest population centers as shown in the figures below. In Pennsylvania there are 77 fiber providers that offer service in the state, as listed in Table 12.1.1-10. The following four maps: Figure 12.1.1-13, Figure 12.1.1-14, Figure 12.1.1-15, and Figure 12.1.1-16 present: i) coverage provided by Toast.net and Comcast; ii) Verizon's coverage; iii) all other providers with coverage above 5 percent; and iv) the coverage of all other providers with less than 5 percent coverage area, respectively.

Table 12.1.1-10: Fiber Provider Coverage

Fiber Provider	Coverage
Toast.net	39.99%
Verizon Pennsylvania	31.80%
Othera	30.47%
Comcast	23.55%
Frontier Communications	9.53%
Broadband Dynamics	8.96%
CenturyLink	8.96%
Windstream Pennsylvania	7.07%
MegaPath Corporation	5.91%
Blue Ridge Communications	5.56%
Armstrong Utilities	5.56%
NetCarrier Telecom, Inc.	5.30%

Source: (NTIA, 2014)

[a]Other: Provider with less than 5% coverage area. Providers include: Zito Media, Service Electric Cablevision, Inc., Atlantic Broadband, Affinity, Service Electric Cable TV, Inc., Adams Cable Service, Nittany Media, Inc., Time Warner Cable, Beaver Valley Cable, The North-Eastern Pennsylvania Telephone Company, Windstream Western Reserve, Inc, RCN and RCN Business Services, Kuhn Communications, Level 3 Communications, LLC, North Penn, Consolidated Communications, MetroCast Communications, Frontier Communications of Breezewood, CATV Service, Frontier Communications of Canton, Tele-Media, One Communications, Laurel Highland Telephone Company, Coaxial Cable TV Corp, Palmerton Telephone Co, Frontier Communications of Oswayo, WestPAnet, EagleZip.com, Mahanoy & Mahatango Telephone Company, Venus Telephone Corporation, QCOL, Inc, Armstrong Telephone- PA (Clinton Area), Citizens of Kecksburg, South Canaan Telephone Company, Marianna and Scenery Hill Telephone Company, Lackawaxen Telephone Co, Hickory Telephone Company, XO Communications Services, Inc. (Affiliated Entity), Pennsylvania Telephone Co, Blue Devil Cable, StarLinX Technical Services, Shen-Heights TV Associates, Inc., Pymatuning Indep. Tel. Company, Bentleyville Communications Corporation, Sugar Valley Telephone Company, RCN and RCN Business Services, Armstrong Telephone - North (Duke Center), Ironton Telephone Co, Yukon Waltz Telephone Company, Citizens Cable Communications, North Penn Long Distance Company, Cablevision, Gap CableTV, Wire Tele-View Corp., Hometown Utili-com, Hancock Telephone Co, Deposit Telephone Company, Inc., Pitcairn Cable, Sidera Networks, Fibertech, West Side Telecommunications, Conterra Ultra Broadband, LLC, SignalPoint Communications, Inc., KCnet, Windstream Conestoga Telephone, Inc, Cogent Communications, Inc.

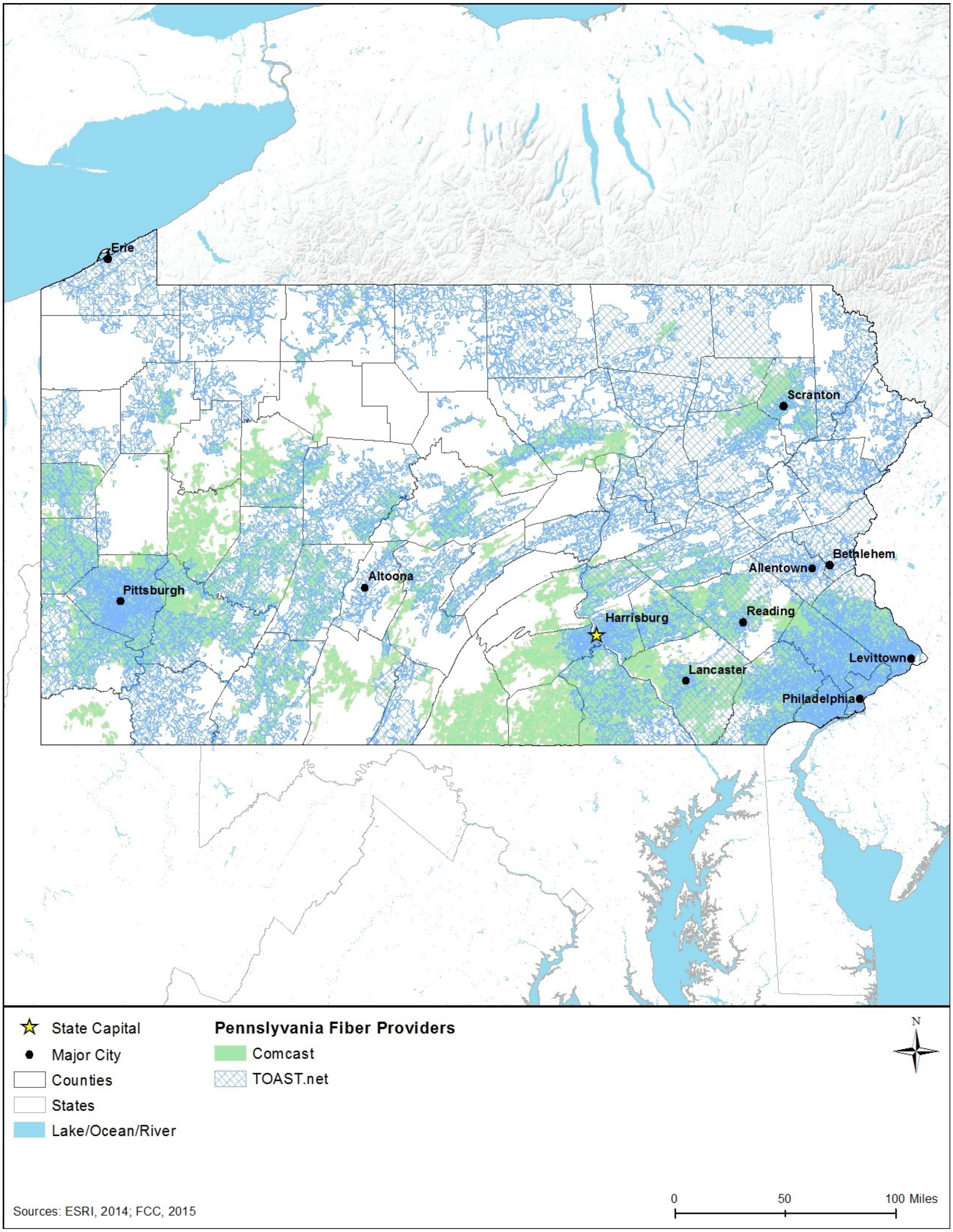


Figure 12.1.1-13: Fiber Availability in Pennsylvania for Toast.net and Comcast

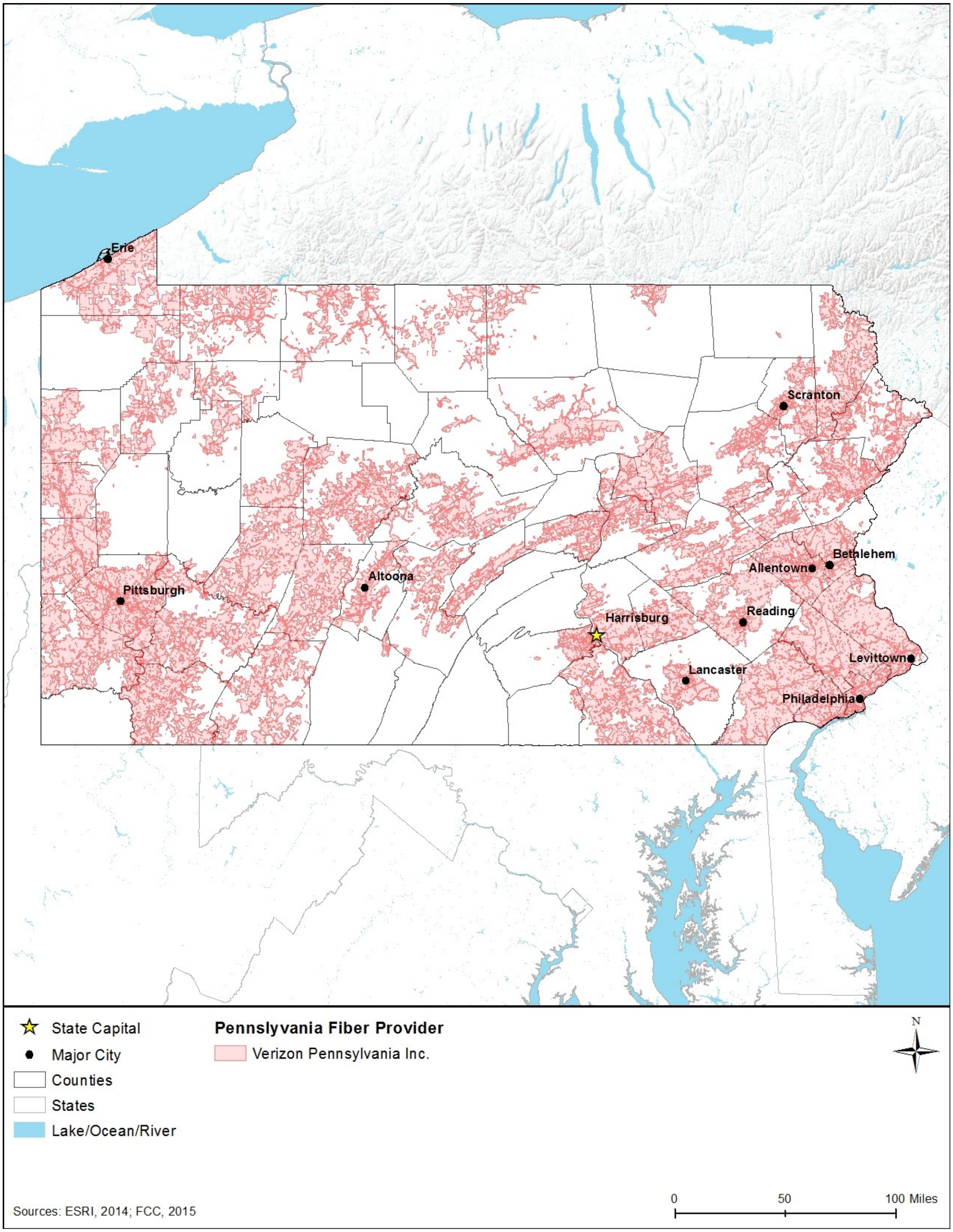


Figure 12.1.1-14: Verizon Fiber Availability in Pennsylvania

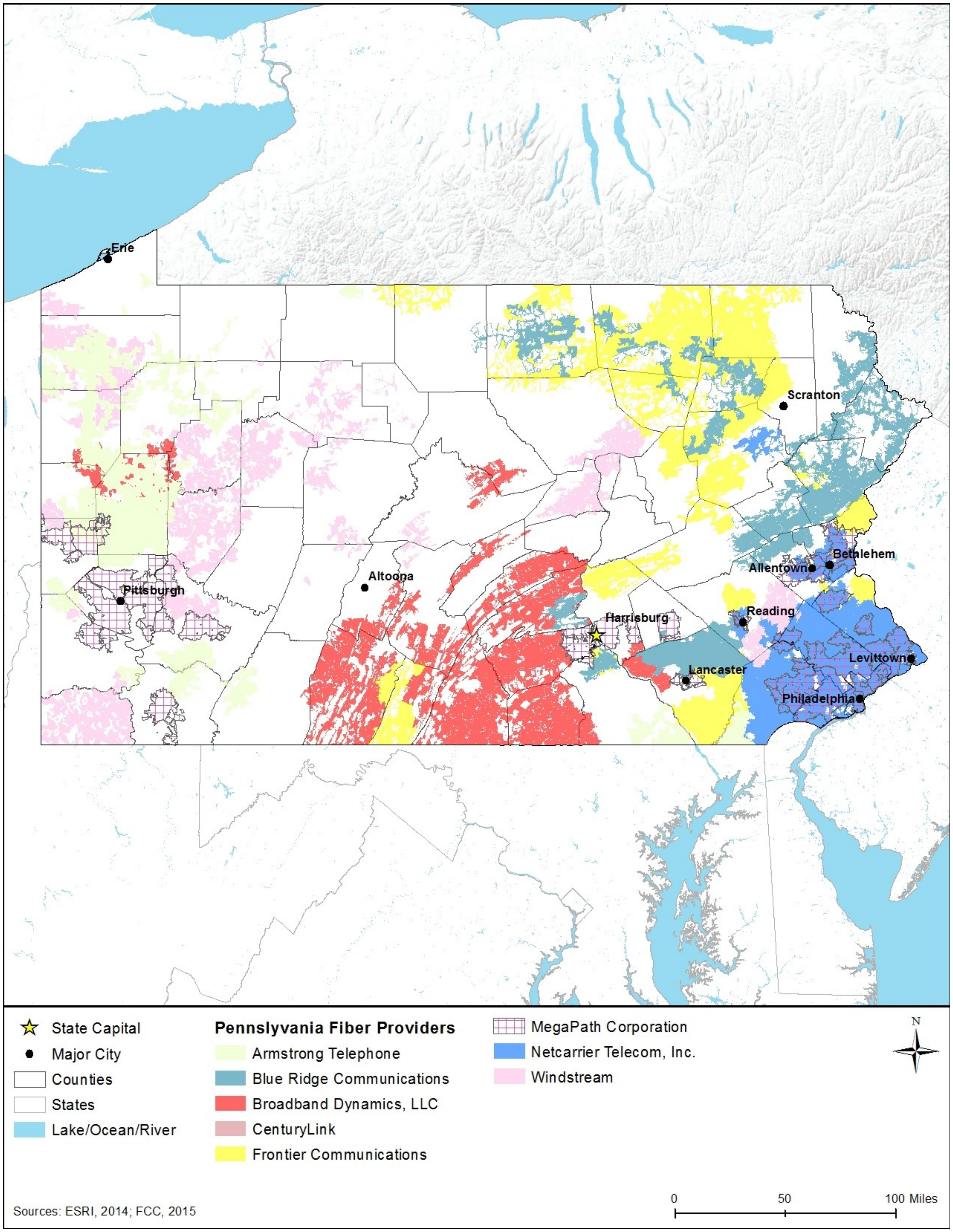


Figure 12.1.1-15: Fiber Availability in Pennsylvania for All Other Providers with Coverage Above 5 Percent

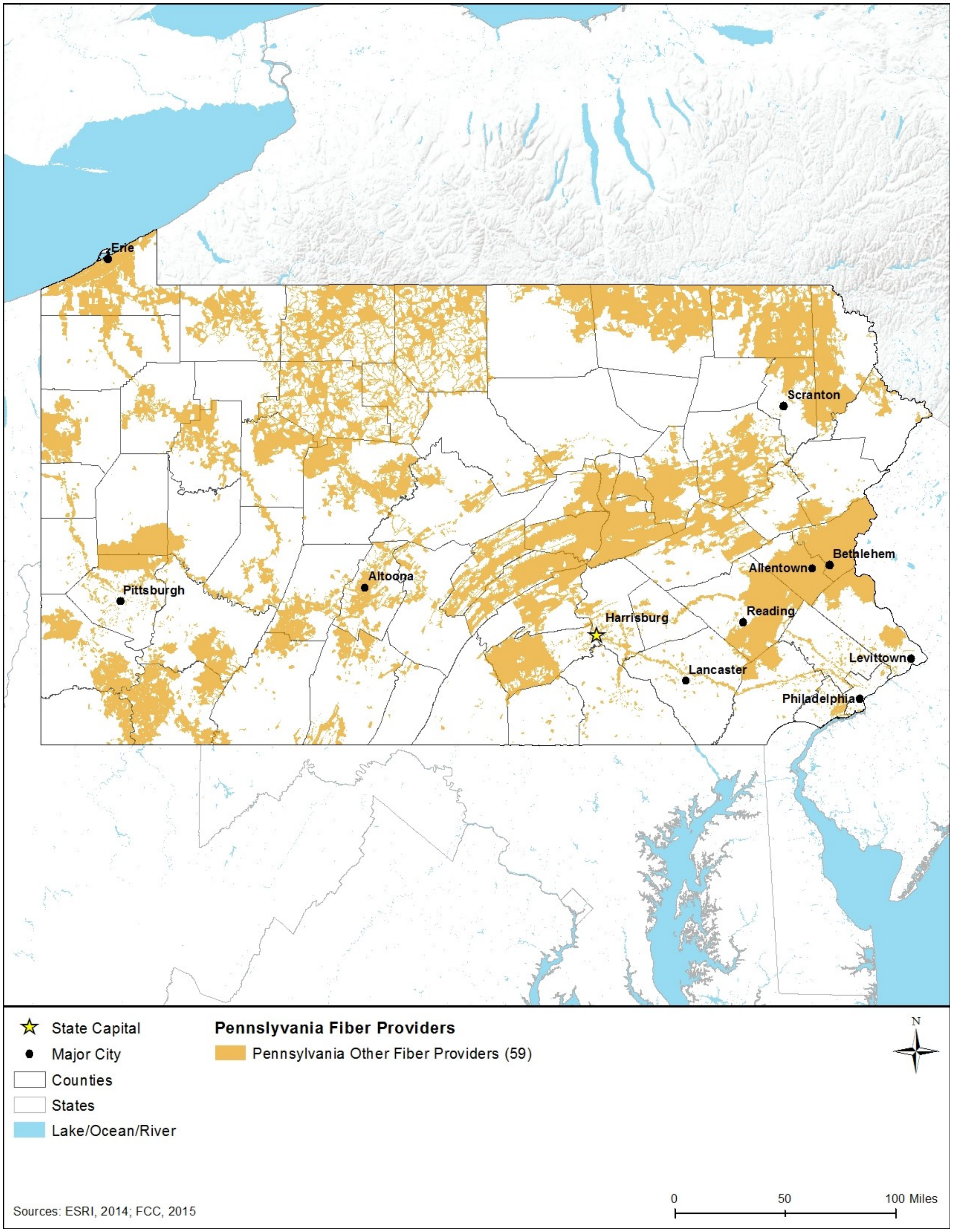


Figure 12.1.1-16: Wireless Availability in Pennsylvania for All Other Coverage Providers Below 5 Percent

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; GAO, 2013).

Utilities

Utilities are the essential systems that support daily operations in a community and cover a broad array of public services, such as electricity, water, wastewater, and solid waste. Section 12.1.4, Water Resources, describes the potable water sources in the state.

Electricity

The majority of Pennsylvania's population gets its electrical service from one of eleven companies. These companies are regulated by the Pennsylvania PUC (PUC, 2015a). The eleven companies under the PUC's jurisdiction are Citizens of Electric of Lewisburg, Duquesne Light Company (DQE), Pennsylvania Power Company (Penn Power), Metropolitan Edison Company (Met-Ed), Pennsylvania Electric Company (Penelec), PPL Electric Utilities, PECO Energy Company, Pike Country Light and Power Company, UGI Utilities Inc., Wellsboro Electric Company and West Penn Power. Penn Power, Met-Ed, Penelec, and West Penn Power are all subsidiaries of FirstEnergy (PUC, 2015b). PUC regulates utility rates and educates consumers, as well as help to promote the use of new technologies (PUC, 2015c). Aside from the 11 companies regulated by the PUC, much of rural Pennsylvania gets its electricity from electricity collectives or municipal systems owned by the local government. Member-owned rural electricity systems are overseen by the Pennsylvania Rural Electric Association (PREA) (PUC, 2015a). There are 13 electric cooperatives in the state that are governed by the PREA, serving close to 600,000 people. These cooperatives own distribution lines and equipment in 42 of Pennsylvania's counties, accounting for 12.5 percent of the state's electrical lines (PREA, 2015).

Pennsylvania's electricity is generated by a number of sources, but coal, natural gas, and nuclear power are the largest sources, accounting for 94 percent of the power generated in 2014 (EIA, 2015f). In 2014, coal accounted for 36 percent of the state's electricity, natural gas for 24 percent, and nuclear power for 34 percent (EIA, 2015f). The nuclear power generated made Pennsylvania the 2nd highest generator of electricity from nuclear power in 2014 (EIA, 2015b). Coal and nuclear power have historically been large sources of power for the state (EIA, 2015b).

Water

As of May 2014, the Pennsylvania PUC oversaw 87 water utilities in the state (PUC, 2015d). These include municipal water utilities that serve customers outside of their municipal boundaries (PUC, 2015e). The DEP Bureau of Safe Drinking Water is responsible for ensuring the quality of water in the state's public water systems. There are almost 9,200 water systems under its jurisdiction (Pennsylvania DEP, 2015a). Information on the water quality of many source waters can be found on the website of the Pennsylvania Water Science Center (http://pa.water.usgs.gov/infodata/waterquality.php). This water quality data can be viewed in real time, including statistics for daily, monthly, or annual time periods (USGS, 2014c).

Wastewater

The rates charged by Pennsylvania's wastewater utilities are managed by the Pennsylvania PUC. There are 55 wastewater utilities under the jurisdiction of the PUC. This number excludes municipal systems, as long as all of the utility's customers reside within that municipality. The same is true of cooperative association wastewater systems that only service the members of the association (PUC, 2015e). Among other responsibilities, the Pennsylvania DEP issues permits allowing facilities to discharge into state waters, as well as issuing permits for the construction of waste treatment facilities (Pennsylvania DEP, 2015w). Pennsylvania is part of the Chesapeake Bay program, and therefore reports on the Total Maximum Daily Load (TMDL) for nitrogen, phosphorus, and sediment in the Chesapeake Bay. Discharges are published by the U.S. Environmental Protection Agency (USEPA) and specify the amount of pollutants discharged into the bay. In 2009, the state "contributed approximately 108 million pounds (lbs.) of nitrogen, 4 million lbs. of phosphorus, and 2.6 billion lbs. of sediment to the Chesapeake Bay." (Pennsylvania DEP, 2015b). Pennsylvania's goal is to reduce these levels by 32 percent for nitrogen, 26 percent for phosphorous, and 25 percent for sediment by 2025. A milestone has also been set to have 60 percent of the reduction accomplished by 2017. Over 200 of the state's discharge facilities are considered significant sources of pollutants, receive permits with specific limits detailing how much nitrogen and phosphorus can be discharged into the bay (Pennsylvania DEP, 2015b).

Solid Waste Management

Solid Waste Management programs in Pennsylvania are overseen by the DEP's Bureau of Waste Management. Some of the Bureau's largest efforts include the Hazardous Waste Program, the Recycling Program, the Residual Waste Program, and the Municipal Waste Program (Pennsylvania DEP, 2015d). It is the job of the Municipal Waste Program to regulate "the storage, transportation, processing, beneficial use, composting, and disposal of municipal waste" (Pennsylvania DEP, 2015g). The state is home to 51 landfills, with 44 used for municipal waste. Three of landfills are designated for construction and demolition waste materials and four facilities are used for residual waste. In addition, there are six waste-to-energy facilities, where waste is combusted to produce energy (Pennsylvania DEP, 2015i). Between 2006 and 2013, Pennsylvania decreased the amount of waste sent to landfills and recovery facilities by nearly 2 million tons, from 10.3 million in 2006 to 8.5 million in 2013. In the same time frame, the per capita disposal of waste dropped from 4.53 lbs./person/day to 3.7 lbs./person/day (Pennsylvania DEP, 2015j). The state's Residual Waste Program oversees the disposal of non-hazardous industrial wastes. Each year, the state generates approximately 20 million tons of solid residual waste, of which roughly 40 percent is ash from coal-burning plants (Pennsylvania DEP, 2015m).

Pennsylvania's Recycling Program has ensured that residents of the state have access to recycling. Approximately 1,050 recycling pick-up programs grant recycling access to 79 percent of the population, and 870 drop-off programs extend this ability to many of Pennsylvania's more rural communities. In 2013, the state recycled more than 6.12 million tons of material. This number reached 8.5 million tons in 2012, but this is largely attributed to damage caused by a number of hurricanes, including Superstorm Sandy (Pennsylvania DEP, 2015n). The Pennsylvania Hazardous Waste Program ensures the "generation, storage, transportation, treatment, and disposal of hazardous waste" (Pennsylvania DEP, 2015r). In 2009, 442,485 tons of hazardous waste were handled by commercial treatment, storage, and disposal facilities. Twenty-three such companies exist in the state (Pennsylvania DEP, 2015s).

12.1.2. Soils

12.1.2.1. 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, 2015b)

(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, 2015b)

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

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

12.1.2.2. 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 Section 1.8. A list of applicable state laws and regulations is included in Table 12.1.2-1 below.

Table 12.1.2-1: Relevant Pennsylvania Soil Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
25 Pa. Code Chapter 102 Erosion and Sediment Control Program	Pennsylvania DEP	Any earth disturbing activity must implement and maintain erosion and sediment control practices. A written Erosion and Sediment Control Plan is required if the total area of disturbance is 5,000 square feet or greater; and/or if the activity has the potential to discharge to a water classified as a High Quality (HQ) or Exceptional Value (EV) water published at 25 Pa. Code Chapter 93 (relating to water quality standards). Local ordinances may require a written and approved Erosion and Sediment Control Plan for disturbances less than 5,000 square feet.

Source: (PA Code, 2000)

12.1.2.3. Environmental Setting

Pennsylvania is composed of four Land Resource Region (LRR),[15] as defined by the National Resources Conservation Service (NRCS) (NRCS, 2006):

- East and Central Farming and Forest Region
- Lake State Fruit, Truck Crop, and Dairy Region
- Northeastern Forage and Forest Region
- Northern Atlantic Slope Diversified Farming Region

Within and among Pennsylvania's four LRRs are eleven Major Land Resource Areas (MLRA),[16] which are characterized by patterns of soils, climate, water resources, land uses, and type of farming. The locations and characteristics of Pennsylvania's MLRAs are presented in Figure 12.1.2-1 and Table 12.1.2-2, respectively.

Soil characteristics are an important consideration for FirstNet insomuch as soil properties could influence the suitability of sites for network deployment. Soil characteristics can differ over relatively short distances, reflecting differences in parent material, elevation and position on the landscape, biota[17] such as bacteria, fungi, biological crusts, vegetation, animals, and climatic variables such as precipitation and temperature. For example, expansive[18] soils 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

[15] Land Resource Region: "A geographical area made up of an aggregation of Major Land Resource Areas (MLRA) with similar characteristics." (NRCS, 2006)
[16] 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).
[17] The flora and fauna of a region.
[18] 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)

loosen topsoil and damage or remove vegetation or other groundcover, which may result in accelerated erosion, compaction, and rutting[19] (discussed further in the subsections below).

Soil Suborders

Soil suborders are part of the soil taxonomy[20] (a system of classification used to make and interpret soil surveys). Soil orders are the highest level in the taxonomy; there are 12 soil orders in the world and they are characterized by both observed and inferred[21] properties, such as texture, color, temperature, and moisture regime. Soil suborders are the next level down, and are differentiated within an order by soil moisture and temperature regimes, as well as dominant physical and chemical properties (NRCS, 2015e). The STATSGO2[22] soil database identifies eight different soil suborders in Pennsylvania (NRCS, 2015a). Figure 12.1.2-2 depicts the distribution of the soil suborders, and Table 12.1.2-3 provides a summary of the major physical-chemical characteristics of the various soil suborders found.

[19] Rutting is indentations in soil from operating equipment in moist conditions or soils with lower bearing strength. (USFS, 2009b)
[20] "A formal representation of relationships between items in a hierarchical structure." (USEPA, 2015e) Reference from http://iaspub.epa.gov/sor_internet/registry/termreg/searchandretrieve/termsandacronyms/search.do
[21] "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, 2015d)
[22] STATS2GO 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. (NRCS, 2015a)

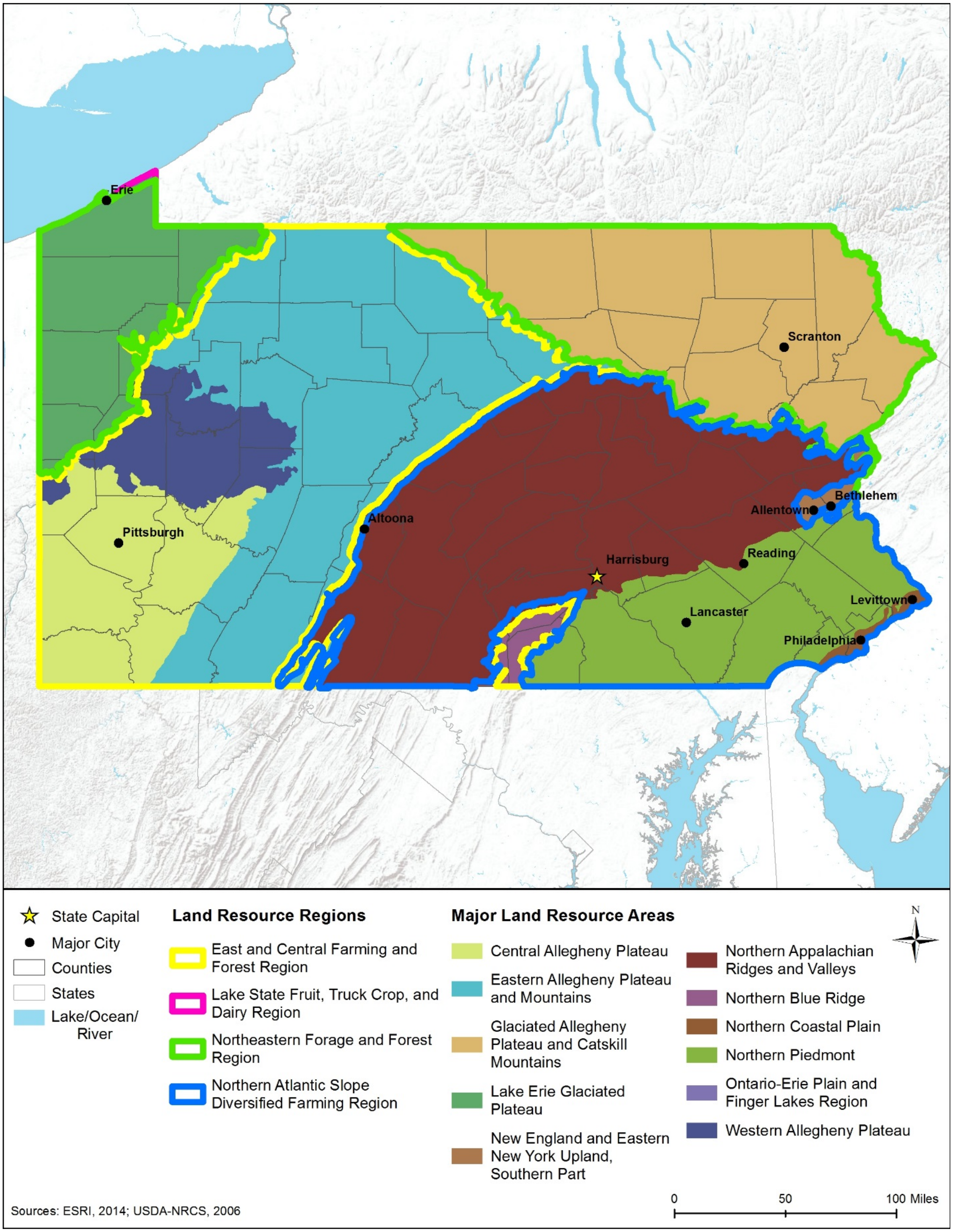


Figure 12.1.2-1: Locations of Major Land Resource Areas in Pennsylvania

Table 12.1.2-2: Characteristics of Major Land Resource Areas in Pennsylvania

MLRA Name	Region of State	Soil Characteristics
Central Allegheny Plateau	Southwestern Pennsylvania	Alfisols[23], Ultisols[24], and Inceptisols[25] are dominant soils orders in this MLRA, and typically shallow to very deep. These soils range from excessively drained to somewhat poorly drained, and are skeletal to clayey.
Eastern Allegheny Plateau and Mountains	Central Pennsylvania	Ultisols and Inceptisols are dominant soils orders in this MLRA. They are moderately deep to very deep, excessively drained to somewhat poorly drained, and loamy.
Glaciated Allegheny Plateau and Catskill Mountains	Northeastern Pennsylvania	Inceptisols are the dominant soil order. They are shallow to very deep, well drained to very poorly drained, and also loamy or loamy-skeletal.
Lake Erie Glaciated Plateau	Northwestern Pennsylvania	Alfisols are the dominant soil order. They are very deep, well drained to poorly drained, and loamy or clayey.
New England and Eastern New York Upland, Southern Part	Eastern Pennsylvania	Dominant soil orders in this MLRA include Entisols[26], Histosols,[27] and Inceptisols, and the soils are generally very deep, somewhat excessively drained to poorly drained, and loamy or sandy.
Northern Appalachian Ridges and Valleys	Central and Eastern Pennsylvania	Inceptisols, Ultisols, and Alfisols are the dominant soil orders. They are shallow to very deep, generally excessively drained to moderately well drained, and also loamy or clayey.
Northern Blue Ridge	South Central Pennsylvania	Inceptisols, Ultisols, and Alfisols are the dominant soil orders. They are moderately deep to very deep and are also loamy-skeletal and sandy-skeletal to clayey.
Northern Coastal Plain	Southeastern Pennsylvania	Ultisols are the dominant soil order in this MLRA, and soils in this area are very deep, excessively drained to very poorly drained, and typically loamy or sandy.
Northern Piedmont	Southeastern Pennsylvania	Dominant soil orders are Alfisols, Inceptisols, 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.
Ontario-Erie Plain and Finger Lakes Region	Northeastern Pennsylvania	Alfisols and Inceptisols are the dominant soil orders. They are deep and well drained to moderately well drained.
Western Allegheny Plateau	Western Pennsylvania	Ultisols and Inceptisols are dominant soil orders. They are moderately deep to very deep, excessively drained to somewhat poorly drained, and loamy as well.

Source: (NRCS, 2006)

[23] Alfisols: "Soils found in semiarid to moist areas that are formed from weathering processes that leach clay minerals and other constituents out of the surface layer and into the subsoil. They are productive for most crop, are primarily formed under forest or mixed vegetative cover, and make up nearly 10% of the world's ice-free land surface." (NRCS, 2015d)

[24] 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, 2015d)

[25] 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, 2015d)

[26] Entisols: "Soils that show little to no pedogenic horizon development. They occur in areas of recently deposited parent materials or in dunes, steep slopes, or flood plains where erosion or deposition rates are faster than rate of soil development. They make up nearly 16% of the world's ice-free land surface." (NRCS, 2015d)

[27] Histosols: "Soils that have a high content of organic matter and no permafrost. Also known as bogs, moors, peats, or mucks, these soils are saturated year round and form in decomposed plant remains. If exposed to air and drained, the microbes will decompose and the soils can subside dramatically. They make up nearly 1% of the world's ice-free land surface." (NRCS, 2015d)

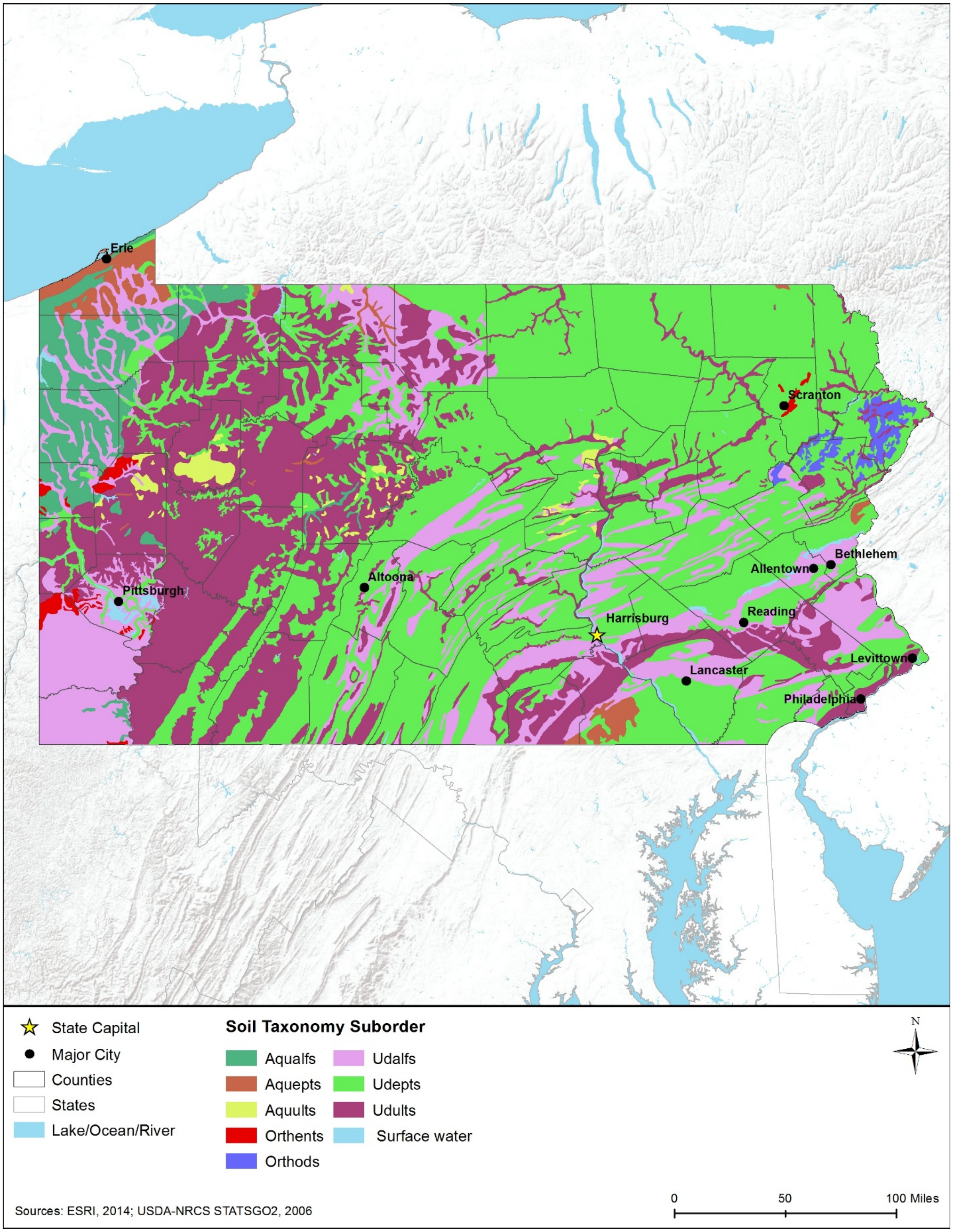


Figure 12.1.2-2: Pennsylvania Soil Taxonomy Suborders

Table 12.1.2-3: Major Characteristics of Soil Suborders Found in Pennsylvania, as Depicted in Figure 12.1.2-2

Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (%)	Drainage Class	Hydric Soil[28]	Hydrologic Group	Runoff Potential	Permeability[29]	Erosion Potential	Compaction and Rutting Potential
Alfisols	Aqualfs	Generally have warm and aquic (saturated with water long enough to cause oxygen depletion) conditions. Aqualfs are used as cropland for growing corn, soybeans, and rice, and most have some artificial drainage or other water control. Nearly all Aqualfs have likely supported forest vegetation in the past.	Channery silty clay loam, gravelly loam, silt loam, Stratified very gravelly sand to gravelly loam	0-8	Poorly drained to somewhat poorly drained	No, Yes	C, D	Medium to High	Low to Very Low	Medium to High, depending on slope	High, due to hydric soil and poor drainage conditions
Inceptisols	Aquepts	Aquepts have poor or very poor natural drainage. If these soils have not been artificially drained, groundwater is at or near the soil surface at some time during normal years (although not usually in all seasons). They are used primarily for pasture, cropland, forest, or wildlife habitat. Many Aquepts have formed under forest vegetation, but they can have almost any kind of vegetation.	Channery loam, channery silt loam, channery silty clay loam, silt loam	0-15	Very poorly drained to somewhat poorly drained	No, Yes	C, D	Medium to High	Low to Very Low	Medium to High, depending on slope	High, due to hydric soil and poor drainage conditions
Ultisols	Aquults	Aquults are found in wet areas where groundwater is very close to the surface during part of each year, usually in winter and spring. Their slopes are gentle, with many soils formerly and currently supporting forest vegetation.	Channery silty clay loam, silt loam	0-15	Somewhat poorly drained	No	C	Medium	Low	Medium	Low
Entisols	Orthents	Orthents are commonly found on recent erosional surfaces and are used primarily as rangeland, pasture, or wildlife habitat.	Channery silty clay loam, silt loam, very channery loam, very channery sandy loam	0-50	Well drained to moderately well drained	No	A, B, C, D	Low to High	High to Very Low	Low to High, depending on slope	Low
Spodosols	Orthods	Orthods have a moderate accumulation of organic carbon, and are relatively freely drained. Most of these soils are either used as forest or have been cleared and are used as cropland or pasture. Although they are naturally infertile, they can be highly responsive to good management.	Very gravelly fine sandy loam	0-8	Well drained	No	C	Medium	Low	Medium	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 clay, channery clay loam, channery loam, channery silty clay loam, clay, clay loam, fine sandy loam, flaggy loam, gravelly silt loam, gravelly silty clay loam, loam, sandy loam, silt loam, stratified very gravelly sand to very gravelly loamy coarse sand, unweathered bedrock, weathered bedrock	0-50	Somewhat poorly drained to well drained	No	B, C	Medium to High	Low to Very Low	Medium to High, depending on slope	Low
Inceptisols	Udepts	Udepts have an udic or perudic (saturated with water long enough to cause oxygen depletion) moisture regime, and are mainly freely drained. Most of these soils currently support or formerly supported forest vegetation, with mostly coniferous forest in the northwest and mixed or hardwood forest in the east. Some also support shrub or grass vegetation, and in addition to being used as forest, some have been cleared and are used as cropland or pasture.	Channery loam, channery silt loam, fine sandy loam, flaggy sandy loam, gravelly fine sandy loam, gravelly loam, gravelly loamy fine sand, gravelly silt loam, loam, silt loam, stratified sand to silt, unweathered bedrock,	0-80	Excessively drained to somewhat poorly drained	No	A, B, C, D	Low to High	High to Very Low	Low to High, depending on slope	Low

[28] 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).
[29] Based on Runoff Potential, described in Section 12.1.2.3

Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (%)	Drainage Class	Hydric Soil[28]	Hydrologic Group	Runoff Potential	Permeability[29]	Erosion Potential	Compaction and Rutting Potential
			very channery fine sandy loam, very channery loam, very channery silt loam, very flaggy loam, very gravelly fine sandy loam, very gravelly loam, very gravelly sandy loam, weathered bedrock								
Ultisols	Udults	Udults are more or less freely drained, relatively humus poor, and have an udic moisture regime. Most of these soils currently support or formerly supported mixed forest vegetation, and many have been cleared and used as cropland (mostly with the use of soil amendments).	Channery loam, channery sandy clay loam, channery sandy loam, channery silt loam, clay loam, gravelly clay loam, loam, loamy fine sand, silt loam, silty clay loam, stratified gravelly sand to clay, unweathered bedrock, very channery sandy clay loam, very channery sandy loam, very channery silt loam, very channery silty clay loam	0-70	Moderately well drained to somewhat excessively drained	No	A, B, C	Low to Medium	High to Low	Low to Medium, depending on slope	Low

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

Runoff Potential

The NRCS uses four Hydrologic Soil Groups (A, B, C, and D) that are based on a soil's runoff potential.[30] Group A generally has the smaller runoff potential, whereas Group D generally has the greatest (Purdue University, 2015). Table 12.1.2-3 provides a summary of the runoff potential for each soil suborder in Pennsylvania.

Group A. Sand, loamy sand or sandy loam soils. This group of soils has "low runoff potential and high infiltration rates[31] 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). Orthents, Udepts, and Udults fall into this category in Pennsylvania.

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. Orthents, Udalfs, Udepts, and Udults fall into this category in Pennsylvania.

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. Aqualfs, Aquepts, Aquults, Orthents, Orthods, Udalfs, Udepts, and Udults fall into this category in Pennsylvania.

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

Soil Erosion

"Soil erosion involves the breakdown, detachment, transport, and redistribution of soil particles by forces of water, wind, or gravity" (NRCS, 2015f). 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 12.1.2-3 provides a summary of the erosion potential

[30] 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.
[31] 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)

for each soil suborder in Pennsylvania. Soils with the highest erosion potential in Pennsylvania include those in the Aqualfs, Aquepts, Aquults, Orthents, Orthods, Udalfs, Udepts, and Udults suborders, which are found throughout the state (Figure 12.1.2-2).

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 (USFS, 2009b). 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 12.1.2-3 provides a summary of the compaction and rutting potential for each soil suborder in Pennsylvania. Soils with the highest potential for compaction and rutting in Pennsylvania include those in the Aqualfs and Aquepts suborders, which are found primarily in the northwestern corner of the state (Figure 12.1.2-2).

12.1.3. Geology

12.1.3.1. 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 Programmatic Environmental Impact Statement (PEIS), including Water Resources (Section 12.1.4), Human Health and Safety (Section 12.1.15), and Climate Change (Section 12.1.14).

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

- Section 12.1.3.3, Major Physiographic Regions and Provinces[32, 33]
- Section 12.1.3.4, Surface Geology
- Section 12.1.3.5, Bedrock Geology[34]
- Section 12.1.3.6, Paleontological Resources[35]
- Section 12.1.3.7, Fossil Fuel and Mineral Resources
- Section 12.1.3.8, Potential Geologic Hazards[36]

12.1.3.2. Specific Regulatory Considerations

The Proposed Action must meet the requirements of the NEPA and other applicable laws and regulations. Applicable federal laws and regulations that apply to Geology, such as the National Historic Preservation Act of 1966, as amended (NHPA) and the Clean Water Act, are detailed in Appendix C. A list of applicable state laws and regulations is included in Table 12.1.3-1.

Table 12.1.3-1: Relevant Pennsylvania Geology Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
17 PA Code § 11.209, Miscellaneous activities	Pennsylvania Department of Conservation and Natural Resources (DCNR)	No engaging in construction or excavation without written permission of the Department. No removing or disturbing a historical or archeological artifact, relic, or object.
Uniform Construction Code	Pennsylvania State Government	Guidelines for seismic design in construction
PennDOT Design Manual, Part 4	PennDOT	Bridges must be designed with seismic considerations, including specific rehabilitation requirements

Sources: (Pennsylvania DCNR, 2015d) (Pennsylvania DCNR, 2015e) (Pennsylvania DCNR, 2015m)

[32] Physiographic regions: Areas of the United States that share commonalities based on topography, geography, and geology. (Fenneman, 1916)
[33] Physiographic provinces: Subsets within physiographic regions. (Fenneman, 1916)
[34] Bedrock: Solid rock beneath the soil and superficial rock. (USGS, 2015g)
[35] Paleontology: "Study of life in past geologic time based on fossil plants and animals." (USGS, 2015g)
[36] 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." (NWS, 2013)

12.1.3.3. 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 U.S. 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 U.S.: 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)

Pennsylvania has three physiographic regions: Atlantic Plain, Appalachian Highlands, and Interior Plains (Figure 12.1.3-1). To characterize differences in physiography across the state and to better support PEIS tiering, the physiographic provinces in Pennsylvania are summarized below.

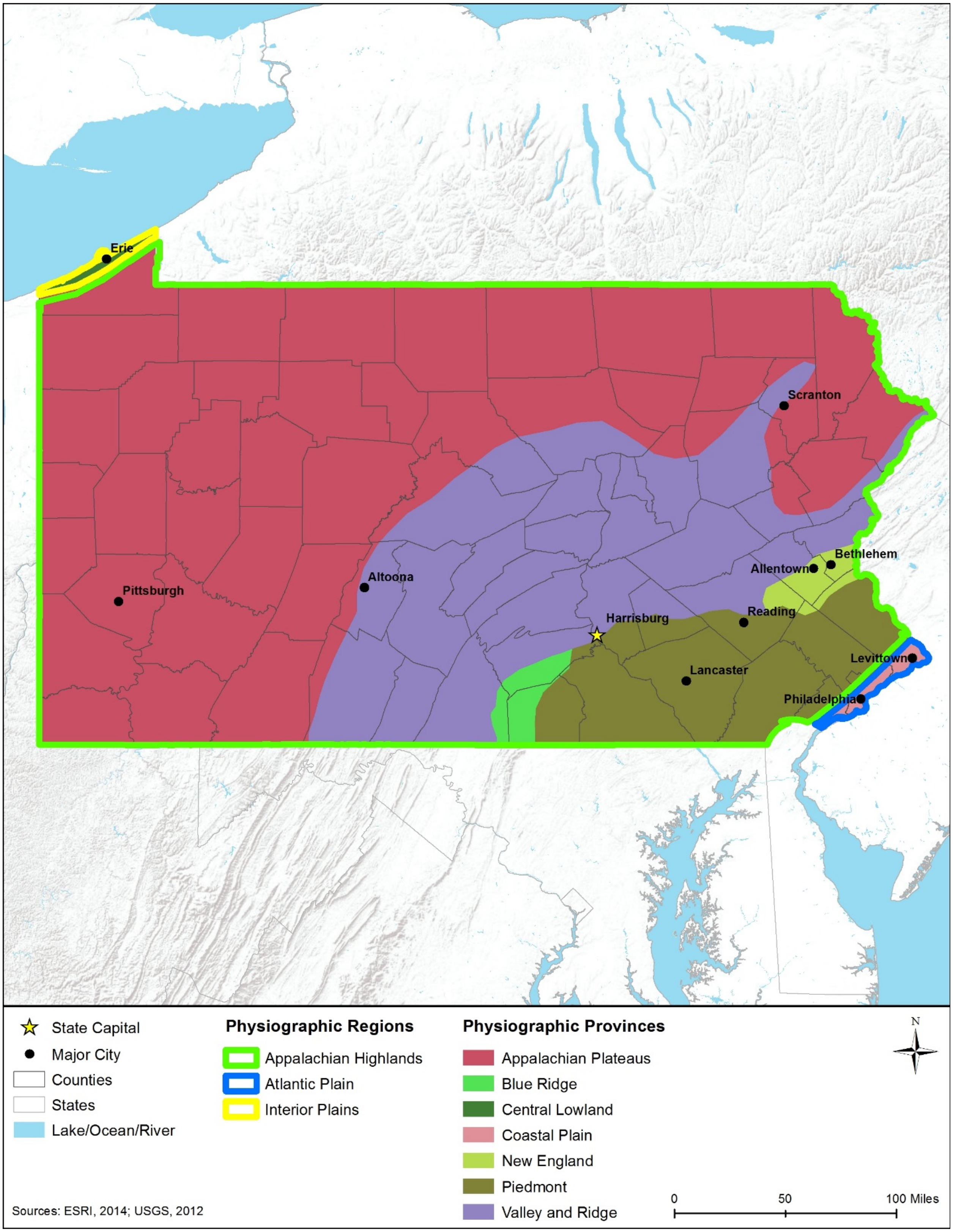


Figure 12.1.3-1: Physiographic Regions and Provinces of Pennsylvania

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. Erosion from the Appalachian Mountains, which began to form 480 to 440 million years ago (MYA), dislodged sediments, which were subsequently deposited by rivers to form the Atlantic Plain. Sedimentary strata are thin in the western side of the region, and thicken to several thousand feet along the coast. The Atlantic Plain is characterized by gentle topography and a transition zone between the land and sea often having marshes, lagoons, swamps, sand bars, and reefs. (NPS, 2015a)

Within Pennsylvania, the Atlantic Plain Region (Coastal Plain Province) is limited to an approximately 4 miles (mi) by 45 mi stretch of land along the Delaware River floodplain in the extreme southeastern portion of the state. Topography is generally flat, except for steep slopes along local streams. Terrace deposits of sand and gravel overlie metamorphic bedrock.[37] The region is flat compared to the adjacent Appalachian Highlands, with elevations ranging from sea level at the Delaware River to approximately 200 feet above sea level (ASL). (Pennsylvania DCNR, 2000)

Appalachian Highlands Region

The Appalachian Highlands Region extends from Canada to Alabama. This region is composed of layers of folded sedimentary rock,[38] 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,[39] 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, 2003b)

<u>Piedmont Province</u> – The Pennsylvania Piedmont Province can be sub-divided into Upland, Lowland, and Gettysburg-Newark Lowland sections. The Upland Section contains metamorphic rocks (e.g., schist[40] and gneiss[41]) that underlie a series of broad rolling hills and valleys; elevations range from 100 feet to 1,220 feet ASL. The Lowland Section contains softer rocks that are more susceptible to weathering and erosion, including shale,[42] limestone,[43] and dolomite,[44] resulting in the formation of valleys in areas where those rocks exist; elevations range from 60 feet to 700 feet ASL. Areas with limestone or dolomite are subject to the

[37] Metamorphic Rock: "A rock that has undergone chemical or structural changes produced by increase in heat or pressure, or by replacement of elements by hot, chemically active fluids." (USGS, 2015g)
[38] 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, 2015g)
[39] The Rocky Mountains exceed 14,000 feet above sea level (NPS, 2004).
[40] Schist: "Metamorphic rock usually derived from fine-grained sedimentary rock such as shale. Individual minerals in schist have grown during metamorphism so that they are easily visible to the naked eye." (USGS, 2015g)
[41] Gneiss: "A coarse-grained, foliated metamorphic rock that commonly has alternating bands of light and dark-colored minerals." (USGS, 2015g)
[42] Shale: "Sedimentary rock derived from mud. Commonly finely laminated (bedded). Particles in shale are commonly clay minerals mixed with tiny grains of quartz eroded from pre-existing rocks. (USGS, 2015g)
[43] Limestone: "A sedimentary rock made mostly of the mineral calcite (calcium carbonate). Limestone is usually formed from shells of once-living organisms or other organic processes, but may also form by inorganic precipitation." (USGS, 2015g)
[44] Dolomite: "A magnesium-rich carbonate sedimentary rock." (USGS, 2015g)

formation of karst[45] topography. The Gettysburg-Newark Lowland contains red and gray sandstone[46] and shale, interspersed with occasional igneous[47] intrusions; the topography contains widespread lowlands with a few hills, with elevations ranging from 20 to 1,355 feet ASL. (Pennsylvania DCNR, 2000)

New England Province – The New England Province is between the Valley and Ridge and Piedmont Provinces, and is underlain by crystalline rocks. The New England Province is characterized by rounded hills and ridges, with local relief of 300 to 600 feet, and elevations ranging from 140 to 1,364 feet ASL. (Pennsylvania DCNR, 2000)

Appalachian Plateaus Province – The Appalachian Plateaus is the largest physiographic province in Pennsylvania. The Appalachian Plateau is underlain by a variety of flat sedimentary rocks, including sandstone, shale, siltstone,[48] limestone, and coal. Elevations range from 440 to 3,210 feet ASL. The highest location in Pennsylvania is Mount Davis (3,210 feet ASL), which is in the Allegheny section. The Allegheny section contains "wide ridges separated by broad valleys; ridge elevations decrease to the north." (Pennsylvania DCNR, 2000)

Valley and Ridge Province – The Valley and Ridge Province is comprised largely of soft sedimentary rocks, including limestone, dolomite, sandstone, shale, and conglomerate.[49] This area of Pennsylvania has undergone several iterations of folding[50] and faulting;[51] millions of years of chemical and mechanical weathering have resulted in the formation of ridges (made of resistant sandstone and conglomerate) and valleys (underlain by weaker shales and limestone). The Valley and Ridge Province ranges in elevation from 140 feet to 2,775 feet ASL. (Pennsylvania DCNR, 2000)

Blue Ridge Province – The northeastern edge of the Blue Ridge Province occurs in southeastern Pennsylvania. "This belt consists mostly of igneous and high-rank metamorphic rocks but also includes low-rank metamorphic rocks of late Precambrian age and small areas of sedimentary rocks of Early Cambrian age along its western margin." Till deposits are present in the Blue Ridge Province's valleys. (USGS, 2015e)

Interior Plains Region

The Interior Plains Region stretches between western New York and eastern Montana, and south to Texas. The region includes the U.S. Great Plains, formed from the erosion of the Rocky Mountains during the Cenozoic Era (i.e., within the last 65 million years), is underlain by sedimentary rock. This region has relatively low topographic relief, compared to the adjacent Appalachian Highlands. (USGS, 2003b)

[45] Karst: "A distinctive landscape (topography) that can develop where the underlying bedrock, often limestone or marble, is partially dissolved by surface or ground water." (USGS, 2015g)
[46] Sandstone: "Sedimentary rock made mostly of sand-sized grains." (USGS, 2015g)
[47] Igneous Rock: "Rock formed when molten rock (magma) that has cooled and solidified (crystallized)." (USGS, 2015g)
[48] Siltstone: "A sedimentary rock made mostly of silt-sized grains." (USGS, 2015g)
[49] Conglomerate: "A sedimentary rock made of rounded rock fragments, such as pebbles, cobbles, and boulders, in a finer-grained matrix." (USGS, 2015g)
[50] Fold: "A bend or flexure in a rock." (USGS, 2006)
[51] Fault: "A surface along which a rock body has broken and been displaced." (USGS, 2006)

Within Pennsylvania, the Interior Plains Region (Central Lowland Province) consists of a series of northwest-trending ridges made up of unconsolidated glacial sediments; ridges paralleling Lake Erie were created following retreat of glaciers during the most recent Ice Age. River valleys cut through these ridges and drain into Lake Erie. Elevation in this region is 570 feet ASL at Lake Erie and rises to a high of 1,000 feet ASL less than 10 miles southward. (Pennsylvania DCNR, 2015r) (Pennsylvania DCNR, 2000)

12.1.3.4. Surface Geology

Surficial geology is characterized by materials such as till,[52] 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,[53] subsidence,[54] and erosion. (Thompson, 2015)

In northwestern Pennsylvania, remnant glacial surface deposits are well preserved. Parallel moraines[55] document periods of glacial advance and retreat across the area. Igneous and metamorphic rock fragments from bedrock originating in Canada have also been found, suggesting transport and deposition by glacial rivers. Limestone and dolostone till deposits also are prevalent, largely from erosion of the nearby bedrock in the Erie Basin (Pennsylvania DCNR, 2015t). The Titusville Till glacial deposits, from the late Illinoian glaciation, form the topography of northwestern Pennsylvania. The landscape includes "long, linear, rounded ridges, and broad uplands separated by linear valleys" (Sevon, Fleeger, & Shepps, 1999). Subsequent deposits from four Wisconsonan glaciation periods were left on top of the Titusville Till, including (from oldest to youngest) the Kent Till, Lavery Till, Hiram Till, and Ashtabula Till (Sevon, Fleeger, & Shepps, 1999).

In northeastern Pennsylvania, on the other hand, few surface glacial deposits are preserved, as each successive glaciation removed deposits from its predecessors. A single (discontinuous) moraine from the most recent Ice Age glaciation extends across northeastern Pennsylvania and proceeds southeastward into northern New Jersey. Few Canadian bedrock or carbonate till deposits are encountered in this area of the state (Pennsylvania DCNR, 2015t).

Figure 12.1.3-2 shows the generalized illustration of the surface geology for Pennsylvania.

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[52] Till: "An unsorted and unstratified accumulation of glacial sediment, deposited directly by glacier ice. Till is a heterogeneous mixture of different sized material deposited by moving ice (lodgement till) or by the melting in-place of stagnant ice (ablation till). After deposition, some tills are reworked by water." (USGS, 2013b).
[53] Slope failure, also referred to as mass wasting, is the downslope movement of rock debris and soil in response to gravitational stresses.
[54] Subsidence: "Gradual settling or sudden sinking of the Earth's surface owing to subsurface movement of earth materials." (USGS, 2000)
[55] Moraine: "A hill-like pile of rock rubble located on or deposited by a glacier." (USGS, 2015g)

12.1.3.5. Bedrock Geology

Bedrock geology analysis, and "the study of distribution, position, shape, and internal structure of rocks" (USGS, 2015c) reveals important information about a region's surface and subsurface characteristics (i.e., 3-dimensional geometry), including dip (slope of the formation),[56] rock composition, and regional tectonism[57]. 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).

Pennsylvania's bedrock geology varies greatly throughout the state. Southeastern Pennsylvania, including York, Lancaster, and Chester Counties, is largely underlain by Precambrian (older than 542 MYA) and Lower Paleozoic (542 to 443 MYA) igneous and metamorphic rocks (Pennsylvania DCNR, 2015v), including schist, gneiss, quartzite,[58] and phyllite[59] (Pennsylvania DCNR, 2007). "The remainder of the state is underlain by sedimentary rocks of practically all types" (Pennsylvania DCNR, 2015v). The most dominant sedimentary units include Ordovician (488 to 444 MYA) shale, limestone, dolostone, and sandstone; Devonian (416 to 359 MYA) red and gray sandstone, conglomerate, shale, and limestone; and Pennsylvanian (318 to 299 MYA) sandstone, red and gray shale, conglomerate, clay, coal, and limestone (Pennsylvania DCNR, 2007).

Figure 12.1.3-3 displays the general bedrock geology for Pennsylvania. For more site-specific information, other sources from the Pennsylvania DCNR[60] (including the County Rock Type Maps of Pennsylvania) and USGS topographical maps[61] should be consulted.

[56] 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." (National Park Service 2000)
[57] Tectonicisms: "Structure forces affecting the deformation, uplift, and movement of the earth's crust." (USGS, 2015b)
[58] Quartzite: "Hard, somewhat glassy-looking rock made up almost entirely of quartz." (USGS, 2015g)
[59] Phyllite: "A very fine-grained, foliated metamorphic rock, generally derived from shale or fine-grained sandstone." (USGS, 2015g)
[60] http://www.dcnr.state.pa.us/
[61] http://www.usgs.gov/pubprod/

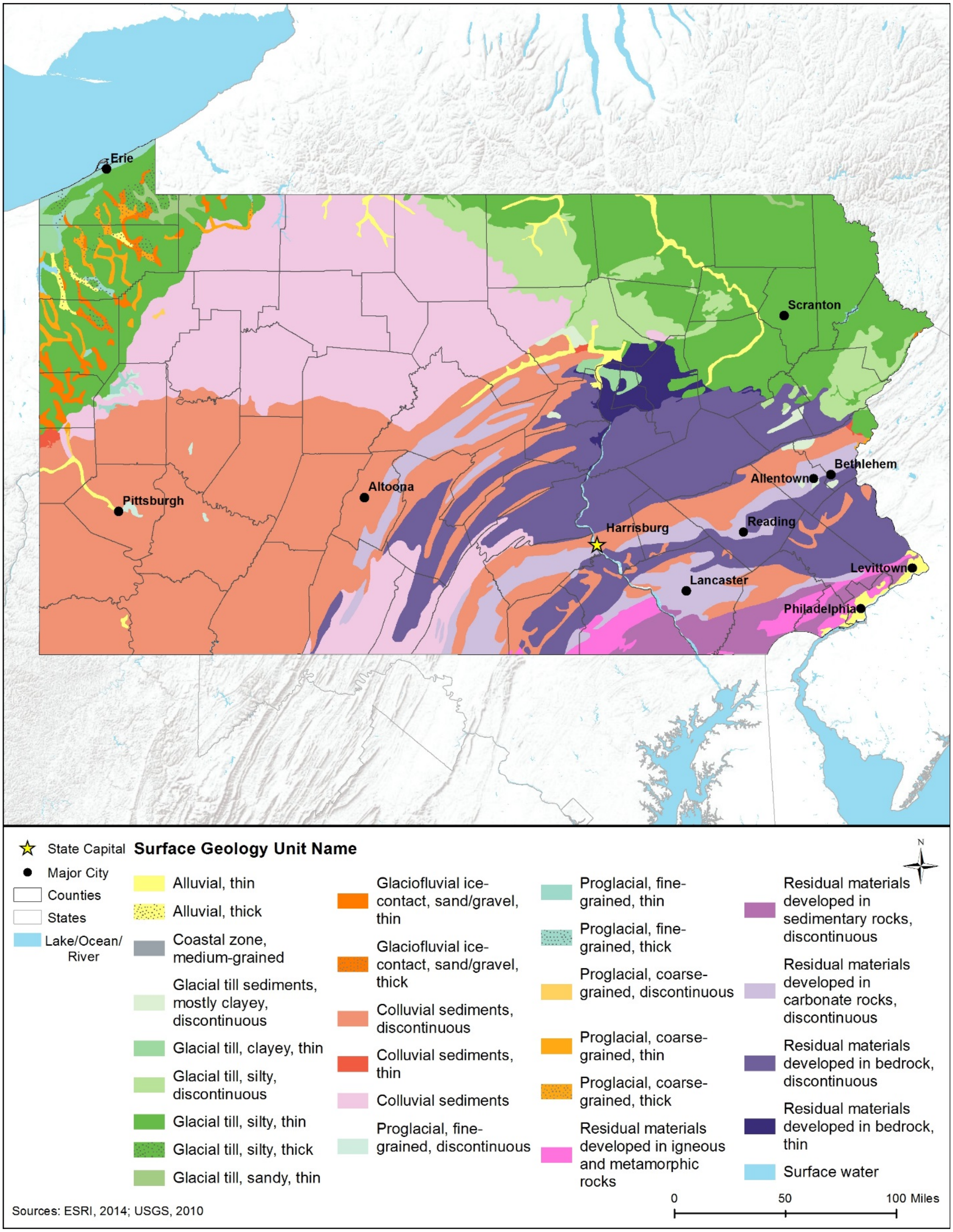

Figure 12.1.3-2: Generalized Surface Geology for Pennsylvania

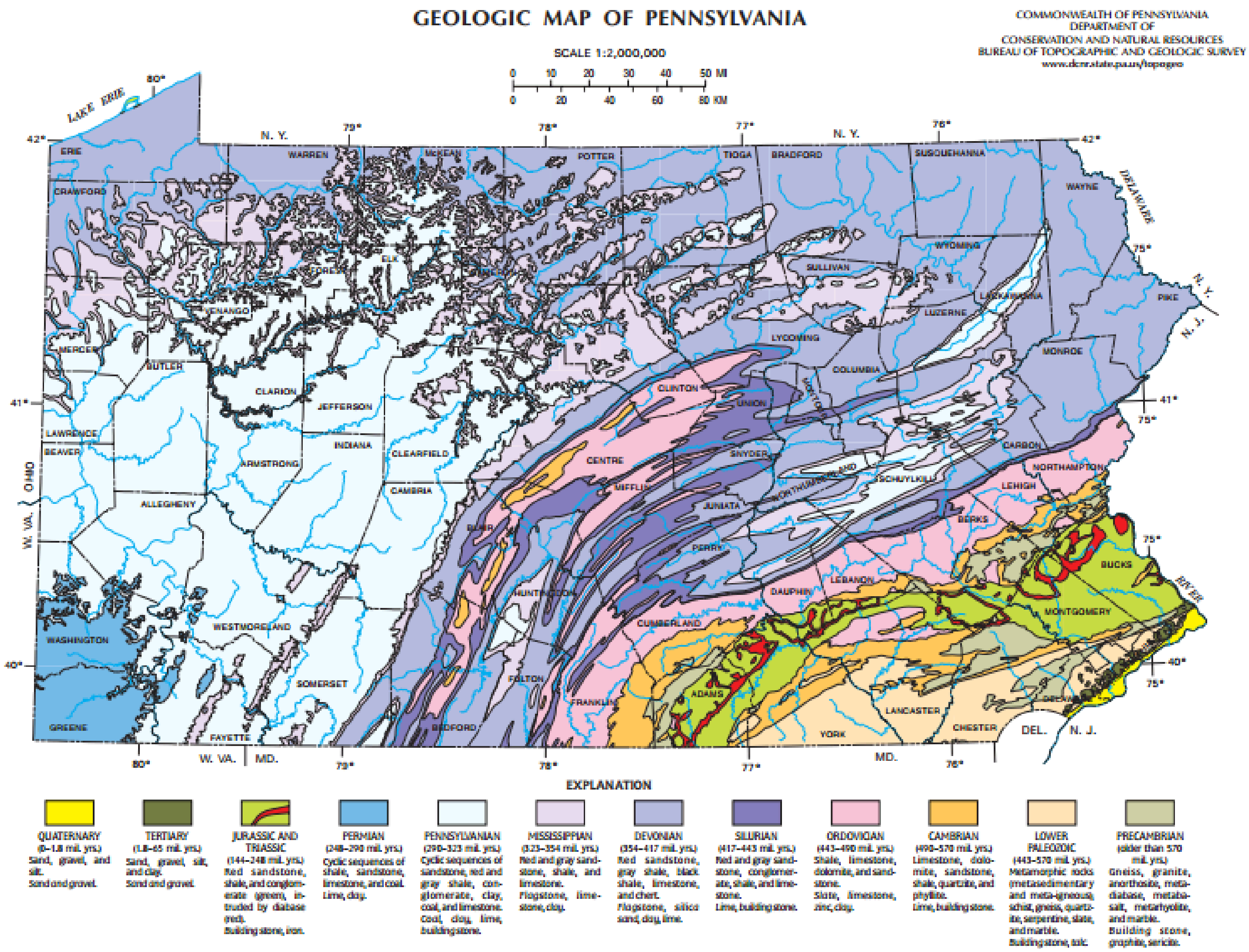

Figure 12.1.3-3: Generalized Bedrock Geology for Pennsylvania

Source: (Pennsylvania DCNR, 2007)

12.1.3.6. Paleontological Resources

During the early Cambrian (542 to 488 MYA) and Ordovician (488 to 444 MYA) Periods, Pennsylvania was covered by a shallow sea; as such, rocks in southeastern and south-central Pennsylvania from this period contain extensive marine fossils; sites with extensive marine fossils include Valley Forge National Historical Park and locations in York County (Figure 12.1.3-4). Plant and marine fossils have also been found from the Devonian Period (416 to 359 MYA). Sporadic dinosaur footprints from the Mesozoic Era have been recorded from lake and river bed sediments (Hoskins, Inners, & Harper, 2015). Erosion persisted through the Cretaceous Period (146 to 66 MYA) and into the Cenozoic Era (66 MYA to present), with only a few marine fossils having been recorded during this time. Between 2.6 MYA and 17,000 years ago, ice covered much of the state until approximately 17,000 years ago (Sevon, Fleeger, & Shepps, 1999); animal and plant fossils from this period have been recorded in ice-free areas of the state. (Paleontology Portal, 2015)

Pennsylvania State Fossil
Phacopsrana

Source: (Pennsylvania DCNR, 2015n)

Common fossils in Pennsylvania from the Paleozoic Era include corals (*Anthozoas*), bryozoans (*Ectoprocta*), brachiopods (*Brachiopoda*), mollusks (*Mollusca*, including bivalves and gastropods), arthropods (*Arthropoda*, including the trilobite *Phacops rana*, which is the official state fossil of Pennsylvania), and echinoderms (*Echinodermata*) (Hoskins, D., 1999). Trilobites, brachiopods, clams, snails, and bryozoans have been recorded from the Cambrian, Ordovician, Silurian, and Devonian Periods. Stromatolites can also be found in Cambrian Period rocks located at Valley Forge National Historical Park, and tube-shaped, vertical trace fossils called *Skolithos* from the Cambrian period have been found in the central part of the state. Ostracodes and a few fish teeth from the Permian Period have been recorded in southwestern Pennsylvania (Paleontology Portal, 2015). Plant fossils are also common, especially in the state's coal bed areas, and include scale trees, scouring rushes, small herbaceous plants, ferns and seed ferns, and trees similar to present-day pines but with large leaves (Hoskins, D., 1999). Mesozoic Era trace fossils, including dinosaur footprints, have been recorded in the state (Paleontology Portal, 2015). Other trace fossils found in Pennsylvania include the burrows *Planolites* and *Zoophycos*, as well as tubes from *Spirorbis sp.*, a small worm, and Gastropod grazing traces (Aulichnites) (University of Pittsburgh, 2015). Fossils ranging from a beetle to the woolly mammoth have been found from the Quaternary Period, along with plant fossils including mountain avens, willow, and sedge (Paleontology Portal, 2015).

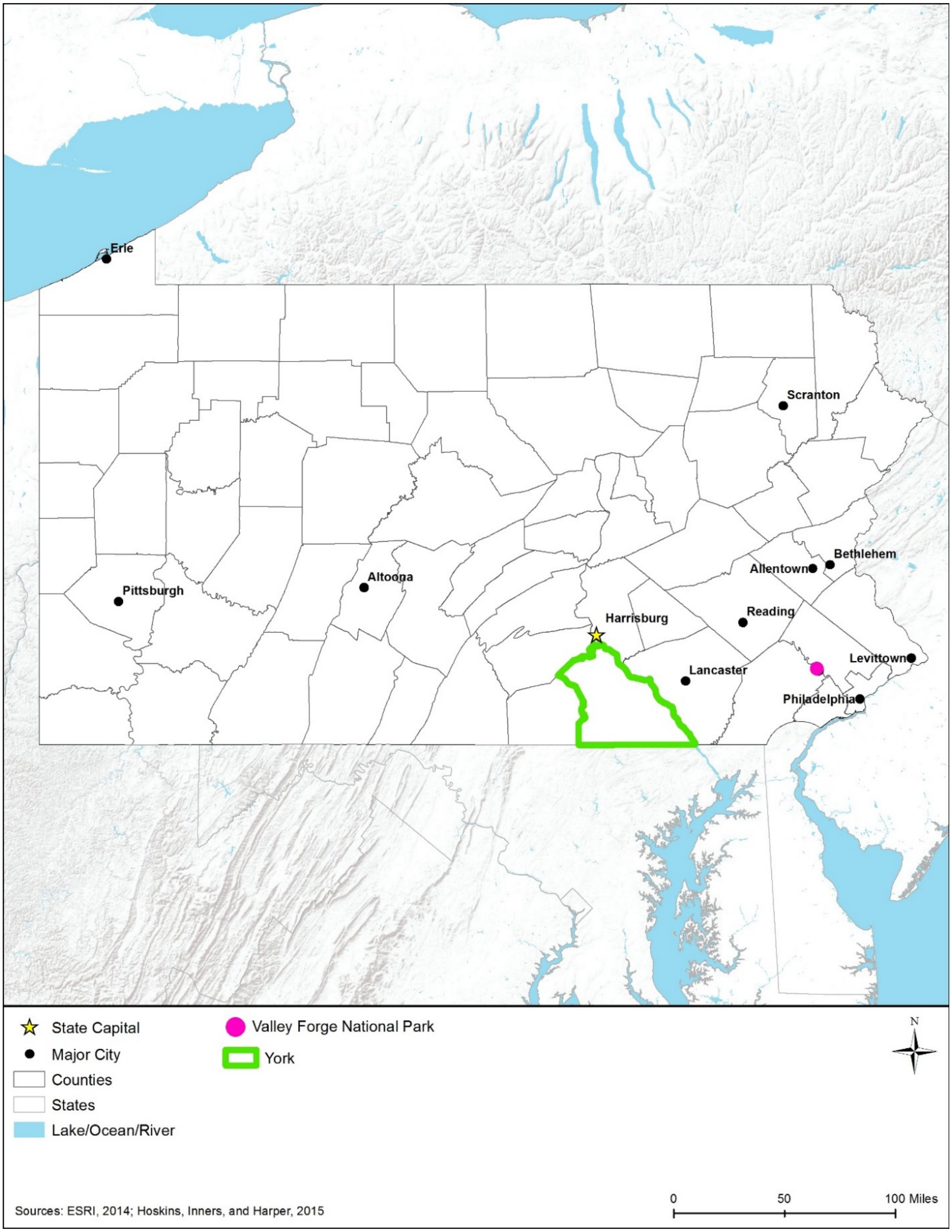

Figure 12.1.3-4: Valley Forge National Park and York County, PA

12.1.3.7. Fossil Fuel and Mineral Resources

Oil and Gas

Pennsylvania has been a crude oil producer since the late 19th century. In 1859, the first commercial oil well in nation was developed in Pennsylvania. More than 6.6M barrels of crude oil were produced in Pennsylvania 2014 (U.S. Energy Information Administration, 2015a). Drilling is particularly common in McKean County in northern Pennsylvania, and Susquehanna County in northeastern Pennsylvania (Pennsylvania DEP, 2015e).

As of 2014, Pennsylvania produced more than 4 trillion feet of natural gas (U.S. Energy Information Administration, 2015a). Natural gas is commonly found in Pennsylvania's shale formations, notably the Marcellus Shale Formation (Pennsylvania DEP, 2015e). The Marcellus Shale Formation is the largest shale play[62] in the region (Figure 12.1.3-5) which stretches across nine states[63] and has been estimated to contain up to 410 trillion cubic feet of natural gas. However, like many other large shale plays, only a portion of the formation has been put into production, primarily in Pennsylvania and West Virginia, so the actual amount of natural gas it contains is unknown (Considine, Watson, Sparks, & Entler, 2009).

Minerals

As of 2014, Pennsylvania's nonfuel mineral production was valued at $1.7B, ranking 16th nationwide (in terms of dollar value), and accounting for 2.2 percent of the country's total nonfuel mineral production. Pennsylvania's leading mineral commodities, by total value of production, were crushed stone (2nd nationwide), portland cement[64], lime, construction sand and gravel, and masonry cement (USGS, 2016a).

Large portions of western and southwestern Pennsylvania are among the most productive for coal extraction nationwide; Pennsylvania is one of the five largest coal-producing states in the country, with two coal mines that are the most productive east of the Mississippi River. As of 2013, Pennsylvania produced 54,009 thousand short tons[65] of coal (about 5.5 percent of total nationwide production). (EIA, 2015b)

[62] Large shale formations beneath the earth's surface which usually contain oil deposits or natural gas deposits.
[63] The Marcellus Shale Formation is found in portions of New York, New Jersey, Pennsylvania, Maryland, Virginia, Ohio, West Virginia, Kentucky, and Tennessee. (National Science Foundation 2015)
[64] Portland cement is the most common type of cement in general use around the world as a basic ingredient of concrete, mortar, stucco, and non-specialty grout.
[65] Short ton: a unit of weight equal to 2,000 pounds.

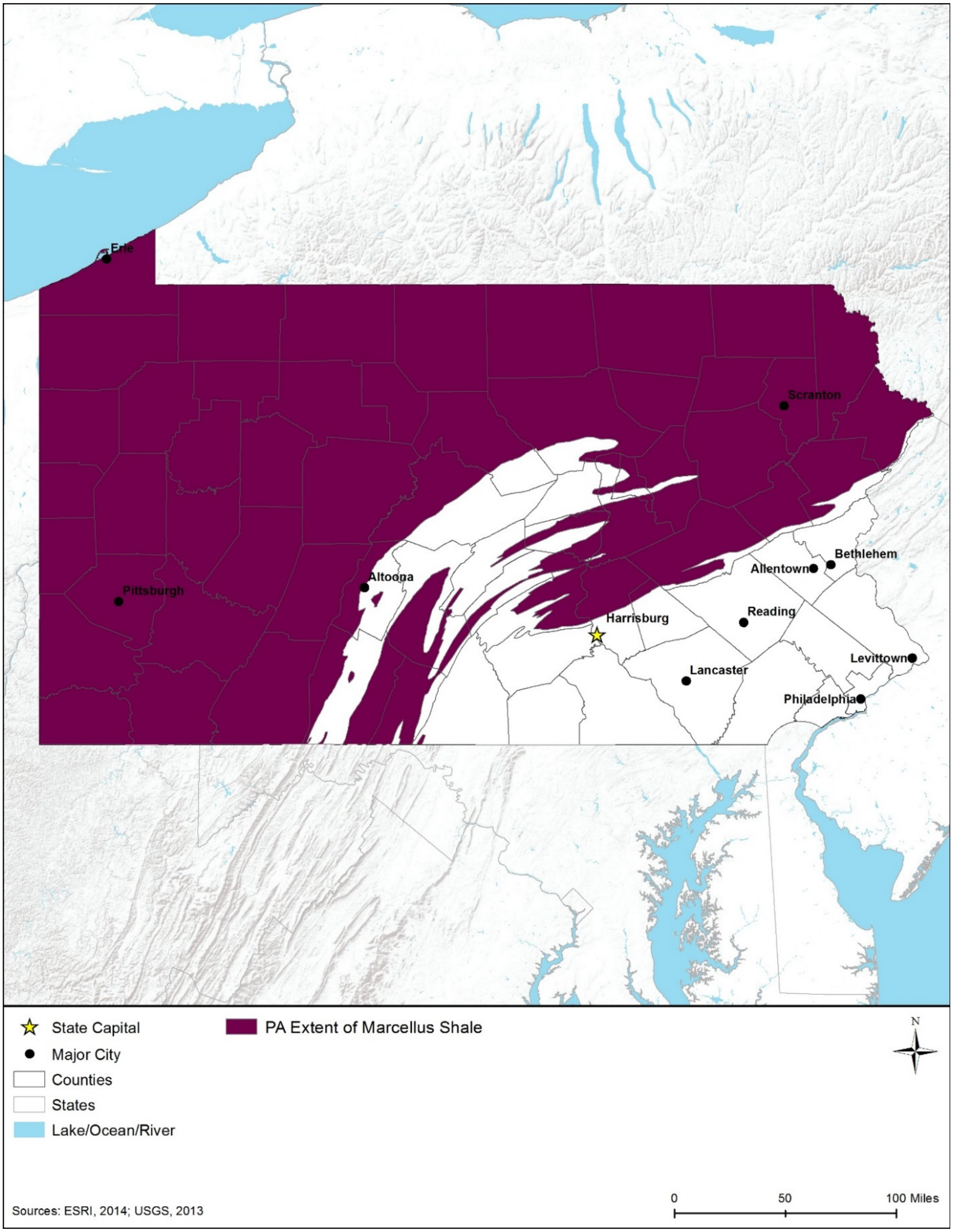

Figure 12.1.3-5: Extent of Marcellus Shale Formation in Pennsylvania

12.1.3.8. Geologic Hazards

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

Earthquakes

Between 1973 and March 2012, there were at least 20 earthquakes of a magnitude 3.5 (on the Richter scale) or greater in Pennsylvania (USGS, 2014a). Earthquakes are the result of large masses of rock moving against each other along fractures called faults. Earthquakes occur when landmasses on opposite sides of a fault suddenly slip past each other; the grinding motion of each landmass sends out shock waves. The vibrations travel through the Earth and, if they are strong enough, they can damage manmade structures on the surface (USGS, 2012b).

Pennsylvania Earthquakes

The largest earthquake ever recorded in Pennsylvania was a magnitude 5.2 quake that occurred in 1998 near the town of Jamestown in the far northwestern portion of the state. While, Southeastern Pennsylvania is the most seismically active portion of the state, no earthquakes exceeding magnitude 4.7 have ever been recorded there (within the last 200 years). "A probabilistic analysis that takes into consideration the threat from earthquakes both outside and inside Pennsylvania's borders indicates a relatively low level of earthquake hazard in [Pennsylvania]" (Pennsylvania Department of Conservation and Natural Resources 2007).

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. 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." 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) Pennsylvania is located far from any convergence boundaries, but is located in the middle of a tectonic plate (Kafka, 2014).

Figure 12.1.3-6 depicts the seismic risk throughout Pennsylvania. The map indicates levels of horizontal shaking (measured in Peak Ground Acceleration (PGA)) that have a 2 percent chance of being exceeded in a 50-year period. Units on the map are measured in terms of acceleration due to gravity (% g). Most pre-1965 buildings are likely to experience damage with exceedances of 10% g.[66] (USGS, 2010)

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

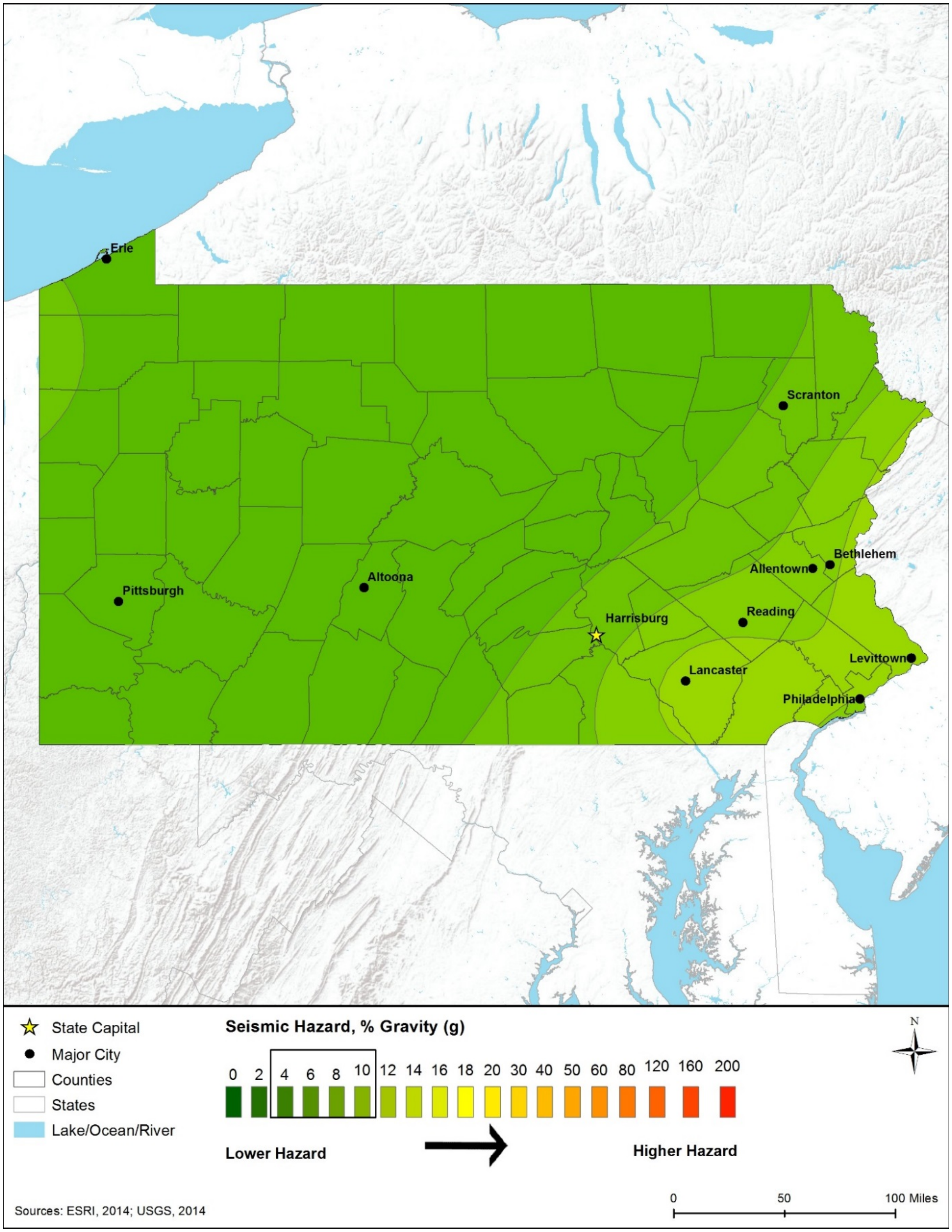

Figure 12.1.3-6: Pennsylvania 2014 Seismic Hazard Map

Landslides

While much of Pennsylvania is susceptible to landslide events, southwestern Pennsylvania is the area of the state that is at greatest risk for significant landslides (Figure 12.1.3-7) (Pennsylvania DCNR, 2015w).

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

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

Allegheny County, where Pittsburgh is located, is one of the most landslide-prone areas of the state, with slumps,[67] being the dominant type of hazard to the area (Figure 12.1.3-7). Landslides are common in portions of the county that are underlain by clay-stone and shale. Other factors that contribute to landslide susceptibility in Pennsylvania are the prevalence of joints,[68] steep slopes, and the presence of unconsolidated overlying soils. Human activities on Allegheny County's slopes, including road cut development, building construction, or overloading fill materials, may account for more than 90 percent of the landslides in the county (Briggs, Pomeroy, & Davies, 1975) (Pennsylvania DCNR, 2001). One study indicated that more than 15,000 landslides, most under 60 meters in total extent, had been recorded in the greater Pittsburgh area (Pomeroy, 1984). In 1991 alone, there were more than 300 landslides in Allegheny County (Pennsylvania DCNR, 2001).

Pittsburgh Area Landslide, 2006

Source: (USGS, 2013a)

[67] Slump: A slow moving landslide, where the surface is curved such that the "material rotates back into the slope as it slides." (Pennsylvania Department of Conservation and Natural Resources 2001)
[68] Joint: "A fracture or parting in a rock in which rock on one side has not been displaced relative to rock on the opposing side. Usually planar or gently curved. Joints often occur in parallel sets in which spacing between joints is more or less regular. Spacing between joints varies widely in different rock types." (Briggs, Pomeroy, & Davies, 1975)

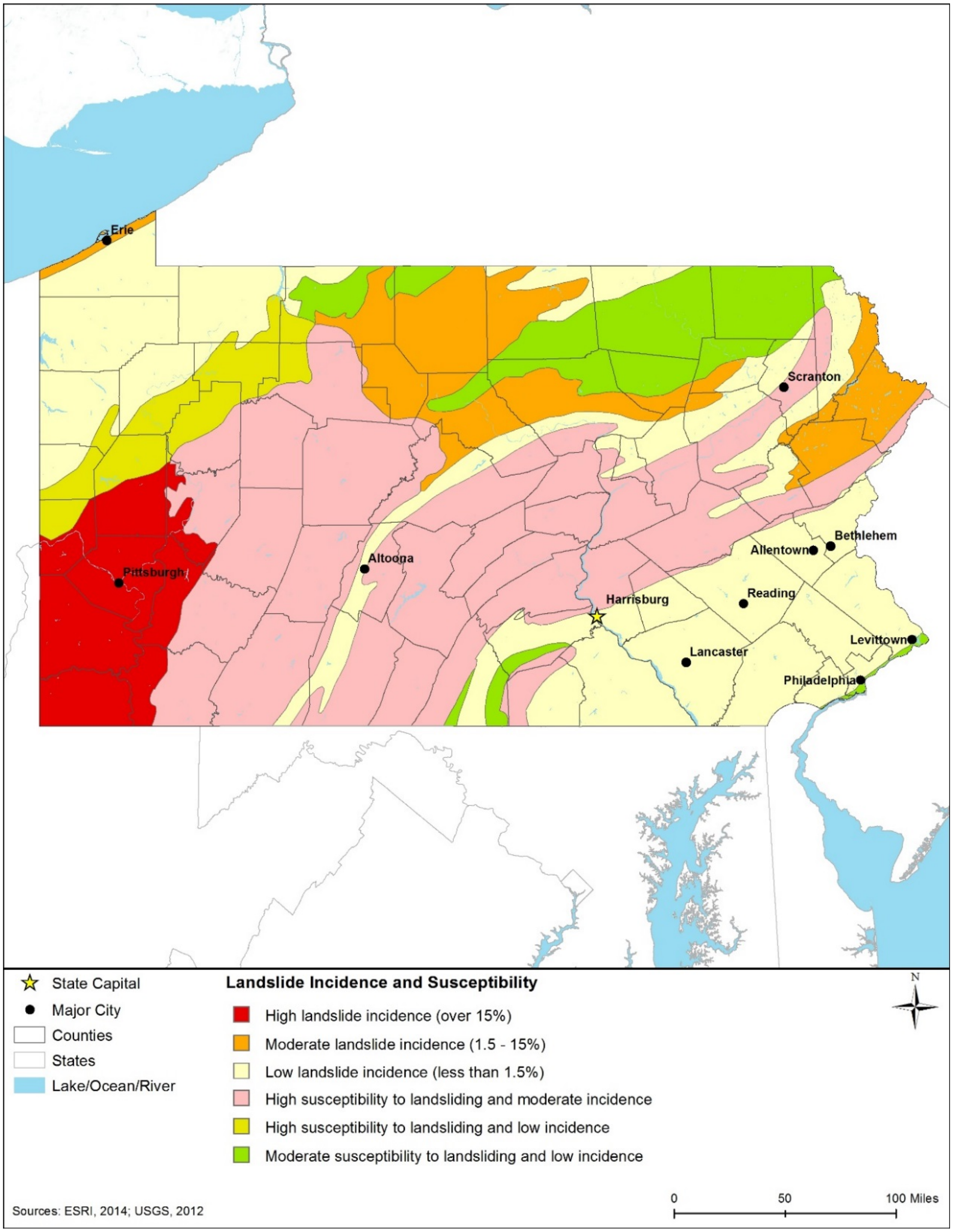

Figure 12.1.3-7: Pennsylvania Landslide Incidence and Susceptibility Hazard Map[69]

[69] Susceptibility hazards not indicated in Figure 12.1.3-7 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, 2014f).

Subsidence

Land subsidence is a "gradual settling or sudden sinking of the Earth's surface owing to subsurface movement of earth materials" (USGS, 2000). The main triggers of land subsidence can be aquifer compaction, drainage of organic soils, mining, sinkholes, and thawing permafrost. In Pennsylvania, a significant cause of land subsidence is the collapse of karst (USGS, 2000). More than 80 percent of subsidence in the U.S. 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. 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 causes slow drainage of water from the clay and silt beds. The reduced water pressure compromises support for the clay and silt beds, causing them to collapse on one another. The effects of this compression are seen in the lowering of the land surface elevation, which is permanent (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-storm 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, 2013a)

Photo of a Sinkhole Resulting from the Stormwater Runoff

Source: (Pennsylvania DCNR, 1999)

Karst sinkholes are usually encountered in areas underlain by carbonate rocks (usually limestone); in Pennsylvania, limestone is most common in the Valley and Ridge Province in the central and eastern parts of the state. Karst topography is of particular concern in urban centers (including Lancaster, York, Harrisburg, Allentown, and State College) where storm drains and gutters funnel stormwater runoff to specific areas on a property. When this scenario occurs, sinkholes can develop. Sinkholes can also occur near utility lines or water mains that leak water into nearby carbonate rocks; when the land under such infrastructure fails, the infrastructure itself often is damaged (Pennsylvania DCNR, 1999). Figure 12.1.3-8 shows the location of areas in Pennsylvania that are susceptible to land subsidence due to karst topography.

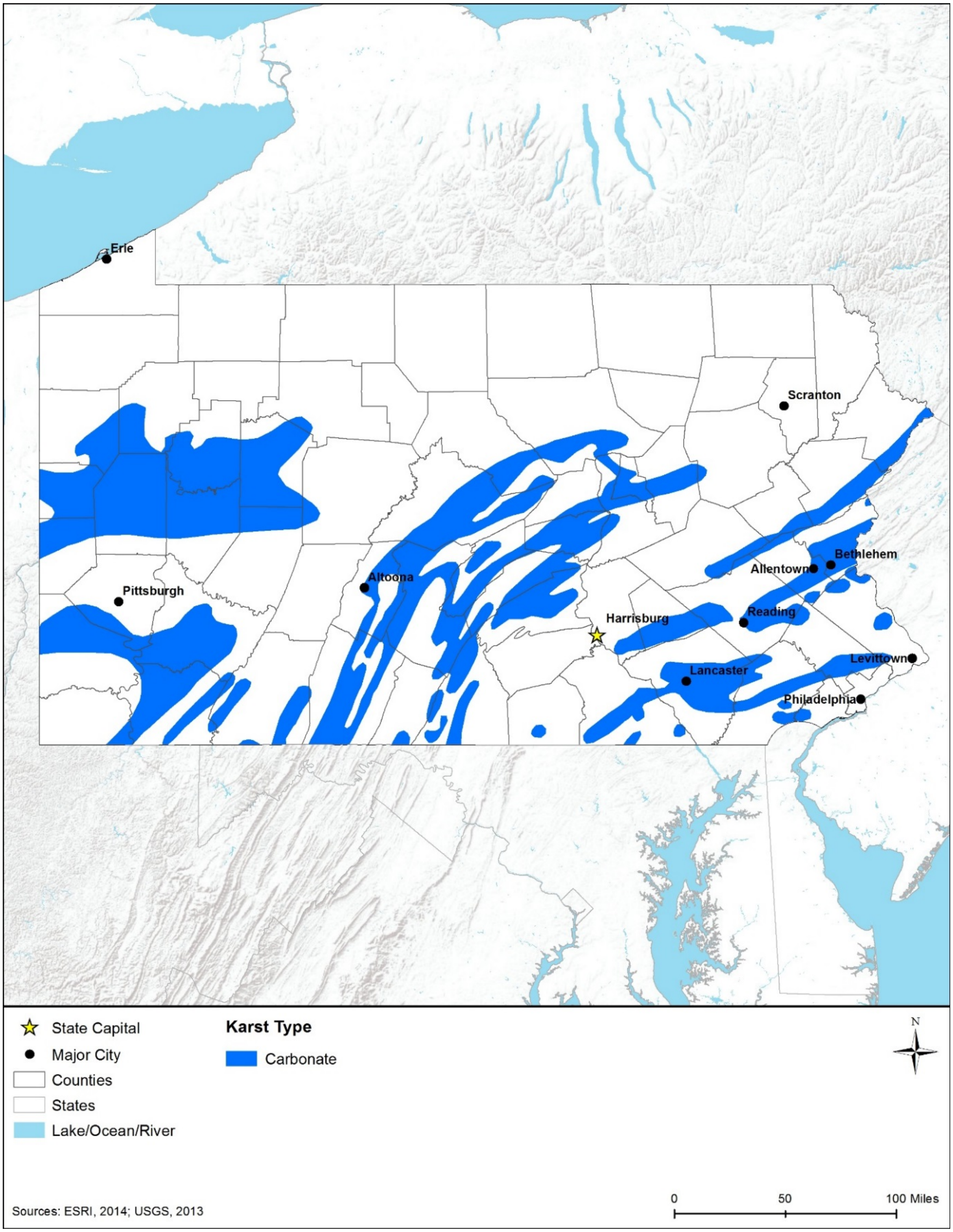

Figure 12.1.3-8: Karst Topography in Pennsylvania

12.1.4. Water Resources

12.1.4.1. Definition of the Resource

Water resources are defined as all surface waterbodies and groundwater systems including streams, rivers, lakes, canals, ditches, estuarine waters, floodplains, aquifers, and other aquatic habitats (wetlands are discussed separately in Section 12.1.5). 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, 2014d)

12.1.4.2. Specific Regulatory Considerations

Federal laws relevant to protecting the quality and use of water resources are summarized in Appendix C, Environmental Laws and Regulations. Table 12.1.4-1 summarizes the major Pennsylvania laws and permitting requirements relevant to the state's water resources.

Table 12.1.4-1 Relevant Pennsylvania Water Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
National Pollutant Discharge Elimination System (NPDES) Stormwater Construction Program	Pennsylvania DEP, Bureau of Waterways Engineering and Wetlands	Stormwater discharges due to construction activities affecting more than one acre. Discharges to High Quality or Exceptional Value waters may not be allowed or may be subject to additional requirements. (Pennsylvania DEP, 2015l)
	Pennsylvania DEP, Bureau of Point and Non-Point Source Management	Stormwater discharges due to industrial activities or non-traditional small municipal separate storm sewer systems. (Pennsylvania DEP, 2010), (Pennsylvania DEP, 2012b)
	Pennsylvania DEP, Bureau of Point and Non-Point Source Management	Facilities discharging wastewater from point sources.[70] General permits cover various activities, while individual permits cover other activities outside the scope of general permits. (Pennsylvania DEP, 2015u)

[70] A source of pollution that can be attributed to a specific physical location -- an identifiable, end-of-pipe "point." (USEPA, 2015g)

State Law/Regulation	Regulatory Agency	Applicability
Submerged Lands	Pennsylvania DEP, Bureau of Waterways Engineering and Wetlands	Construction of “public service lines” (e.g., electric transmission lines or telephone lines) “upon, in or over submerged lands.” Submerged lands are “waters and permanently or periodically inundated lands owned by the Commonwealth, including lands in the beds of navigable lakes and rivers and beds of streams declared public highways which are owned and held in trust by the Commonwealth.” (Pennsylvania DEP, 2014a), (PA Code, 2011)
Utility Line Stream Crossings	Pennsylvania DEP, Bureau of Waterways Engineering and Wetlands	“The installation, operation, and maintenance of utility line stream crossings of the regulated waters of the Commonwealth.” (Pennsylvania DEP, 2013b)
Clean Water Act (CWA), Section 404	Pennsylvania DEP	Any “discharge of dredged, excavated or fill material or structures into waters of the United States and waters of the Commonwealth.” (Pennsylvania DEP, 2013d)
Water Quality Certification	Pennsylvania DEP	In accordance with Section 401 of the CWA, activities that may result in a discharge to waters of the U.S. require a Water Quality Certification from Pennsylvania DEP indicating that the proposed activity will not violate state water quality standards. (Pennsylvania DEP, 1997)
Nationwide Permit, Pennsylvania State Regional Conditions	USACE, Philadelphia District	Regional conditions apply to Nationwide Permits for the following activities: maintenance, utility line activities, bank stabilization, minor discharges, minor dredging, structural discharges, and temporary construction access and dewatering. Permittees must complete a Pennsylvania Natural Diversity Inventory screening and follow specific procedures for in pre-construction notification. (USACE, Philadelphia District, 2012)
Bluff Recession Setback Act	Pennsylvania DEP, Bureau of Interstate Waters	Construction, installation, or improvement to structures or utility facilities is prohibited within Lake Erie Bluff Recession Hazard Areas (i.e., “area[s] or zone[s] where the rate of progressive bluff recession creates a substantial threat to the safety or stability of nearby or future structures or utility facilities”) (Pennsylvania DEP, 2004b), (Pennsylvania DEP, 2015aa), (PA Code, 1980)
Floodplain Management Act	Pennsylvania DEP, Bureau of Waterways Engineering and Wetlands	“Any structure or activity which changes, expands or diminishes the course, current or cross section of a watercourse, floodway or body of water.” (Pennsylvania DEP, 2013d)

12.1.4.3. *Environmental Setting: Surface Water*

Surface water resources are lakes, ponds, rivers, and streams, as well as estuarine[71] and coastal waters. According to the Pennsylvania DEP, Pennsylvania has "an estimated 86,000 stream and river miles and 161,455 lake acres" as well as 17 square miles of estuary and 63 miles of Great Lakes coastline (Pennsylvania DEP, 2014b). These surface waters supply drinking water; provide flood control and aquatic habitat; and support recreation, tourism, agriculture, fishing, power generation, industry, and mining across the state. (Pennsylvania DEP, 2012a)

Watersheds

Watersheds, or drainage areas, consist of surface water and all underlying groundwater, and encompass an area of land that drains all the streams and rainfall to a common outlet (e.g., reservoir, bay). Pennsylvania's waters (lakes, rivers, and streams) are divided into six major watersheds, or drainage basins (Figure 12.1.4-1). Pennsylvania Appendix A, Table A-1, provides detailed information on the state's major watersheds, as defined by Pennsylvania DEP. These river basins include the Delaware, Susquehanna, Genesee, Potomac, Ohio, and Lake Erie. (Pennsylvania DEP, 2014b). Visit www.pawaterplan.dep.state.pa.us/statewaterplan/docroot/default.aspx for information and additional maps about each Pennsylvania DEP watershed's location, size, and water quality.

The Delaware watershed lies along the eastern border with New Jersey. Within Pennsylvania, this watershed drains the approximately 6,425 square mile area east of the Pocono Mountains. South of Morrisville, the Delaware River is considered a tidal estuary, rather than a river. The Susquehanna River Basin, stretching across Pennsylvania into New York to the north and Maryland to the south, is the second largest watershed—next to the Ohio River Basin—east of the Mississippi River and the largest watershed within the state (20,960 square miles). The Genesee River Basin is the smallest, occupying almost 100 square miles on the Pennsylvania-New York border in Potter County. The basin contains the headwaters of the Genesee River, which eventually drains into Lake Ontario. The Potomac River Basin is comprised of approximately 1,600 square miles in southcentral Pennsylvania, containing only the headwaters of the Potomac River, which itself does not run through the state. The majority of the Potomac River Basin is in Virginia, West Virginia, Maryland, and D.C. The Ohio River Basin is the second largest in the state, located west of the Allegheny Mountains, and occupying approximately 15,600 square miles. This river basin includes drainages of the Allegheny, Conemaugh, Youghiogheny, Beaver, Clarion, and Monongahela rivers. To the north, the Lake Erie Watershed encompasses approximately 66 miles of Lake Erie shoreline, which represents the northwestern boundary of the state. The basin is the second smallest in Pennsylvania, spanning only approximately 500 square miles. (Pennsylvania DEP, 2012a)

[71] 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, 2015g)

Freshwater

As shown in Figure 12.1.4-1, there are 15 major rivers in Pennsylvania: the Delaware and its tributaries (the Schuylkill, Lehigh, and Lackawaxen Rivers), the Ohio and its tributaries (the Allegheny, Monongahela, and Youghiogheny Rivers) the Susquehanna and its tributaries (the West Branch Susquehanna, Juniata, Raystown Branch Juniata, Conestoga, and Lackawanna Rivers), and the Genesee River. The Delaware River is the "longest un-dammed river east of the Mississippi," (Pennsylvania DEP, 2012a) and serves as part of the border between Pennsylvania and New York and the entire border between Pennsylvania and New Jersey. The Allegheny River, with its headwaters in northcentral Pennsylvania, joins the Monongahela in Pittsburgh to form the Ohio River, which flows for 50 miles within the state to the Ohio border. The Susquehanna flows from New York and its drainage into the Chesapeake Bay account for half of the freshwater therein. Pennsylvania is part of the Chesapeake Bay program because of the proximity of the watershed and because the Susquehanna is the Bay's largest tributary. The Genesee River begins in northcentral Pennsylvania only 11 miles from the New York border and drains north into Lake Ontario (Pennsylvania DEP, 2012a).

The Great Lakes form the largest surface freshwater system on the planet spanning more than 94,000 square miles of surface area (NOAA, 2015a). Of the five Great Lakes, Lake Erie borders 63 miles of Pennsylvania, and 750 square miles of the lake fall under the commonwealth's jurisdiction (Pennsylvania DEP, 2012a) . According to the Pennsylvania DEP, residents and industry along Pennsylvania's Lake Erie coast withdraw 70 million gallons of water per day (Pennsylvania DEP, 2012a).

Lake Erie, the second smallest and shallowest of the Great Lakes, has an average depth of 82 feet and a maximum depth of 210 feet. Much of the water inflow to the lake comes from the Detroit River and the remaining from tributaries and precipitation. The high levels of urbanization[72] and industrialization surrounding the lake have led to impaired water quality in the lake.

Presque Isle Bay

The Presque Isle Bay on the coast of Lake Erie is designated as an Area of Concern by the USEPA, indicating that it was one "of the most polluted places around the Great Lakes" (USEPA, 2015m). Designated in 1991 due to contamination by municipal wastewater and industrial pollution, the water column and sediments experienced elevated levels of heavy metals, hydrocarbons, and nutrients. Improved wastewater and stormwater management coupled with economic shifts from industrial to commercial uses of the Bay, led to delisting the Bay as an Area of Concern in 2013. (USEPA, 2015m)

Source: (USEPA, 2013c)

[72] Urbanization: "The process where an area of land becomes more urban in character, developed, and otherwise changed to more closely resemble a city or town." (USEPA, 2015g)

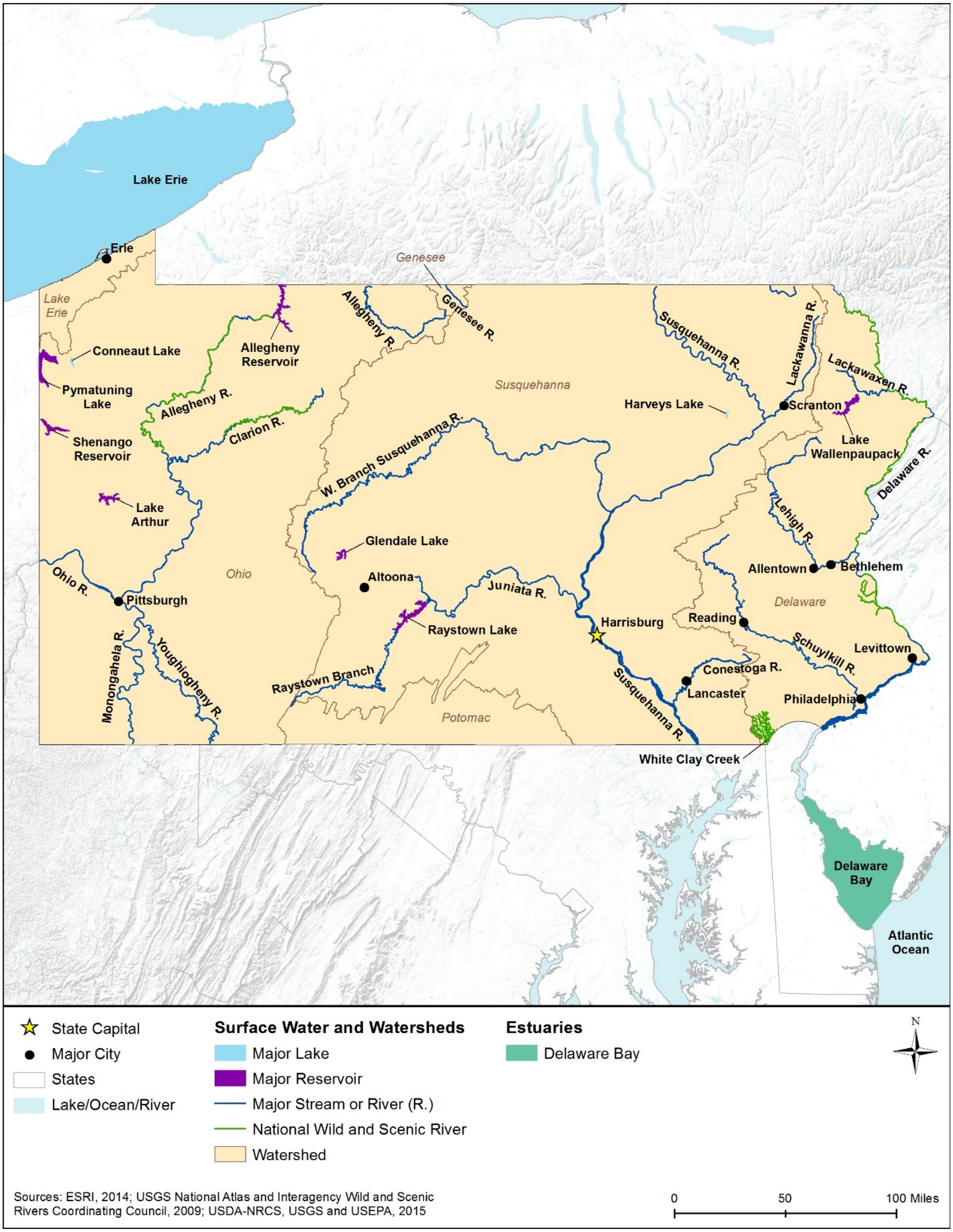

Figure 12.1.4-1: Major Pennsylvania Watersheds, Defined by Pennsylvania DEP, and Surface Waterbodies

Wastewater runoff from sewage treatment plants and excess sediment loading from agriculture and urbanization have affected water quality, resulting in eutrophication, excessive algae growth, and aquatic habitat loss. Chemicals, such as polychlorinated biphenyls (PCBs), chlordane, and other toxic compounds, have also degraded water quality in the lake. (USEPA & Environment Canada, 2006)

Pennsylvania DEP works with local, federal, and international agencies to protect and restore the Great Lakes. In 1987, the U.S. and Canada committed to develop and implement Lakewide Management Plans (LaMPs) (in 2012 renamed Lakewide Action and Management Plans (LAMPs)) for the Great Lakes, including Lake Erie. The Lake Erie LAMP identifies priority environmental concerns, opportunities public involvement, and details remedial action and work plans to address the concerns. (USEPA & Environment Canada, 2006)

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. Pennsylvania's estuarine environments support a variety of habitats, including tidal wetlands, mudflats, rocky shores, oyster reefs, freshwater wetlands, sandy beaches, and eelgrass beds, and are a critical part of the lifecycle of many different plant and animal species. (USEPA, 2012e)

Pennsylvania's one estuarine environment is the tidal Delaware River along the southeast border of the state (see Figure 12.1.4-1). National Oceanic and Atmospheric Administration (NOAA), Pennsylvania DEP and other state agencies, local municipalities, and nonprofits have developed programs to manage coastal hazards, dredge and fill activities, fisheries, wetlands, recreational access, cultural resources, ports, and power plants. Information on Pennsylvania's coasts is available on the Pennsylvania DEP Coastal Resources Management Program's site (www.dep.state.pa.us/river/about/about.htm). (Pennsylvania DEP, 2015aa)

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 12.1.4-1). 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 National Estuary Program (NEP) recognized the Delaware Bay as an Estuary of National Significance (USEPA, 2014d). The estuary's 1996 Comprehensive Conservation & Management Plan 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, 2014d). For more information on the Delaware Estuary, visit the USEPA's NEP website at water.epa.gov/type/oceb/nep/index.cfm#tabs-2.

12.1.4.4. Sensitive or Protected Waterbodies

Wild and Scenic Rivers

Five river segments in Pennsylvania have been designated as Wild and Scenic Rivers (see Appendix C for more information on the Wild and Scenic Rivers Act) (National Wild and Scenic Rivers System, 2015a). These include the Allegheny River; Clarion River; Lower, Middle, and Upper Delaware River; and White Clay Creek (Figure 12.1.4-1).

- Within the Allegheny National Forest, three separate reaches of the Allegheny River, totaling 86.6 miles, are designated as recreational due to their accessibility to the public, safe waters for boating and good fishing conditions (National Wild and Scenic Rivers System, 2015b).
- The Clarion River, in the Allegheny National Forest, Cook Forest State Park, and Clear Creek State Park, has 17.1 miles designated scenic and 34.6 miles designated recreational; the river valley provides camping, fishing, birdwatching, and other recreational opportunities. (National Wild and Scenic Rivers System, 2015c).
- The Lower Delaware River segment includes approximately 39 miles of the Delaware River and 28 miles of tributaries (Tinicum, Tohickon, and Paunacussing Creeks) (Delaware River Basin Commission, 2015). The river is considered one of the most significant corridors in the nation with many Native American and colonial archaeological sites. (NPS, 2014h) (National Wild and Scenic Rivers System, 2015d)
- The Middle Delaware River segment extends 40 miles from “the northern boundary of the Delaware Water Gap National Recreation Area to the point where the river crosses the southern boundary.” The river provides many recreational, sightseeing, and geological study opportunities. (National Wild and Scenic Rivers System, 2015e)
- The Upper Delaware River, part of “the largest free-flowing river in the eastern United States,” (NPS, 2015d) from where it crosses the New York-Pennsylvania border to north of the New York- New Jersey-Pennsylvania border, contains 23.1 miles designated as scenic and 50.3 miles designated as recreational. (National Wild and Scenic Rivers System, 2015f)
- White Clay Creek and tributaries in its watershed are designated as scenic (31.4 miles) and recreational (167.6 miles); these areas provide habitat for the endangered bog turtle and contain cultural resources including “lime kilns and 19th century mills” (National Wild and Scenic Rivers System, 2015g).

In addition to federally designated Wild and Scenic Rivers, Pennsylvania’s Scenic Rivers Act protects rivers that “possess outstanding aesthetic and recreational values of present and potential benefit to the citizens of Pennsylvania” (Pennsylvania DCNR, 1982). Pennsylvania’s Scenic River system classifies these waterbodies as wild, scenic, pastoral, recreational, and/or modified recreational based on their free-flowing character, support of aquatic life and/or recreation, and shoreline attributes (Pennsylvania DCNR, 2015f). Pastoral rivers generally flow freely, but may have historic dams, and are surrounded by agricultural lands while modified recreational rivers may have dams and other flow control devices (Pennsylvania DCNR, 1982). Statewide, there are 13 rivers or segments, totaling more than 500 miles, designated as Scenic Rivers in Pennsylvania; Pennsylvania Appendix A, Table A-2, identifies each of these rivers

(Pennsylvania DCNR, 2015i). Most of these rivers or segments are in southeastern Pennsylvania.

State Designated High Quality and Exceptional Value Waters

Pennsylvania defines two classes of existing uses for waterbodies whose existing quality must be protected from degradation. Generally, NPDES permitted discharges are only permissible to HQ Waters and EV Waters if they maintain existing quality. However, discharges to HQ Waters may lower water quality if there is a social or economic justification. (Pennsylvania DEP, 2003) More information on criteria used for defining HQ and EV Waters is in Pennsylvania DEP's Water Quality Antidegradation Implementation Guidance available at www.elibrary.dep.state.pa.us/dsweb/Get/Document-47704/391-0300-002.pdf.

Pennsylvania DEP has identified 76 streams (465 miles) with HQ existing (i.e., actual) uses exceeding their current designated uses.[73] An additional 119 streams (2,988 miles) have been identified with EV existing uses exceeding their current designated uses. These stream segments await formal rulemaking to change their designated use to align with their existing use. A full list of these streams is available at files.dep.state.pa.us/Water/Drinking%20Water%20and%20Facility%20Regulation/WaterQualityPortalFiles/Existing%20Use/EU%20table%20list.pdf. (Pennsylvania DEP, 2014c)

12.1.4.5. Impaired Waterbodies

Several elements, including temperature, dissolved oxygen, suspended sediment, nutrients, metals, oils, observations of aquatic wildlife communities, and sampling of fish tissue, are used to evaluate water quality. Under Section 303(d) of the CWA, states are required to assess water quality and report a listing of impaired waters,[74] the causes of impairment, and probable sources. Table 12.1.4-2 summarizes the water quality of Pennsylvania's assessed major waterbodies by category, percent impaired, designated use, cause, and probable sources. Figure 12.1.4-2 shows the Section 303(d) waters in Pennsylvania as of 2014.

Table 12.1.4-2 Section 303(d) Impaired Waters of Pennsylvania, 2006[75]

Water Type[a]	Amount of Waters Assessed (Percent)	Amount Impaired (Percent)	Designated Uses of Impaired Waters	Top Causes of Impairment	Top Probable Sources for Impairment
Rivers and Streams	100%	19%	Fish consumption, recreation, drinking, aquatic life	Sediment, metals, pH, nutrients	Abandoned mine drainage, agriculture and grazing, urban runoff and storm sewers

Source: (USEPA, 2015p)

a Pennsylvania has not assessed waterbodies other than streams and rivers within the state.

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73 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, 2015g)

74 Impaired waters: Waterways that do not meet state water quality standards. Under the CWA, Section 3
03(d), states, territories, and authorized tribes are required to develop prioritized lists of impaired waters. (USEPA, 2015g)

75 2006 is the latest data available for Pennsylvania from USEPA's Watershed Assessment, Tracking & Environmental Results System.

Various sources affect Pennsylvania's rivers and streams, causing impairments, as shown in Table 12.1.4-2. Pennsylvania DEP has identified agriculture causing siltation and abandoned mine drainage causing increased metals concentrations as the primary water quality issues for streams. In lakes, agriculture is also the source of various water quality problems, including nutrient loading, sediments, and decreased dissolved oxygen (Pennsylvania DEP, 2014b). For example, the Lake Erie coastal zone has been impacted by runoff associated with agricultural production, increased suburban development, timber harvesting activities reducing forested areas, and erosion of bluffs. (Pennsylvania DEP, 2012a)

Pennsylvania DEP engages in continuous instream monitoring of waterbodies throughout the state. Of available reports on 18 waterbodies, monitoring identified six streams showing poor water quality (Pennsylvania DEP, 2015ae). For example, agricultural runoff is likely responsible for high pH and large daily fluctuations in dissolved oxygen in Cooks Creek, a tributary to the Delaware River, (Pennsylvania DEP, 2015ah) and high sediment loads and pH fluctuations in Raccoon Creek, a tributary to the Juniata River (Pennsylvania DEP, 2015ai). In the Schuylkill River basin, residential and municipal runoff contributed to algae blooms, large fluctuations in flow, and reduction of animal communities to predominantly stress-tolerant species in Towamencin Creek (Pennsylvania DEP, 2015aj) and high nutrients, sediments, fluctuating dissolved oxygen, and algae blooms in Skippack Creek (Pennsylvania DEP, 2015ak). Glad Run, located in northwest Pennsylvania in the Allegheny River basin, was found to have low pH, characteristic of acid deposition (Pennsylvania DEP, 2014d). A brine treatment facility and abandoned mine drainage caused high salinity, fluctuating pH, and high metal concentrations at Blacklick Creek, in the Ohio River basin (Pennsylvania DEP, 2014e).

To address pollutant-impaired waters, Pennsylvania is in the process of developing TMDLs. The USEPA defines a TMDL as "calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that load among the various sources of that pollutant" (USEPA, 2013d). TMDLs address both point and nonpoint[76] source pollution, and build in a "margin of safety" to ensure pollutant reductions achieve desired water quality end states. TMDLs inform implementation plans that outline corrective actions to return impaired waters to designated uses. (USEPA, 2013d)

By 2014, the state had developed approved TMDL documents for 6,851 miles of impaired streams and 11,096 acres of impaired lakes; approximately 9,031 stream miles and 6,052 lake acres still require TMDLs (Pennsylvania DEP, 2014b). For example, the TMDL most recently approved by USEPA addresses metals and pH impairment due to acid mine drainage in the Panther Creek watershed (Pennsylvania DEP, 2014f). While the TMDL sets limits only for iron, manganese, aluminum, and pH, the watershed is also impacted by municipal runoff and untreated sewage discharges (Pennsylvania DEP, 2014f). Pennsylvania DEP provides a searchable database of all TMDLs across the commonwealth that is available at www.ahs.dep.pa.gov/TMDL/.

[76] 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, 2015g)

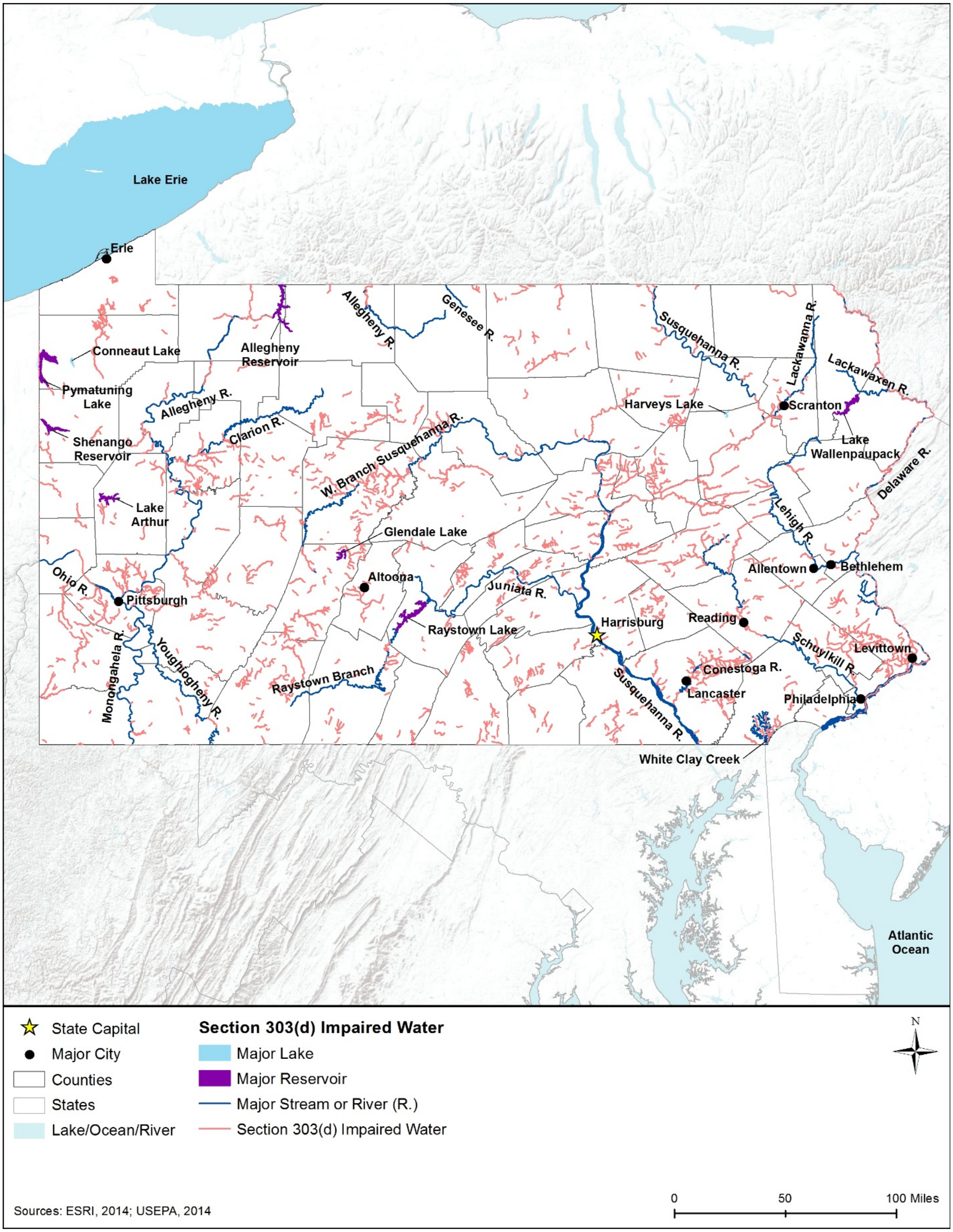

Figure 12.1.4-2: Section 303(d) Impaired Waters of Pennsylvania, 2014

Due to PCB, chlordane, and mercury contamination in waters and sediments, Pennsylvania has issued a general fish consumption advisory to eat not more than one-half pound per week of "recreationally caught sport fish" in state waterbodies (Pennsylvania DEP, 2015q). The state also issues consumption advisories for particular species by waterbody, recommending meal frequency limits more stringent than the general advisory due to mercury and PCB contamination (Pennsylvania DEP, 2015t). As of 2014, there were 2,496 stream miles and 35,408 lake acres with fish consumption advisories; Pennsylvania DEP has developed approved TMDLs for 712 stream miles and 5,642 lake acres (Pennsylvania DEP, 2014b).

12.1.4.6. 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 provides shade, which helps to regulate water temperature for aquatic species. During flood events, sediment and debris settle out and collect on the floodplain, enriching the soil with additional nutrients. Pollutants from floodwater runoff are also filtered by floodplain vegetation and soils; thereby improving water quality. Furthermore, floodplains protect natural and built infrastructure by providing floodwater storage, erosion control, water quality maintenance, and groundwater recharge. Historically, floodplains have been favorable locations for agriculture, aquaculture, and forest production due to the relatively flat topography and nearby water supply. Floodplains can also offer recreational activities, such as boating, swimming, and fishing, as well as hiking and camping. (FEMA, 2014a)

There are two primary types of floodplains in Pennsylvania:

- Riverine and lake floodplains occur along rivers, streams, or lakes where overbank flooding may occur, inundating adjacent land areas. In mountainous areas, such as the Poconos, floodwaters can build and recede quickly, with fast moving and deep water. Flooding in these areas can cause greater damage than typical riverine flooding due to the high velocity of water flow, the amount of debris carried, and the broad area affected by floodwaters. Whereas, flatter floodplains may remain inundated for days or weeks, covered by slow-moving and shallow water. (FEMA, 2014b)
- Coastal floodplains in Pennsylvania border the Delaware River Estuary and the shoreline of Lake Erie. Coastal flooding can occur when strong wind and storms, usually nor'easters and hurricanes, increase water levels on the adjacent shorelines. (FEMA, 2013) Lake coastal flooding can occur in Pennsylvania when strong wind and storms increase water levels on the shores of Lake Erie, (NOAA, 2014b). In addition, a storm surge event that takes place

during high tide can cause floodwaters to exceed normal tide levels, resulting from strong winds preventing tidal waters to recede in conjunction with additional water pushed toward the shore, as was the case during Hurricane Sandy (NOAA, 2015d).

Hurricane Irene and Tropical Storm Lee

In August and September of 2011, eastern Pennsylvania was hit first by Hurricane Irene and second, a week and a half later, by Tropical Storm Lee. Hurricane Irene made landfall twice in two days, raining 2-8” over the Delaware watershed. Tropical Storm Lee predominantly delivered record-breaking precipitation in the Susquehanna watershed. The storms, with flooding as extensive as 10-12 feet, resulted in ten deaths, tens of thousands of evacuations, damage to nearly 24,000 structures, and crop destruction. Damages were estimated at $200 million. (PEMA, 2013)

The photograph below depicts the scene of an airlift evacuation in State College, PA. (NOAA, 2012)

Source: (NOAA, USGS, SERPD, and USACE, 2012)

Flooding is the leading cause for disaster declaration by the President in the U.S. and results in significant damage throughout the state annually (NOAA, 2015f). There are several causes of flooding in Pennsylvania, often resulting in loss of life and damage to property, infrastructure, agriculture, and the environment. These include “excessive rainfall, snow melt, ice jams, mountainous terrain, and increased land development.” (Pennsylvania DEP, 2012c)

Although some areas, such as floodplains, are more prone to flooding than others, no area in the state is exempt from flood hazards. Based on the historical number of flood events (1950-2013), flood problems are most severe in and around Philadelphia and Pittsburgh. Over this same period, there are 24 counties with at least one flood event annually and no counties having fewer than 15 total flood events in Pennsylvania. Between 2001 and 2013, there was approximately $820 million paid out for over 27,000 claims related to flood-induced losses of buildings and their contents. (PEMA, 2013)

Local communities often have floodplain management or zoning ordinances that restrict development within the floodplain. FEMA provides floodplain management assistance, including mapping of 100-year floodplain limits, to approximately 2,500 communities in Pennsylvania through the National Flood Insurance Program (NFIP) (FEMA, 2015a). 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, 2015b). 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, Pennsylvania had 25 communities participating in the CRS (FEMA, 2014c).[77]

12.1.4.7. Groundwater

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

Groundwater in Pennsylvania represents an important source for human use, accounting for 27.3 percent of irrigation, 15.9 percent of public supply, 100 percent of domestic self-supply, 8.5 percent of industrial self-supply, and 87.2 percent of livestock use in 2010 (USGS, 2014b). Groundwater also plays an important role in providing 65 percent of inflow to streams maintaining base flow throughout the year (Pennsylvania DEP, 2012a). Approximately four and a half million residents draw drinking water from Pennsylvania's groundwater resources (Pennsylvania DEP, 2012a). Generally, the water quality of Pennsylvania's aquifers is suitable for drinking and daily water needs; however, Pennsylvania DEP has identified several activities as "high priority sources" of contaminants to groundwater, including chemical facilities and manure/fertilizer applications, underground and aboveground storage tanks, closed landfills, septic systems, abandoned oil/gas wells, abandoned mines, and industrial and hazardous waste sites (Pennsylvania DEP, 2014b).

Pennsylvania's principal aquifers consist of sand and gravel aquifers of alluvial and glacial origin,[78] carbonate-rock aquifers,[79] and sandstone aquifers.[80] Table 12.1.4-3 provides details on aquifer characteristics in the state; Figure 12.1.4-3 shows Pennsylvania's principal and sole source aquifers (SSAs). Two other aquifers, Northern Atlantic Coastal Plain and New York and New England Carbonate-Rock aquifer, are situated in small portions of southeastern and eastern Pennsylvania. These two aquifers are more extensive in other states and represent a relatively small area within Pennsylvania, and thus are not discussed in detail. For more information on the Northern Atlantic Coastal Plain aquifer, see Section 10.1.4, New Jersey Groundwater. For

[77] A list of the 25 CRS communities can be found in the most recent FEMA CRS report dated May 1, 2014. (www.fema.gov/media-library-data/1398878892102-5cbcaa727a635327277d834491210fec/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).
[78] Sand and gravel aquifers of alluvial (sand, silt, or gravel materials left by river waters) and glacial origin are highly productive aquifers in the northern part of the country, consisting of mostly sand and gravel deposits formed by melting glaciers. (USGS 2015)
[79] Carbonate-rock aquifers typically consist of limestone with highly variable water-yielding properties (some yield almost no water and others are highly productive aquifers). (Olcott 1995a)
[80] Sandstone aquifers form from the conversion of sand grains into rock caused by the weight of overlying soil/rock. The sand grains are rearranged and tightly packed, thereby reducing or eliminating the volume of pore space, which results in low-permeability rocks such as shale or siltstone. These aquifer types are highly productive in many places and provide large volumes of water. (Olcott 1995b)

more information on the New York and New England Carbonate-Rock aquifer, see Section 11.1.4, New York Groundwater.

Table 12.1.4-3: Description of Pennsylvania's Principal Aquifers

Aquifer Type and Name	Location in State	Groundwater Quality
Aquifers of Alluvial and Glacial Origin Sand, gravel, silt, clay, and bedrock eroded by glaciers or deposited by streams	Found beneath major river and stream valleys or lake plains and terraces, along the northern border of the state	The water is hard and generally suitable for most uses. Locally, chloride and sulfate concentrations can be high due to discharge from deeper aquifers. These shallow aquifers are susceptible to surface contamination, including nitrogen-containing runoff.
Early Mesozoic basin Sandstone, siltstone, shale aquifers with some limestone	Southeastern Pennsylvania	The water is hard and slightly acidic, but generally suitable for most uses. At depth, chloride and sulfate concentrations can be high.
Pennsylvanian Sandstone, shale, and clay aquifer with coal deposits and minimal limestone	Western Pennsylvania	The water is hard, and useable at shallow depths, but too saline at great depth. Where mine drainage is present, water can be acidic and have high concentrations of metals. Saline contamination from past oil/gas extraction is present locally at shallow depths.
Valley and Ridge aquifers: Consist of permeable rocks of primarily sandstone, shale, and carbonates	Southern central Pennsylvania sweeping northeast along the Appalachian Plateau to the New Jersey border	Water is generally suitable for municipal supplies and other purposes, with locally excessive iron, hardness, and low pH (acidic).
Valley and Ridge carbonate-rock aquifers: Contiguous fractured-bedrock aquifers.	Southern central Pennsylvania sweeping northeast along the Appalachian Plateau to the New Jersey border	Water is generally suitable for municipal supplies and other purposes, with locally excessive iron, hardness, and low pH (acidic). The groundwater flow system is different where these rocks are folded and where they are not. Soluble carbonate rocks and easily eroded shales underlie the valleys in the province, and more erosion-resistant siltstone, sandstone, and some cherty dolomite underlie ridges.
Mississippian Shale, sandstone and siltstone aquifers with minimal limestone	North western to central Pennsylvania	The water is hard, and useable at shallow depths, but too saline at great depth. Saline contamination from past oil/gas extraction is present locally at shallow depths.
Piedmont and Blue Ridge crystalline-rock aquifers: Composed of crystalline metamorphic and igneous (volcanic) rocks of many types	Southeastern Pennsylvania	Natural water quality within the Piedmont and Blue Ridge aquifers is generally satisfactory, but locally, dissolved iron concentrations may be high (greater than 0.3 parts per million).
Piedmont and Blue Ridge carbonate-rock aquifers: Limestone, dolomite, and marble	Southeastern Pennsylvania	Water generally is suitable for drinking and other uses, but locally, excessive iron, manganese, and sulfate concentrations can occur.

Source: (Trapp & Horn, 1997a) (Trapp & Horn, 1997b) (Trapp & Horn, 1997c) (Trapp & Horn, 1997d) (Trapp & Horn, 1997e)

SSAs

The USEPA defines SSAs as "an aquifer that supplies at least 50 percent of the drinking water consumed in the area overlying the aquifer" and are areas with no other drinking water sources (USEPA, 2015r). 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, 2015r).

Pennsylvania has one designated SSA within the state, the Seven Valleys Aquifer, in York County (as shown in Figure 12.1.4-3). When the SSA was designated in 1985, it provided about 60,000 gallons per day (95 percent of the drinking water supply for the area). The aquifer faces threats from "abandoned wells, septic tanks, leaking fuel tanks, and leaching from open dumps and improperly operated landfills." (USEPA, 1985)

Several eastern Pennsylvania counties are included in the streamflow source zone[81] for the New Jersey Coastal Plain Aquifer, an SSA discussed in detail in 3.1.4.7, New Jersey Groundwater (USEPA, 1988).

[81] A streamflow source zone is "an upstream headwaters area which drains into a recharge zone." (USEPA, 1988)

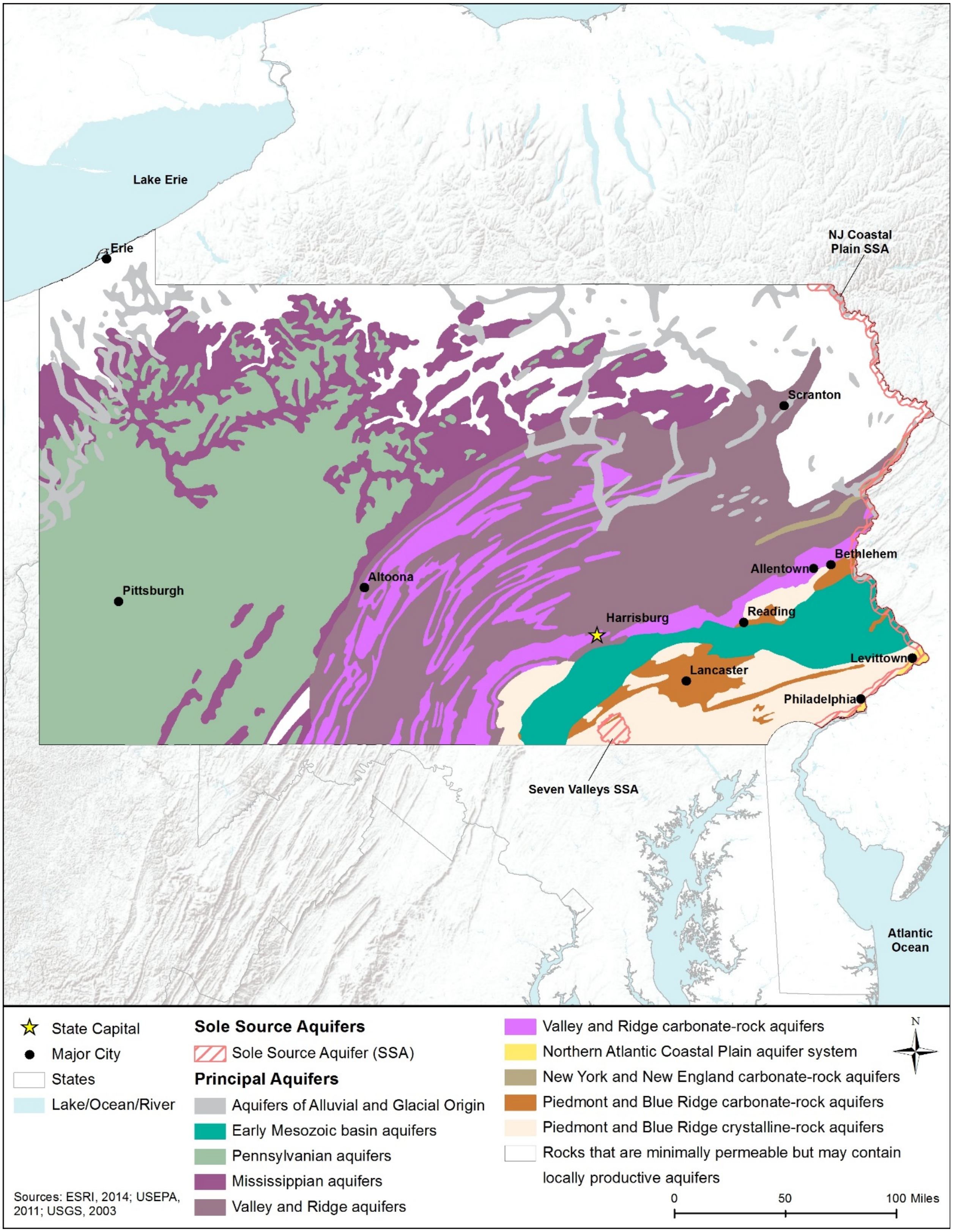

Figure 12.1.4-3: Principal and SSAs of Pennsylvania

12.1.5. Wetlands

12.1.5.1. 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).

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

12.1.5.2. Specific Regulatory Considerations

Appendix C explains the pertinent federal laws to protecting wetlands in detail. Table 12.1.5-1 summarizes the major Pennsylvania state laws and permitting requirements relevant to the state's wetlands.

Table 12.1.5-1: Relevant Pennsylvania Wetland Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Utility Line Stream Crossings	Pennsylvania DEP, Bureau of Waterways Engineering and Wetlands	"The installation, operation and maintenance of utility line stream crossings of the regulated waters of the Commonwealth" including wetlands smaller than ten acres. (Pennsylvania DEP, 2013b), (Pennsylvania DEP, 2013c)
Minor Road Crossings	Pennsylvania DEP, Bureau of Waterways Engineering and Wetlands	"Construction, operation and maintenance of minor road crossings across wetlands which individually disturbs less than 0.1 acre of wetlands while cumulative impacts total less than 0.25 acres." (Pennsylvania DEP, 2013c)
Temporary Road Crossings	Pennsylvania DEP, Bureau of Waterways Engineering and Wetlands	"Construction, operation and maintenance of temporary road … wetland crossings less than 200 feet, where no practicable alternatives exist." (Pennsylvania DEP, 2013c)
Floodplain Management Act	Pennsylvania DEP, Bureau of Waterways Engineering and Wetlands	"Any structure or activity which changes, expands or diminishes the course, current or cross section of a watercourse, floodway or body of water" including wetlands (Pennsylvania DEP, 2013d) (PA Code, 2011)

State Law/Regulation	Regulatory Agency	Applicability
CWA, Section 404	Pennsylvania DEP	Any "discharge of dredged, excavated or fill material or structures into waters of the United States and waters of the Commonwealth" including wetlands. (Pennsylvania DEP, 2013d)
Water Quality Certification	Pennsylvania DEP	In accordance with Section 401 of the CWA, activities that may result in a discharge to waters of the U.S. (including wetlands) require a Water Quality Certification from Pennsylvania DEP indicating that the proposed activity will not violate state water quality standards. (Pennsylvania DEP, 1997)
Nationwide Permit, Pennsylvania State Regional Conditions	USACE, Philadelphia District	Regional conditions apply to Nationwide Permits for the following activities in wetlands: utility line activities, temporary construction access and dewatering, and commercial and institutional developments. Permittees must follow specific procedures for pre-construction notification. (USACE, Philadelphia District, 2012)
Endangered Species Act (ESA)	Pennsylvania DEP, USACE, PA Fish and Boat Commission, USFWS	Activities covered under a State Programmatic General Permit, Nationwide Permit, or Water Obstruction and Encroachment Permit that impact wetlands in Adams, Berks, Bucks, Chester, Cumberland, Delaware, Franklin, Lancaster, Lebanon, Lehigh, Monroe, Montgomery, Northampton, Swatara Creek Watershed in Schuylkill, and York Counties. (Pennsylvania DEP, 2006)

12.1.5.3. Environmental Setting: Wetland Types and Functions

The U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) mapping adopted a national Wetlands Classification Standard (WCS) that classifies wetlands according to shared environmental factors, such as vegetation, soils, and hydrology, as defined in Cowardin et al. (1979). The WCS includes five major wetland systems: Marine, Estuarine, Riverine, Lacustrine, and Palustrine (as detailed in Table 12.1.5-2). The first four of these include both wetlands and deepwater habitats but the Palustrine includes only wetland habitats. (USFWS, 2015c)

- 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 percent 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 percent 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) (FGDC, 2013)

In Pennsylvania, the main types of wetlands are palustrine (freshwater) found on river and lake floodplains across the state. Table 12.1.5-2 uses 2014 NWI data to characterize and map Pennsylvania wetlands on a broad-scale. The data are not intended for site-specific analyses and is not a substitute for field-level wetland surveys, delineations, or jurisdictional determinations which may be conducted, as appropriate, at the site-specific level once those locations are known. As shown in Figure 12.1.5-1, Figure 12.1.5-2, and Table 12.1.5-2, palustrine forested and scrub-shrub wetlands are by far the most common, concentrated in the northwest and northeast corners of the state. The map codes and colorings in Table 12.1.5-2 correspond to the wetland types in the figures. Estuarine/marine (tidal), riverine, and lacustrine wetlands comprise approximately one percent of the wetlands in the state. Therefore, they are not discussed in detail in this PEIS.

Table 12.1.5-2: Pennsylvania 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, predominantly northeast and northwest Pennsylvania	313,403
Palustrine scrub-shrub wetland	PSS	Woody vegetation less than 20 feet tall dominates PSS wetlands. Thickets and shrub swamps are examples of PSS wetlands.		
Palustrine emergent wetlands	PEM	PEM 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,[82] prairie potholes, and sloughs[83].	Throughout the state, predominantly northeast and northwest Pennsylvania	63,034

[82] Fens are nutrient-rich, grass- and sedge-dominated emergent wetlands that are recharged from groundwater and have continuous running water. (Edinger, et al., 2014)
[83] Slough: "Swamp or shallow lake system, usually a backwater to a larger body of water." (NOAA, 2014a)

Wetland Type	Map Code and Color	Description[a]	Occurrence	Amount (Acres)[b]
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	63,271
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[84], and other miscellaneous wetlands are included in this group.	Throughout the state	618
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	2,851
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, predominantly along Lake Erie	3,352
Estuarine and Marine intertidal wetland	E2/M2	These intertidal wetlands include the areas between the highest tide level and the lowest tide level. Semidiurnal tides (two high tides and two low tides per day) periodically expose and flood the substrate. Wetland examples include vegetated and non-vegetated brackish (mix of fresh and saltwater), and saltwater marshes, shrubs, beaches, sandbars, or flats.	Along the Delaware River Estuary	4

Source: (Cowardin, Carter, Golet, & LaRoe, 1979), (USFWS, 2015c), (FGDC, 2013)

[a] The wetlands descriptions are based on information from the Federal Geographic Data Committee (FGDC)'s Classification of Wetland and Deepwater Habitats of the U.S. Based on Cowardin, et.al, 1979, some data has been revised based on the latest scientific advances. The USFWS uses these standards as the minimum guidelines for wetlands mapping efforts. (FGDC, 2013)
[b] All acreages are rounded to the nearest whole number. The maps are prepared from the analysis of high altitude imagery. A margin of error is inherent in the use of imagery. The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. (USFWS, 2015d)

Palustrine Wetlands

In Pennsylvania, palustrine wetlands are categorized as palustrine forests, woodlands, and shrub lands; herbaceous wetlands; and sparsely vegetated wetland communities. Within these groups, wetlands are described by dominant plant species; for example, the black spruce – tamarack palustrine woodland is comprised of a community of mainly black spruce (*Picea mariana*) and

[84] Saline seep is an area where saline groundwater discharges at the soil surface. These wetland types are characterized by saline soils and salt tolerant plants. (City of Lincoln 2015)

tamarack (*Larix laricina*) trees with some gray birch (*Betula populifolia*) and red maple (*Acer rubrum*) interspersed. Palustrine forests commonly contain hemlock (*Tsuga*), maples, spruces, and other hardwood species. Palustrine woodlands consist of predominantly spruces and maples along with mixed hardwoods and bushes, shrubs, and sedges.[85] Palustrine shrub lands frequently contain leatherleaf (*Chamaedaphne calyculata*) or blueberry (*Cyanococcus*) bushes and various other broadleaf species. Herbaceous wetlands are characterized as either emergent or non-persistent and are home to cattails (*Typha latifolia*), reeds, sedges, and grasses. Sparsely vegetated regions include rocky or sandy shorelines and floodplains with little soil. For more information on Pennsylvania's palustrine wetlands, visit www.naturalheritage.state.pa.us/Wetlands.aspx. (Pennsylvania DCNR, 2012)

Pennsylvania's wetlands declined by 28,000 acres between 1956 and 1979, but showed increases in acreage during more recent times (Pennsylvania DEP, 2015k). Between 1982 and 1989, the extent of wetlands grew by approximately 4,700 acres (Pennsylvania DEP, 2015k), and between 1990 and 2013, Pennsylvania increased wetland area by another 4,000 acres (Pennsylvania DEP, 2013e). Currently, there are approximately 447,000 acres of freshwater wetlands in the state, of which about 313,000 are PFO/PSS, 63,000 are PAB/PUB, and 63,000 are PEM (USFWS, 2014). Main threats to palustrine wetlands in Pennsylvania include past conversion for agricultural and other development, non-point source pollution, and groundwater withdrawals (PGC, 2008).

Legislative and regulatory authority for the commonwealth to protect its wetlands arises from the Dam Safety and Encroachments Act of 1978, the Clean Streams Law of 1937, and Dam Safety and Waterway Management regulations first adopted in 1980 (Pennsylvania DEP, 2014b). While Pennsylvania DEP's aim was originally only to prevent net loss of wetlands, the organization's role has since expanded to a more proactive stance of protection and restoration to increase wetland quantity and quality as part of watershed management (Pennsylvania DEP, 2013e).

[85] Sedge: An herbaceous plant with triangular cross-sectional stems and spirally arranged leaves (grasses have alternative leaves) typically associated with wetlands or poor soils.

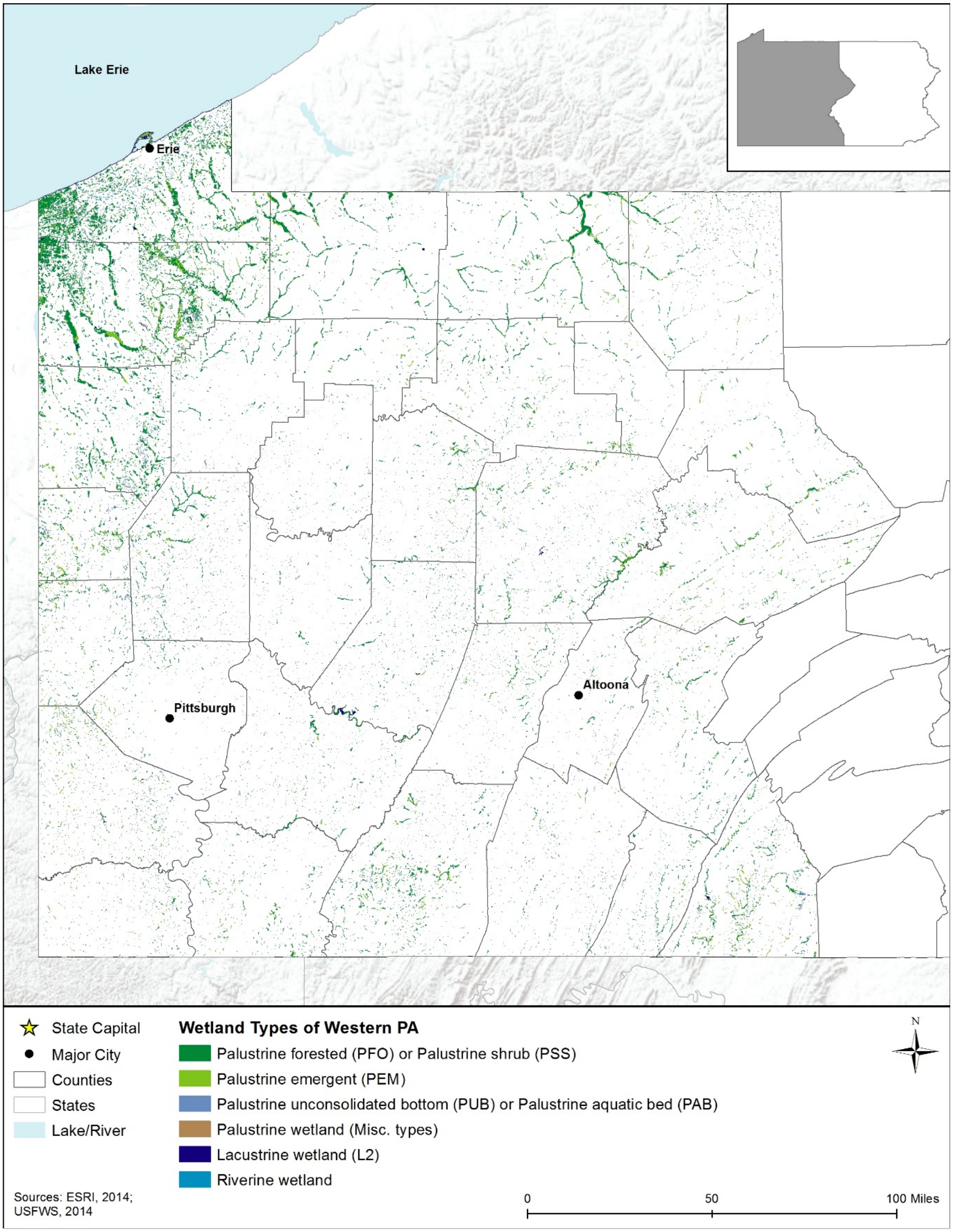

Figure 12.1.5-1: Wetlands by Type, in Western Pennsylvania, 2014

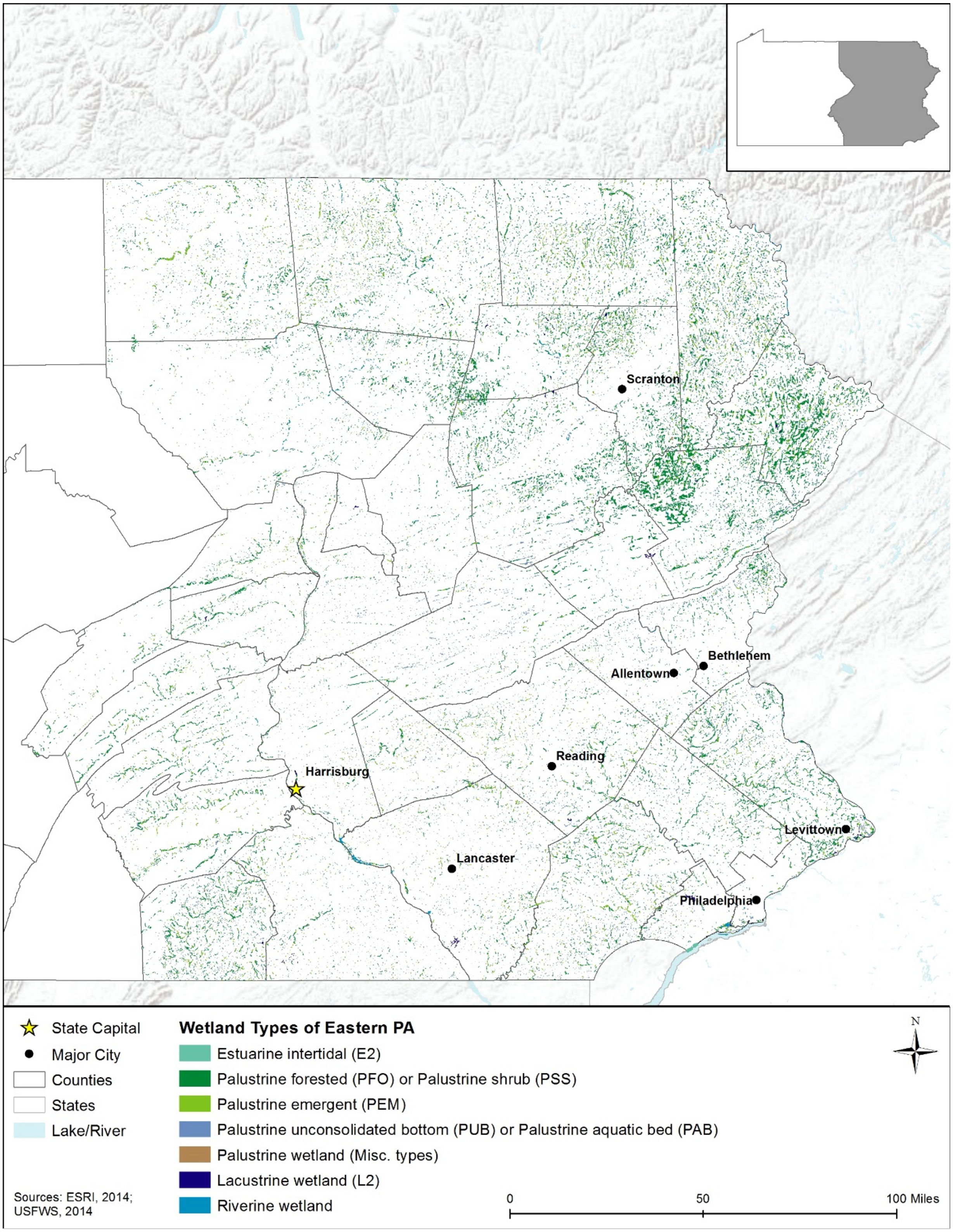

Figure 12.1.5-2: Wetlands by Type, Eastern Pennsylvania, 2014

12.1.5.4. Wetlands of Special Concern or Value

In addition to protections under state legislation/regulation discussed in Section 12.1.5.2, Environmental Laws and Regulations, and the national CWA, Pennsylvania considers certain wetland communities as areas of special value due to rarity, vulnerability, or habitat they support. These include exceptional value wetlands, threatened wetlands, and vernal pools.

Exceptional Value Wetlands

The Pennsylvania Code defines exceptional value wetlands as those that are:

- Habitat to threatened or endangered species;
- Hydraulically connected to threatened and endangered species habitat;
- On or along the floodplain of state or federally designated Wild and Scenic Rivers or state designated exceptional value waters (see Section 12.1.4.4, Environmental Setting: Sensitive or Protected Waterbodies);
- Along a drinking water supply; or
- In state forests or parks, federal wilderness areas, or national natural landmarks (NNLs). (PA Code, 2011)

Threatened Wetlands

Pennsylvania DCNR characterizes the threat level experienced by particular types of wetlands within the state on a five-point scale of conservation status. The most threatened wetlands in Pennsylvania, their conservation value (typically due to the presence of rare species), and primary threats, are described below in Table 12.1.5-3. For more information on each palustrine wetland community, visit www.naturalheritage.state.pa.us/Wetlands.aspx. (Pennsylvania DCNR, 2012)

Great Lakes Bluff Seep

The Great Lakes Bluff Seep is a threatened wetland along the Pennsylvania coast of Lake Erie.

Source: (Pennsylvania DCNR, 2012)

Table 12.1.5-3: Threatened Wetlands in Pennsylvania

Wetland Community	Location in PA	Conservation Value/Rare Species	Threats
Elm – Ash – Maple Lakeplain Forest	Near Lake Erie	Habitat for pumpkin ash	Hydrologic modifications,[86] nearby agricultural and urban development, and invasive species introductions
Red Maple – Magnolia Palustrine Forest	Southeastern Pennsylvania	Home to sweet-bay magnolia, fetter-bush, and possum-haw	Hydrologic modifications, nearby agricultural and urban development, and invasive species introductions
Sweetgum – Willow Oak Coastal Plain Palustrine Forest	Along the Delaware River estuary in Bucks County	Habitat for Willow oak, swamp chestnut oak, two sedge varieties; breeding grounds for eastern spadefoot toad, New Jersey chorus frog, wood frog, and eastern mud turtle	Habitat fragmentation from development
Great Lakes Bayberry – Mixed Shrub Wetland	Presque Isle State Park on Lake Erie	Home to 77 state rare, threatened, or endangered plant species; used by migratory birds	Invasive Morrow's honeysuckle and recreational uses of the state park
Great Lakes Bluff Seep	Along Lake Erie	Nesting grounds for bank swallows and habitat for the rare grass-of-Parnassus, golden-fruited sedge, rook lobelia, and three rushes	Development and changes to groundwater flows near bluffs has increased the rate of bluff erosion; colt's foot, common reed, and European alder, all invasive species
Poison Sumac – Red-cedar – Bayberry Fen87	Northeastern Pennsylvania	Contains three rare sedges: capillary break-rush, brook lobelia, and grass-of-Parnassus	Groundwater quality and quantity affected by drilling mining, septic systems, and agricultural infiltration
Sweet-gale – Leatherleaf Shrub Fen	Small extent of the Pocono Mountains in the northeastern portion of Pennsylvania	Habitat for the follow rare plants: sweet-gale, Labrador-tea, coastal mannagrass, and water bulrush	Beaver dam building activities that modify water flow
Freshwater Tidal Mixed High Marsh	Along the Delaware River estuary in Bucks County; higher reaches of the intertidal zone	Home to wild-rice, showy bur-marigold, salt-marsh water-hemp, swamp beggar's-ticks, river bulrush, Walter's barnyard grass, and gypsy-wort	Land conversion for development and sea level rise
Great Lakes Palustrine Sandplain	Presque Isle State Park on Lake Erie	Important to birds for migratory refuge, nesting, and foraging	The invasive *australis* subspecies of the common reed
River Bluff Seep	Steep shorelines of streams draining into Lake Erie	Habitat for rare plants including grass-of-Parnassus, golden fruited sedge, and Kalm's lobelia	Erosion of bluffs due to human disturbances and two invasive species (colt's foot and common reed)

[86] Hydrologic modifications are "activities that disturb natural flow patterns of surface water and groundwater," (e.g., construction, dams and impoundments, channelization, dredging, and land reclamation activities). (USEPA, 1975)
[87] Fens "are peat-forming wetlands that receive nutrients from sources other than precipitation: usually from upslope sources through drainage from surrounding mineral soils and from groundwater movement." (USEPA, 2012d)

Wetland Community	Location in PA	Conservation Value/Rare Species	Threats
Riverbank Freshwater Tidal Marsh	Along the Delaware River estuary in Bucks County; full intertidal zone, approximately 6.6 feet vertically	Habitat to 16 rare plant species and buffers potential Delaware River estuary flooding	Land conversion for development, sea level rise, susceptible to erosion induced by recreational and commercial boating activities that damages substrate necessary for plant seeding and growth
Sedge – Mixed Forb Fen	Western Pennsylvania	Contains three rare sedges: capillary break-rush, brook lobelia, and grass-of-Parnassus	Groundwater quality and quantity affected by drilling mining, septic systems, and agricultural infiltration
Serpentine Seep	Southeastern Pennsylvania, where underlying bedrock causes groundwater with high dissolved magnesium and metals	Home to wood frogs, spotted salamander, marbled salamander, and Jefferson salamander	Agricultural nonpoint source pollution
Floodplain Scour Community	Throughout the state along rocky riverbanks	Habitat for 13 rare plant species, rare dragonflies and damselflies, and northern water and copperhead snakes	Floodplain development and construction of dams have altered the natural flooding these communities were once subject to, changing soil composition to favor several invasive species
Great Lakes Sparsely Vegetated Shore	Along Lake Erie's shores	Home to the rare American beachgrass, sea-rocket, beach pea, and silverweed – all species that are unique to this geography	Development and recreation along the shoreline as well as the invasive crown-vetch and Japanese knotweed

Source: (Pennsylvania DCNR, 2012)

Vernal Pools

Vernal pools are palustrine wetlands that the state has identified as wetlands of special concern. Found throughout the state, vernal pools are a type of small, temporary wetland present in forest or shrub land areas, though the pools themselves lack trees. The pools occur in shallow depressions that fill during spring, and are usually dry by late summer or during droughts since they are not connected to a permanent water source. Vernal pools fill from rain, snowmelt, or groundwater. These small wetlands contribute to storage and filtration of surface water and help recharge aquifers. Vernal pools are an important breeding habitat for the state endangered blue-spotted salamander and the rare eastern spadefoot frog. The federally endangered northeastern bulrush (*Scirpus ancistrochaetus*) is supported by this type of ecosystem "almost exclusively" in Pennsylvanian vernal pools (Pennsylvania DCNR, 2015c). Due to their small size, seasonal nature, and lack of connectivity to streams or rivers, vernal pools may not be protected by state and federal wetland regulations, and may not even be identified as wetlands. Pennsylvania maintains a registry of vernal pools throughout the state based on information volunteered by citizens. (Pennsylvania DCNR, 2015c)

Other Important Wetland Sites

Other important wetland sites in Pennsylvania include:

- Natural Areas within state parks contain "unique scenic, geologic or ecological value which will be maintained in a natural condition" and many contain wetland communities (Pennsylvania DCNR, 2015k). More information on these areas is available at www.dcnr.state.pa.us/stateparks/recreation/sightseeing/naturalareas/where/index.htm.
- NNLs range in size from less than an acre to approximately 30,000 acres, and are owned by PA DCNR, USFWS, U.S. Forest Service (USFS), counties, municipalities, and other conservation organizations and individuals (NPS, 2015j). Visit www.nature.nps.gov/nnl/state.cfm?State=PA to learn more about Pennsylvania's NNLs.
- Pennsylvania DEP in partnership with the National Fish and Wildlife Foundation implements the Pennsylvania Wetland Replacement Project, which creates and restores wetlands (Pennsylvania DEP, 2015x). To learn more about the program, visit www.portal.state.pa.us/portal/server.pt/community/pennsylvania_wetlands_replacement_project/21665.
- The Growing Greener Program, managed by Pennsylvania DEP, provides grants for watershed protection projects, including wetlands protection and restoration activities (Pennsylvania DEP, 2015ab). More information on the program is available at www.portal.state.pa.us/portal/server.pt/community/growing_greener/13958.
- The U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) administers the Agricultural Conservation Easement Program, which includes wetland reserve easements and enhancement partnerships. These programs aim to protect and restore wetlands on private property (USDA, 2015a). More information is available at www.nrcs.usda.gov/wps/portal/nrcs/main/mt/programs/easements/acep/.

For more information on Pennsylvania's state parks, NNLs, conservation programs, and easements, see Section 12.1.8, Visual Resources, and Section 12.1.7, Land Use.

12.1.6. Biological Resources

12.1.6.1. Definition of the Resource

This Chapter describes the biological resources of Pennsylvania. Biological resources include terrestrial[88] vegetation, wildlife, fisheries and aquatic habitats[89], and threatened[90] and endangered[91] species as well as species of conservation concern. Wildlife habitat and associated biological ecosystems are also important components of biological resources. Pennsylvania

[88] Terrestrial: "Pertaining to the land." (USEPA, 2015e)
[89] Habitat: "The environment in which an organism or population of plants or animals lives; the normal kind of location inhabited by a plant or animal." (USEPA, 2015e)
[90] 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. Code [U.S.C.] §1532(20))
[91] 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))

supports diverse biological resources given the landscape of mountains, valleys, wetlands[92], lakes, and rivers. Each of these topics is discussed in more detail below.

12.1.6.2. Specific Regulatory Considerations

The federal laws relevant to the protection and management of biological resources in Pennsylvania are summarized in detail in Appendix C. Table 12.1.6-1 summarizes major state laws relevant to Pennsylvania's biological resources.

Table 12.1.6-1. Relevant Pennsylvania Biological Resources Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Noxious Weed Control Law (3 Pennsylvania Statutes and Consolidated Statutes [PA Cons Stat] § 255.1-255.11)	Pennsylvania Department of Agriculture	Establishes a program to regulate and control noxious weeds and to create a statewide species list.
Restrictions on transport, sale, importation or release of nonnative injurious fish (30 PA Cons Stat § 2508)	Pennsylvania Fish and Boat Commission	Restricts the introduction of nonnative, potentially damaging, fish to Pennsylvania.
Game or Wildlife Protection – Endangered or threatened species (34 PA Cons Stat § 2167)	Pennsylvania Game Commission (PGC)	Provides protection for the taking, possessing, or transportation of wildlife or plants that are members of an endangered or threatened species. Revises list of threatened and endangered species for the state.
Wild Resource Conservation Act of 1982 (32 PA Cons Stat 32 § 5301—5314)	Pennsylvania DCNR	Preserves and enhances flora/fauna species, including endangered species, which are not commonly pursued, killed, or consumed for sport or profit. Establishes a plant classification system for wild plants and an enforcement system to protected endangered, threatened, and vulnerable wild plant species.

12.1.6.3. Terrestrial Vegetation

The distribution of flora within the state is a function of the characteristic geology[93], soils, climate[94], and water of a given geographic area and correlates with distinct areas identified as ecoregions.[95] 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;

[92] Wetlands: "Areas that are inundated or saturated by surface or ground water 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." (USEPA, 2004)

[93] 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. (USEPA, 2015e)

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

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

USDA, 2015b; World Wildlife Fund, 2015). 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 Level III ecoregions (Griffith, et al., 2009).

As shown in Figure 12.1.6-1, the USEPA lists 11 Level III ecoregions in Pennsylvania. These ecoregions divide the state based the various mountain ranges, valleys, Great Lakes plains, and highlands. On a broad level, plant communities in Pennsylvania can be described by three to six forest types. Northern hardwood forest dominates the northern portions of the state including Allegheny Forest and Poconos Mountains regions and extend southward along the high elevations of the Allegheny Mountains to the Laurel Highlands/Southern Alleghenies region. Beech-maple forests occur primarily along the northeast corner of the state, in portions of the Lake Erie and Pittsburgh regions. Appalachian oak forests dominate the lower two-thirds of the state. Mixed mesophytic[96] forest and hickory-oak-pine forest occur in small portions of the Laurel Highlands/Southern Alleghenies regions. Table 12.1.6-2 provides a summary of the general abiotic[97] characteristics, vegetative communities, and the typical vegetation found within the 11 Pennsylvania ecoregions, broken down by commonly referred geographic regions.

[96] Mesophytic: Mesophytic plant species are terrestrial plants that are adapted to an intermediate climate that is neither a particularly dry nor particularly wet.
[97] Abiotic: "Nonliving characteristic of the environment; the physical and chemical components that relate to the state of ecological resources." (USEPA, 2015c)

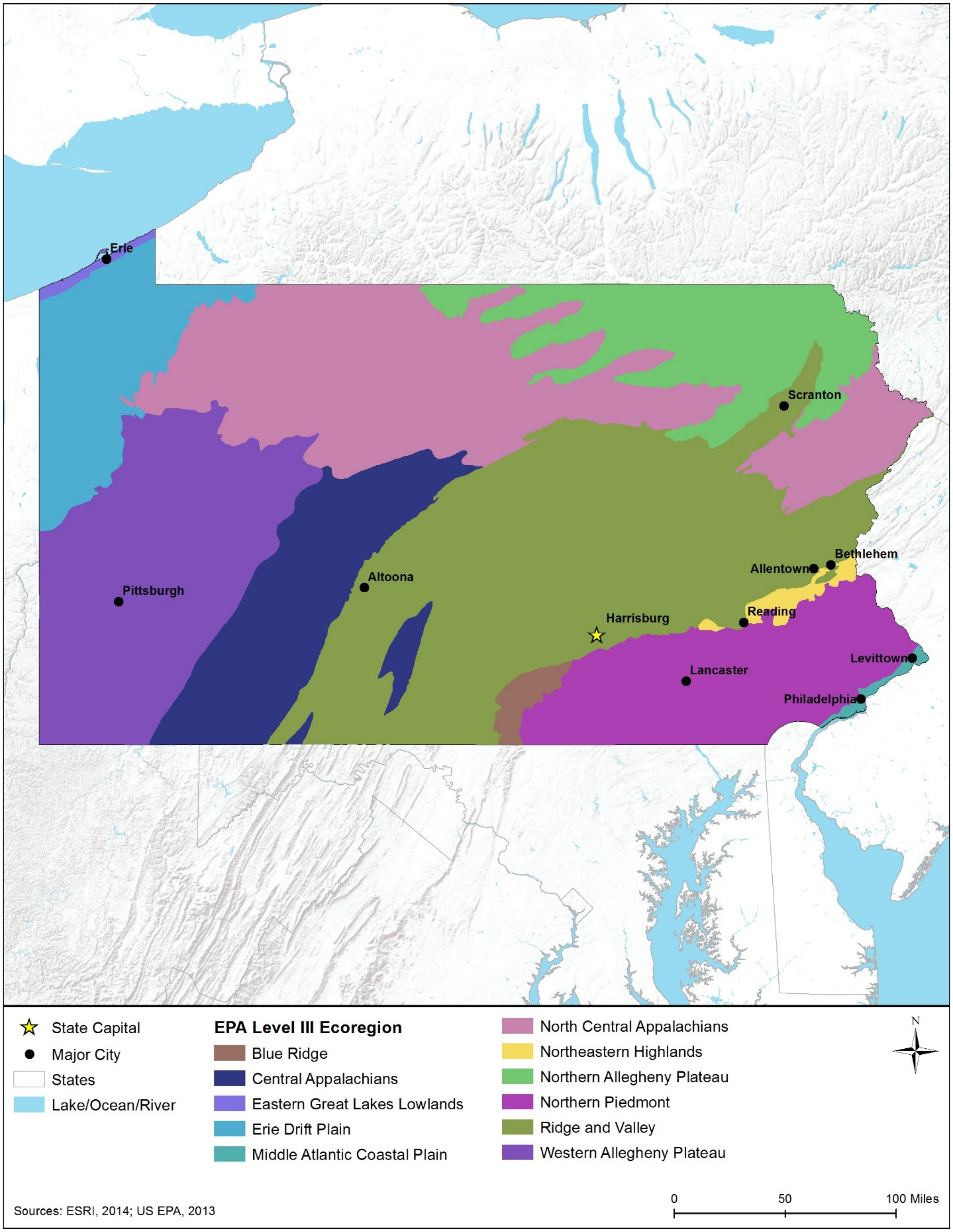

Figure 12.1.6-1: USEPA Level III Ecoregions of Pennsylvania

Table 12.1.6-2: USEPA Level III Ecoregions of Pennsylvania

Ecoregion Number	Ecoregion Name	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
Geographic Region: Lake Erie				
83	Eastern Great Lakes Lowlands	This is a region of irregular plains bordered by hills with a history of glacial activity. Composed of glaciated irregular plains bordered by hills, exhibiting more agricultural activity relative to adjacent ecoregions	Beech-Maple; Pine-Oak-Heath Sandplain Forest; White Pine-Red Oak-Black Oak	• **Hardwood Trees –** American beech (*Fagus grandifolia*); Maples (*Acer* spp.); Oaks (*Quercus* spp.); Basswood (*Tilia americana*); American elm (*Ulmus americana*); White ash (*Fraxinus americana*) • **Conifer Trees –** White pine (*Pinus strobus*)
61	Erie Drift Plain	Largely agricultural but historically forested; composed of nearly level to rolling terrain of hills, glaciated and unglaciated landscapes, wetlands, and human urban and industrial development	Historically Northern Hardwoods and Beech-Maple Forest, but now mostly agricultural	• **Hardwood Trees** – American beech (*Fagus grandifolia*); Maples (*Acer* spp.); Basswood (*Tilia americana*); American elm (*Ulmus americana*); Ironwood (*Ostrya virginiana*) • **Shrubs** – Spicebush (*Lindera benzoin*)
Geographic Region: Allegheny Forest[98]				
62	North Central Appalachians	Forested plateaus[99], high hills, and low mountains, largely unaffected by glaciation. Cool summers and cold winters.	Northern Hardwoods Forest, Appalachian Oak Forest; Maple-Beech-Birch	• **Hardwood Trees –** Sugar maple (*Acer sachharum*); Oaks (*Quercus* spp.); American beech (*Fagus grandifolia*); Yellow birch (*Betula allegheniensis*); Hickories (*Fagus* spp.); Black cherry (*Prunus serotina*) • **Conifer Trees** – Eastern hemlock (*Tsuga Canadensis*) • **Shrubs –** Eastern dogwood (*Cornus florida*)

[98] Allegheny Forest region includes the area also commonly referred to as the Pennsylvania Wilds region in north-central Pennsylvania.
[99] Plateau: "An elevated plain, tableland or flat-topped region of considerable extent." (USEPA, 2015e)

Ecoregion Number	Ecoregion Name	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
69	Central Appalachians	High, rugged plateau with hill and mountains dissected by ridges. More densely forested than adjacent ecoregions. Coal is commonly mined in this ecoregion.	Appalachian Oak Forest, Mixed Mesophytic Forest	• **Hardwood Trees –** Oaks (*Quercus* spp.); Hickories (*Carya* spp.); Maples (*Acer* spp.); Cherry (*Prunus serotina*); Beech (*Fagus* spp.); American basswood (*Tilia americana*); Buckeyes (*Aesculus* spp.) • **Conifer Trees** – Black spruce (*Picea mariana*); Pitch pine (*Pinus rigida*) • **Shrubs –** Tulip tree (*Liriodendron tulipifera*), Mountain laurel (*Kalmia latifolia*), Flowering dogwood (*Cornus florida*)
Geographic Region: Poconos Mountains[100]				
60	Northern Allegheny Plateau	Composed of till-covered rolling hills, open valleys, and low mountains that are a mix of agricultural land and woodland	Appalachian Oak Forest and Northern Hardwood Forest	• **Hardwood Trees –** Sugar maple (*Acer sachharum*); Oaks (*Quercus* spp.); American beech (*Fagus grandifolia*); Birches (*Betula* spp.); American basswood (*Tilia americana*); Hickories (*Carya* spp.) • **Conifer Trees** – Eastern hemlock (*Tsuga canadensis*) • **Shrubs –** Black cherry (*Prunus serotina*)
62	North Central Appalachians	Forested plateaus, high hills, and low mountains, largely unaffected by glaciation. Cool summers and cold winters.	Northern Hardwoods Forest, Appalachian Oak Forest; Maple-Beech-Birch	• **Hardwood Trees –** Sugar maple (*Acer sachharum*); Oaks (*Quercus* spp.); American beech (*Fagus grandifolia*); Yellow birch (*Betula allegheniensis*); Hickories (*Fagus* spp.); Black cherry (*Prunus serotina*) • **Conifer Trees** – Eastern hemlock (*Tsuga Canadensis*) • **Shrubs –** Eastern dogwood (*Cornus florida*)

[100] The Poconos Mountains region includes the areas commonly referred to as the Endless Mountains or Northeast Mountains.

Ecoregion Number	Ecoregion Name	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
Geographic Region: Lehigh Valley[101]				
58	Northeastern Highlands	Characterized by hills and mountains, mostly forested land cover, nutrient-poor soils, and numerous high-gradient streams and glacial[102] lakes.	Maple-Beech-Birch; Spruce-Fir; Oak-Hickory	• **Hardwood Trees –** Maples (*Acer* spp.); Oaks (*Quercus* spp.); Bitternut hickory (*Carya cordiformis*); American beech (*Fagus grandifolia*); Birches (*Betula* spp.); White walnut (*Juglans cinerea*); • **Conifer Trees** – Balsam fir (*Abies balsamea*); White pine (*Pinus strobus*); Spruces (*Picea* spp.); Eastern hemlock (*Tsuga canadensis*) • **Shrubs** – Highbush blueberry (*Vaccinium corymbosum*); Mountain laurel (*Kalmia latifolia*)
64	Northern Piedmont	Transitional region composed of low hills, irregular plains, and open valleys in contrast to low mountains to the north and west and flatter coastal plains to the east	Appalachian Oak Forest, Mixed Hardwoods	• **Hardwood Trees –** Oaks (*Quercus* spp.); Maples (*Acer* spp.); Black birch (*Betula lenta*), Hickory (*Carya* spp.) • **Conifer Trees –** Virginia pine (*Pinus virginiana*); Pitch pine (*Pinus rigida*) • **Shrubs -** Tulip tree (*Liriodendron tulipifera*)
63	Middle Atlantic Coastal Plain	Low elevation flat plains and terraces, with swamps, marshes, and estuaries, transitioning to dunes, barrier islands, and beaches	Appalachian Oak Forest, Oak-Hickory-Pine Forest	• **Hardwood Trees –** Oaks (*Quercus* spp.); Hickory (*Carya* spp.); Maples (*Acer* spp.); Beech (*Fagus* spp.) • **Conifer Trees –** Shortleaf pine (*Pinus echinata*); Pitch pine (*Pinus rigida*)

[101] Lehigh Valley includes the Philadelphia countryside region.
[102] Glacial: “Of or pertaining to distinctive processes and features produced by or derived from glaciers and ice sheets.” (USEPA, 2015e)

Ecoregion Number	Ecoregion Name	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
Geographic Region: Hershey/Dutch Country				
64	Northern Piedmont	Transitional region composed of low hills, irregular plains, and open valleys in contrast to low mountains to the north and west and flatter coastal plains to the east	Appalachian Oak Forest, Mixed Hardwoods	• **Hardwood Trees –** Oaks (*Quercus* spp.); Maples (*Acer* spp.); Black birch (*Betula lenta*), Hickory (*Carya* spp.) • **Conifer Trees** – Virginia pine (*Pinus virginiana*); Pitch pine (*Pinus rigida*) • **Shrubs -** Tulip tree (*Liriodendron tulipifera*)
66	Blue Ridge	Rugged varying terrain of narrow ridges to hilly plateaus to mountainous high peaks with mostly forested slopes.	Appalachian Oak Forest and Northern Hardwood Forest	• **Hardwood Trees –** Sugar maple (*Acer sachharum*); Oaks (*Quercus* spp.); American beech (*Fagus grandifolia*); Birches (*Betula* spp.); American basswood (*Tilia americana*); Hickories (*Carya* spp.) • **Conifer Trees** – Eastern hemlock (*Tsuga canadensis*); Shortleaf pine (*Pinus echinata*); • **Shrubs -** Tulip tree (*Liriodendron tulipifera*)
67	Ridge and Valley	Diverse region composed of ridges and valleys with a variety of widths, heights, and geologic[103] composition, with numerous springs and caves	Appalachian Oak Forest, Oak-Hickory-Pine Forest	• **Hardwood Trees –** Oaks (*Quercus* spp.); Hickories (*Carya* spp.); Sugar maple (*Acer saccharum*); Birches (*Betula* spp.); American basswood (*Tilia americana*) • **Conifer Trees** - Eastern hemlock (*Tsuga canadensis*); Shortleaf pine (*Pinus echinata*) • **Shrubs -** Tulip tree (*Liriodendron tulipifera*), Mountain laurel (*Kalmia latifolia*)

[103] Geologic: “Referring to the history and structure of the solid portion (rocks, soils, and minerals) of the earth.” (USEPA, 2015e)

Ecoregion Number	Ecoregion Name	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
58	Northeastern Highlands	Characterized by hills and mountains, mostly forested land cover, nutrient-poor soils, and numerous high-gradient streams and glacial lakes.	Maple-Beech-Birch; Spruce-Fir; Oak-Hickory	• **Hardwood Trees –** Maples (*Acer* spp.); Oaks (*Quercus* spp.); Bitternut hickory (*Carya cordiformis*); American beech (*Fagus grandifolia*); Birches (*Betula* spp.); White walnut (*Juglans cinerea*); • **Conifer Trees** – Balsam fir (*Abies balsamea*); White pine (*Pinus strobus*); Spruces (*Picea* spp.); Eastern hemlock (*Tsuga canadensis*) • **Shrubs –** Highbush blueberry (*Vaccinium corymbosum*); Mountain laurel (*Kalmia latifolia*)
Geographic Region: Susquehanna Valleys				
67	Ridge and Valley	Diverse region composed of ridges and valleys with a variety of widths, heights, and geologic composition, with numerous springs and caves	Appalachian Oak Forest, Oak-Hickory-Pine Forest	• **Hardwood Trees –** Oaks (*Quercus* spp.); Hickories (*Carya* spp.); Sugar maple (*Acer saccharum*); Birches (*Betula* spp.); American basswood (*Tilia americana*) • **Conifer Trees** - Eastern hemlock (*Tsuga canadensis*); Shortleaf pine (*Pinus echinata*) • **Shrubs -** Tulip tree (*Liriodendron tulipifera*), Mountain laurel (*Kalmia latifolia*)
69	Central Appalachians	High, rugged plateau with hill and mountains dissected by ridges. More densely forested than adjacent ecoregions. Coal is commonly mined in this ecoregion.	Appalachian Oak Forest, Mixed Mesophytic Forest	• **Hardwood Trees –** Oaks (*Quercus* spp.); Hickories (*Carya* spp.); Maples (*Acer* spp.); Cherry (*Prunus serotina*); American basswood (*Tilia americana*); Buckeyes (*Aesculus* spp.) • **Conifer Trees** – Black spruce (*Picea mariana*); Pitch pine (*Pinus rigida*) • **Shrubs -** Tulip tree (*Liriodendron tulipifera*), Mountain laurel (*Kalmia latifolia*), Flowering dogwood (*Cornus florida*)

Ecoregion Number	Ecoregion Name	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
Geographic Region: Laurel Highlands/Southern Alleghenies[104]				
69	Central Appalachians	High, rugged plateau with hill and mountains dissected by ridges. More densely forested than adjacent ecoregions. Coal is commonly mined in this ecoregion.	Appalachian Oak Forest, Mixed Mesophytic Forest	• **Hardwood Trees** – Oaks (*Quercus* spp.); Hickories (*Carya* spp.); Maples (*Acer* spp.); Cherry (*Prunus serotina*); American basswood (*Tilia americana*); Buckeyes (*Aesculus* spp.) • **Conifer Trees** – Black spruce (*Picea mariana*); Pitch pine (*Pinus rigida*) • **Shrubs -** Tulip tree (*Liriodendron tulipifera*), Mountain laurel (*Kalmia latifolia*), Flowering dogwood (*Cornus florida*)
70	Western Allegheny Plateau	A moderately forested unglaciated, dissected plateau consisting of hills, narrow valleys, and ridges. Coal mining is common, as well as agricultural and dairy farms and urban development.	Appalachian Oak Forest, Mixed Mesophytic Forest, Beech-Maple Forest	• **Hardwood Trees** – Oaks (*Quercus* spp.); Hickories (*Carya* spp.); Maples (*Acer* spp.); Cherry (*Prunus serotina*); Beech (*Fagus* spp.); American basswood (*Tilia americana*); Buckeyes (*Aesculus* spp.) • **Conifer Trees** – Black spruce (*Picea mariana*); Shortleaf pine (*Pinus echinata*); Virginia pine (*Pinus virginiana*); Pitch pine (*Pinus rigida*) • **Shrubs -** Tulip tree (*Liriodendron tulipifera*), Mountain laurel (*Kalmia latifolia*), Flowering dogwood (*Cornus florida*)

Sources: (Woods, Omernik, & Brown, 1999; USEPA, 2015b)

[104] The Laurel Highlands/Southern Alleghenies region also includes the greater Philadelphia region in the southeastern portion of the state.

Communities of Concern

Pennsylvania 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 Pennsylvania Natural Heritage Program (PNHP) statewide inventory includes lists of all types of natural communities known to occur, or that have historically occurred, in the state. Historical occurrences are important for assessing previously undocumented occurrences or re-occurrences of previously documented species. Each natural community is assigned a rank based on its rarity and vulnerability. As with most state heritage programs, the PNHP ranking system assesses rarity using a state rank (S1, S2, S3, S4, S5) that indicates its rarity within Pennsylvania. Communities ranked as an S1 by the PNHP are of the greatest concern. This rank is typically based on the number of known examples, total area occupied, and the degree of threat to the community. As new data become available, ranks are revised as necessary to reflect the most current information (PNHP, 2015b).

Thirty vegetative communities are ranked as S1 communities[105] in Pennsylvania. These communities occur throughout the state, many of which are associated with Lake Erie or serpentine barrens in the Lehigh Valley and Hershey/Dutch Country regions. Pennsylvania Appendix B, Table B-1 provides a description of the S1 communities of conservation concern in Pennsylvania along with their distribution, abundance, and the associated USEPA Level III ecoregions and geographic regions (PNHP, 2015b).

Two endangered or threatened plants are located in Pennsylvania. Section 12.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, identifies these protected species.

Nuisance and Invasive Plants

Nuisance and invasive plants are 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 weeds greatly affect agricultural, forest management, natural, and open areas (U.S. Legal, 2015). The U.S. government has designated certain plant species as noxious weeds in accordance with

[105] S1: "Critically imperiled in the nation or state because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state." (PNHP, 2015b).

the Plant Protection Act of 2000 (7 U.S.C. 7701 *et seq.*). As of September 2014, 112 federally recognized noxious weed species have been catalogued in the U.S., of which 88 are terrestrial, 19 are aquatic, and five are parasitic (USDA, 2014).

Noxious weeds are a threat to Pennsylvania's forests, agricultural lands, waterways, and natural areas. Noxious weeds can have adverse ecological and economic impacts to these resources by displacing and outcompeting plants in both natural ecosystems and managed lands. The Pennsylvania Noxious Weed Control Law regulates the importation, movement, sale, possession, cultivation, and distribution of certain invasive plants and included provisions for establishing a statewide noxious weed list. The Pennsylvania Department of Agriculture Noxious Weed Control Committee is responsible for maintaining the statewide prohibited noxious weed list and updates to that list, as necessary. Plants on the noxious weed list are prohibited from sale in the nursery and landscaping trades (PNHP, 2015a).

A total of 13 state-listed noxious weeds are regulated in Pennsylvania under the Noxious Weed Control List (Pennsylvania Department of Agriculture, 1997). All 13 of these species are terrestrial species. The following noxious weed species are regulated in Pennsylvania:

- **Shrubs and Vines –** multiflora rose (*Rosa multiflora*) and kudzu-vine (*Pueraria montana* var. *lobata*).
- **Terrestrial Forbs, Grasses, and Grass-like Plants –** marijuana (*Cannabis sativa*), purple loosestrife (*Lythrum salicaria*) complex (including European wand loosestrife [*Lythrum virgatum*], any nonnative *Lythrum*, their cultivars and any combination thereof), Canadian thistle (*Cirsium arvense*), johnsongrass (*Sorghum halepense*), musk thistle (*Carduus nutans*), bull thistle (*Cirsium vulgare*), jimson weed (*Datura stramonium*), mile-a-minute (*Polygonum perforliatum*), shattercane (*Sorghum bicolor*), giant hogweed (*Heracleum mantegazzianum*), and goatsrue (*Galega officinalis*).

12.1.6.4. Terrestrial Wildlife

This section discusses the terrestrial wildlife species in Pennsylvania, divided among mammals[106], birds[107], reptiles and amphibians[108], and invertebrates[109]. 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[110], nongame animals, game birds, waterfowl, and migratory birds as well as their habitats within Pennsylvania. 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.

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

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

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

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

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

According to the Draft 2015 Pennsylvania Wildlife Action Plan prepared by the PGC and Pennsylvania Fish & Boat Commission (PFBC), the state is home to 66 mammal species, 414 bird species, approximately 76 reptile and amphibian species, an estimated 10,000 or more invertebrate species, and over 100 fish species (PGC, 2015c) (PGC, 2011a) (PGC, 2011b) (PFBC, 2015b) (West Chester University, 2005) (PFBC, 2016a).

Mammals

Common and widespread mammalian species in Pennsylvania include white-tailed deer (*Odocoileus virginianus*), woodchuck (*Marmota monax*), deer mice (*Peromyscus* spp.), raccoons (*Procyon lotor*), and squirrels, and moose (*Alces alces*). Other species such as black bear (*Ursus americanus*), beaver (*Castor* spp.), opossum (*Burramyidae* spp.), river otter (*Lontra canadensis*), muskrat (*Ondatra zibethicus*), and mink (*Neovison vison*) are also common but less widespread. Most mammal species are widely distributed throughout the state; however, some species may be more commonly encountered in certain areas of the state, such as marsh rice rat (*Oryzomys palustris*) in the Lehigh Valley, eastern spotted skunk (*Spilogale putorius*) in the Southern Alleghenies, and bobcat (*Lynx rufus*) and beaver in the more heavily forested central and northern portions of the state (PGC, 2016a). Two threatened or endangered mammal species are known to occur in Pennsylvania. Section 12.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, discusses these species.

In Pennsylvania, elk (*Cervus* spp.), whitetail deer *(Odocoileus virginianus)*, bear, and wild turkey (*Meleagris gallopavo*) are considered big game species. Small game species include small mammals (e.g., cottontail rabbit [*Sylvilagus* spp.], snowshoe hare [*Lepus americanus*], red [*Sciurus vulgaris*], gray [*Sciurus carolinensis*] and fox squirrel [*Sciurus niger*], groundhog) furbearers, and upland and migratory bird species including waterfowl. The following 13 species of furbearers may be legally hunted or trapped in Pennsylvania: fisher (*Martes pennanti*), mink, muskrat, opossum, river otter, eastern coyote (*Canis latrans*), striped skunk (*Mephitis mephiti*s), beaver, raccoon, all weasels, red (*Vulpes vulpes*) and gray fox (*Urocyon cinereoargenteus*), and bobcat (PGC, 2016b).

Pennsylvania has identified 19 mammals as 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 prevent fish and wildlife populations[111] from becoming endangered. 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 Wildlife Action Plan. (PGC, 2015c)

Birds

The number of native bird species documented in Pennsylvania varies according to the timing of the data collection effort, changes in bird taxonomy[112], and the reporting organization's method

[111] Population: "Aggregate of individuals of a biological species that are geographically isolated from other members of the species and are actually or potentially interbreeding." (USEPA, 2015e)
[112] Taxonomy: "A formal representation of relationships between items in a hierarchical structure." (USEPA, 2015e)

for categorizing occurrence and determining native versus non-native status. The diverse ecological communities (i.e., mountains, large rivers and lakes, swamps, grasslands, etc.) found in Pennsylvania support a variety of bird species. As of 2015, 414 species of resident and migratory birds have been documented in Pennsylvania. Among the 414 extant[113] species in Pennsylvania, 90 SGCN have been identified (PGC, 2011b). Two threatened or endangered bird species are known to occur in Pennsylvania. Section 12.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, discusses these species.

Pennsylvania is located within the Atlantic Flyway, which generally follows the Atlantic Coast and Appalachian Mountains. The Atlantic Flyway extends from the Arctic islands and coast of Greenland south to eastern Mexico and the Caribbean Sea. Large numbers of migratory birds utilize these flyways and other migration corridors and pathways throughout the state each year during their annual migrations northward in the spring and southward in the fall. The federal 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).

A number of Important Bird Areas (IBAs) have also been identified in Pennsylvania, as shown in Figure 12.1.6-2. 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 for native bird populations (USFWS, 2013a).

According to the Pennsylvania Audubon Society, a total of 86 IBAs have been identified in the state, including breeding[114], migratory stop-over, and winter staging areas in a wide variety of habitats (National Audubon Society, 2016). These IBAs are widely distributed throughout the state, although the largest concentration of IBAs are located in the Allegheny Forest, Susquehanna Valleys, and Southern Alleghenies regions of the state.

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 (eBird, 2015a). Golden eagles are infrequently observed throughout the state, primarily during winter months (eBird, 2015b).

[113] Extant: "A species that is currently in existence (the opposite of extinct)." (USEPA, 2015e)
[114] Breeding range: "The area utilized by an organism during the reproductive phase of its lifecycle and during the time that young are reared." (USEPA, 2015e)

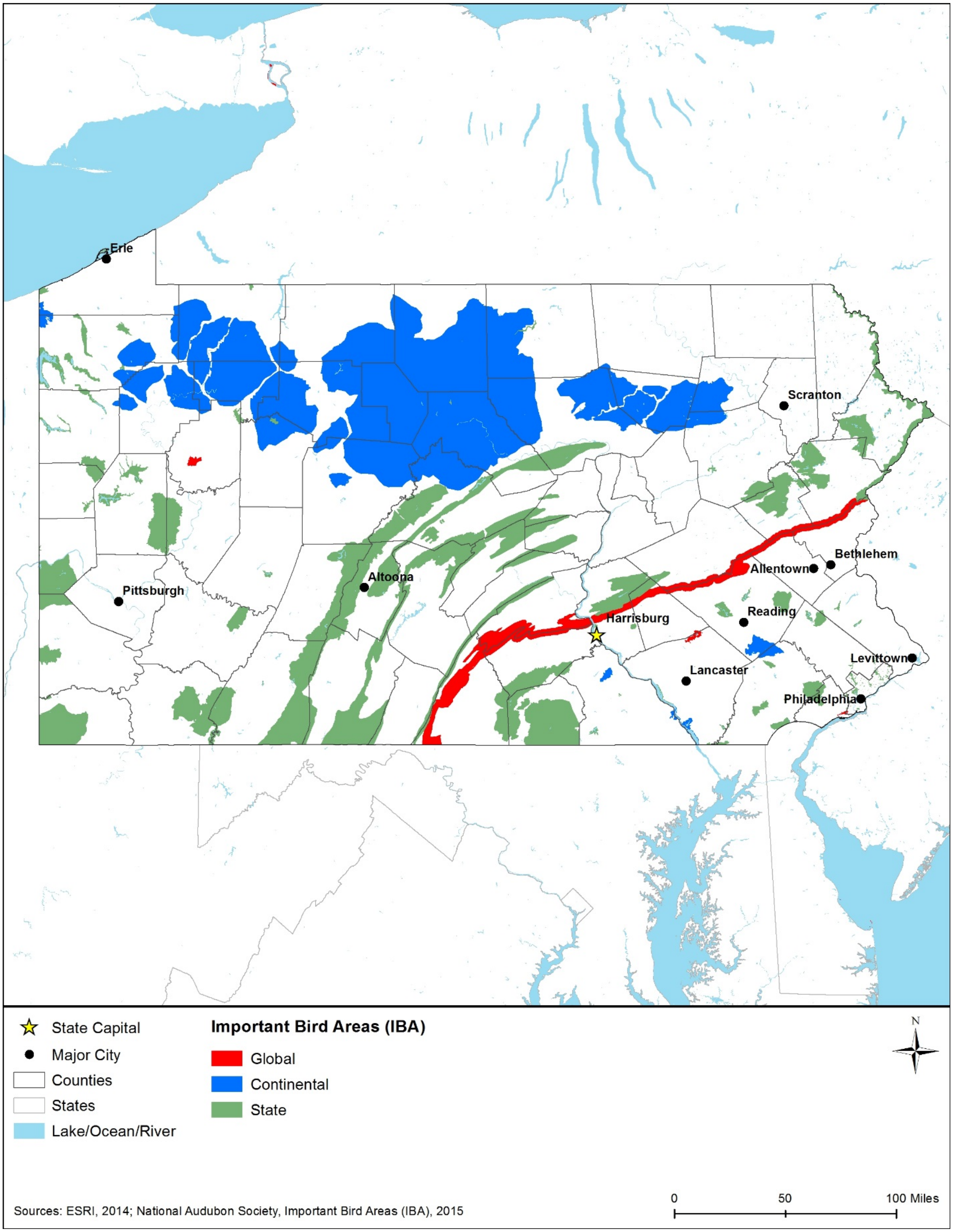


Figure 12.1.6-2: Important Bird Areas of Pennsylvania

In Pennsylvania, several species of birds may be hunted. Game bird species include geese (*Anserini*), brant (*Branta bernicla*), wild ducks (*Anatidae*), mergansers (*Mergus merganser*), and swans (*Cygnus*); coots (*Fulica*), gallinules (*Rallidae*), and woodcock (*Scolopax*); turkeys (*Meleagris*), grouse (*Tetraoninae*), pheasants (*Phasianus colchicus*), Hungarian partridges (*Perdix perdix*), bobwhite quail (*Colinus virginianus*), and mourning dove (*Zenaida macroura*). All wild bird species not included within the term "game birds" are considered protected bird species and are not permitted to be hunted (PGC, 2011b).

Reptiles and Amphibians

A total of 76 reptile and amphibian species are native to Pennsylvania. These species include 22 salamanders, 16 frogs and toads, 13 turtles, 4 lizards, and 21 snakes (PFBC, 2015b). Several examples include the marbled salamander (*Ambystoma opacum*), the easter cricket frog (*Acris* crepitans), and the northern ring-nacked snake (*Diadophis* punctatus). These species occur in a wide variety of habitats across the state, with some having widespread distribution and others being limited to a smaller region or locations in the state. Of the 76 native reptile and amphibian species, 40 SGCN have been identified. Two threatened or candidate endangered reptile species are known to occur in Pennsylvania (PFBC, 2015b). Section 12.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, discusses these species.

Pennsylvania reptile and amphibian species are classified as wild animals. Pennsylvania rules allow for the take of "small game, furbearing animals, crows, or wildlife" (Title 58, Pennsylvania Code, Chapter 141, Subchapter A).

Invertebrates

Pennsylvania is believed to be home to more than 10,000 species of invertebrates, including a wide variety of dragonflies, damselflies, butterflies, moths, skippers, mayflies, and beetles (West Chester University, 2005). These invertebrates provide an abundant food source for birds, reptiles, amphibians, fish, mammals, and other invertebrates, and many invertebrate species also serve as pollinators. In the U.S., one third of all agricultural output depends on pollinators[115]. In natural systems, the size and health of the pollinator population is linked to ecosystem health, with a direct relationship between pollinator diversity[116] and plant diversity. "As a group, native pollinators are threatened by habitat loss, pesticides, disease, and parasites" (NRCS, 2009). Life history, distribution, and abundance information is limited to a small number of Pennsylvania's invertebrates. Even with the lack of information on invertebrate species within the state, Pennsylvania acknowledges the threats to invertebrates and has identified SGCN for species and species groups for which information is available, resulting in a list of 450 invertebrate SGCN (PGC, 2015c). No threatened or endangered terrestrial invertebrate species, as defined by the ESA, are known to occur in Pennsylvania. Aquatic invertebrate species are discussed in the following Section 12.1.6.5, Fisheries and Aquatic Habitat.

[115] Pollinators: "Animals or insects that transfer pollen from plant to plant." (USEPA, 2015e)
[116] Diversity: "An ecological measure of the variety of organisms present in a habitat." (USEPA, 2015e)

Invasive Wildlife Species

The Pennsylvania Invasive Species Management Plan addresses feral swine (*Sus scrofa*) as an invasive mammal (PISC, 2015b). Feral swine may cause considerable damage to environments once they are introduced to an area, including forests, agricultural crops, and livestock production areas. In addition, they are known to carry diseases that infect humans, domestic animals, and wildlife.

The link between nonnative forest insect and disease infestations and firewood as a major source of these infestations has been widely recognized. The Pennsylvania Department of Agriculture has the regulatory authority to enact firewood restrictions and quarantines under the Plant Pest Act (3 PA Cons Stat § 258.1-258.27). Firewood in Pennsylvania is limited to that originating from Pennsylvania or that is kiln dried and in original packaging, and in some areas may include limitations on out-of-county firewood. The Pennsylvania DCNR and the Pennsylvania Department of Agriculture protect the health of native trees and woodlands, as well as those used by the agricultural and commercial trades, respectively. Several pest species are known to occur in Pennsylvania, which include emerald ash borer (*Agrilus planipennis*), spotted lanternfly (*Lycorma delicatula*), thousand cankers disease/walnut twig beetle (*Pityophthorus juglandis*), Asian long horned beetle (*Anoplophora glabripennis*), gypsy moth (*Lymantria dispar*), forest tent caterpillar (*Malacosoma disstria*), hemlock woolly adelgid (*Adelges tsugae*), and beech bark disease (Pennsylvania DCNR, 2015b) (PISC, 2015a).

12.1.6.5. Fisheries and Aquatic Habitat

This section discusses the aquatic wildlife species in Pennsylvania, including freshwater fish and invertebrates. A summary of non-native and/or invasive aquatic species is also presented. Fish in Pennsylvania include coldwater, coolwater, coolwater transition, and warmwater[117], reflecting the general habitats in which fish occur. A distinctive feature of the Pennsylvania landscape with regard to aquatic wildlife is the variety of fisheries habitats, including more than 86,000 miles of streams and rivers, 4,000 inland lakes and ponds, and 470,000 acres of Lake Erie. No essential fish habitat (EFH) identified by the Magnuson-Stevens Fishery Conservation and Management Act exists in Pennsylvania. Additionally, federally designated critical habitat for threatened or endangered fish species, as defined by the ESA, does not exist within Pennsylvania.

Freshwater Fish

Pennsylvania is home to over 100 species of freshwater fish, ranging in size from small minnows to larger species such as salmon and sturgeon. These species are grouped as follows: lamprey, sturgeon, paddlefish, gars, bowfin, mooneye, freshwater eels, herring, carps and minnows, suckers, North American catfish, smelt, trout and salmon, pikes and mudminnows, cod, topminnows, sticklebacks, sculpins, temperate basses, sunfish/bass, perches and darters, and drums and croakers. Among these species are several important recreational and game fish, such as yellow perch (*Perca flavescens*), walleye (*Sander vitreus*), catfish (*Ictalurus* spp.), sunfishes,

[117] Fish species are naturally attracted to specific habitat water temperature, classified by coldwater, coolwater, coolwater transition, and warmwater.

bass (*Micropterus* spp.), trout (*Oncorhynchus* spp.), and whitefish (PFBC, 2016a). Of these, 65 SGCN fish species have been identified (PGC, 2015c). No federally listed threatened or endangered fish species are known to occur in Pennsylvania.

Fish communities in Pennsylvania follow a roughly defined distribution among three general habitat types: habitats adjacent to and including Lake Erie, the Delaware River, and those of interior mountain streams, lakes, and ponds. Large lake and river habitat fish species include sturgeon, Atlantic salmon (*Salmo salar*), lamprey, walleye, and American eel (*Anguilla rostrate*), among others. Mountain lake and stream fish species include bass, pike, and brook, brown, and rainbow trout. Some fish species use both habitat types (including but not limited to walleye, yellow perch, and Atlantic salmon), but many tend to occur in one of the three general habitat types (PFBC, 2016b).

The salmon family is considered a very important fish family in the U.S. for many reasons, including commercial and recreational fishing value, their role in aquatic and terrestrial ecosystems, and their role in fisheries management. Several salmon species occur in Pennsylvania, including the native Atlantic salmon and introduced salmon such as Pacific, Coho (*Oncorhynchus kisutch*), and Kokanee salmon (*Oncorhynchus nerka*). Introduced pink salmon (*Oncorhynchus gorbuscha*) are self-sustaining and have spread through all the Great Lakes. In addition to cold lake habitats, some of these salmon (i.e., landlocked Atlantic salmon) utilize tributary rivers of large lakes for spawning and nursery habitat. Ideal spawning habitat requires riverbeds with rapidly flowing water with good gravel substrate (PFBC, 2016b).

Freshwater fish and associated freshwater habitats are considered one of the most highly threatened ecosystems based on the vast decline in species population numbers. Approximately 40 percent of fish species in North America are considered at risk or vulnerable to extinction[118] (National Fish Habitat Board, 2010; USFWS, 2015y). Major threats to freshwater fisheries include habitat modification and destruction (dams, culverts, weirs, urban development, and agricultural practices), overfishing, invasive species, and environmental pollution and impaired water quality. Among freshwater fish in Pennsylvania and the northeastern U.S. in general, three groups of fish are considered to be the most threatened by habitat loss and degradation[119]: headwater fishes (e.g., brook lamprey [*Lampetra planer*], channel darter [*Percina copelandi*], eastern sand darter [*Ammocrypta pellucida*]), lake fishes (e.g., lake sturgeon [*Acipenser fulvescen*], lake chub [*Couesius plumbeus*]), and migratory fishes (e.g., American eel, Atlantic salmon) (National Fish Habitat Board, 2010).

Shellfish and Other Invertebrates

A complete inventory of freshwater mollusks and crustaceans has not been completed for Pennsylvania, although at least 113 species are known to occur in the state, including 66 freshwater mussel species (PNHP, 2015a). Aside from a multitude of freshwater invertebrates

[118] Extinction: “The disappearance of a species from part or all of its range.” (USEPA, 2015e)
[119] Degradation: “The reduction of the capacity of the environment to meet social and ecological objectives, and needs. (USEPA, 2015e)

whose adult forms are terrestrial insects (e.g., flies, beetles, etc.), other Pennsylvania freshwater invertebrates that spend their lives in aquatic systems include crayfish, amphipods, and snails.

Pennsylvania has identified 57 freshwater mollusk, 12 freshwater snail, and 1 crayfish SGCN. Aquatic invertebrates, excluding mussels, are combined with terrestrial invertebrates in the state's identification of SGCN (PGC, 2015c). Seven threatened or endangered mussel species are located in Pennsylvania and are discussed in Section 12.1.6.6, Threatened and Endangered Species and Species of Conservation Concern.

Invasive Aquatic Species

As previously discussed, Pennsylvania has adopted regulations that prohibit or regulate the importation, movement, sale, possession, cultivation, and distribution of certain invasive plants. Given the magnitude of aquatic invasive species in Pennsylvania and the variety of activities pertaining to these species, the Pennsylvania Invasive Species Council has developed an aquatic invasive species management plan to coherently address aquatic invasive species issues across the state (PISC, 2007). The following aquatic wildlife species are banned from the sale, barter, possession, or transport in the state: bighead carp (*Hypophtalmichtys nobilis*), black carp (*Mylopharyngodon piceus*), European rudd (*Scardinius erythropthalmus*), quagga mussel (*Dreissena bugensis*), round goby (*Neogobius melanostomus*), ruffe (*Gymnocephalus cernuus*), rusty crayfish (*Orconectes rusticus*), silver carp (*Hypophtalmichtys molitrix*), snakehead (*Channa* spp.), tubenose goby (*Proterothinus marmoratus*), and zebra mussel (*Dreissena polymorpha*). In addition to these fish species, the PFBC considers the following aquatic nuisance species: didymo, golden alga, hydrilla (*Hydrilla verticillata*), Eurasian watermilfoil (*Myriophyllum spicatum*), spiny water flea (*Bythotrephes cederstroemi*), sea lamprey (*Petromyzon marinus*), Asian clam (*Corbicula fluminea*), and red-eared slider (*Trachemys scripta elegans*) (PFBC, 2015a).

12.1.6.6. 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 Pennsylvania. The USFWS has identified 10 endangered[120] and 4 threatened[121] species known to occur in Pennsylvania[122] (USFWS, 2015z). Of these 14 federally listed species, one has designated critical habitat[123] (USFWS, 2015aa). The 14 federally listed species include 2 mammals, 1 reptile, 1 bird, 1 fish, 7 invertebrates, and 2 plants (USFWS, 2015z), and are discussed in detail under the following sections. These species are distributed throughout the state; however, most occur within or adjacent to freshwater aquatic habitats.

[120] 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))
[121] 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))
[122] Note that for this document, only species identified by USFWS are discussed.
[123] 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)).

Mammals

One endangered and one threatened mammal species are federally listed and known to occur in Pennsylvania as summarized in Table 12.1.6-3. The Indiana bat (*Myotis sodalis*) and northern long-eared bat (*Myotis septentrionalis*) are found in natural caves around the state. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Pennsylvania is provided below.

Table 12.1.6-3: Federally Listed Mammal Species of Pennsylvania

Common Name	Scientific Name	Federal Status [a]	Critical Habitat	Habitat Description
Indiana Bat	*Myotis sodalis*	E	No	Trees and snags; caves and abandoned mines found throughout the state
Northern Long-eared Bat	*Myotis septentrionalis*	T	No	Trees and snags; caves and abandoned mines found throughout the state.

Source: (USFWS, 2015z)

[a] E = Endangered, T = Threatened

Indiana Bat. The endangered Indiana bat is a small, insectivorous[124] mammal measuring approximately 3.5 to 5.5 inches in length with a wingspan of 9.5 to 10.5 inches. The Indiana bat has dull grayish chestnut fur and strongly resembles the more common little brown bat (*Myotis lucifugus*) (PGC, 2010; USFWS, 2015e). The Indiana bat was originally federally listed as “in danger of extinction” under early endangered species legislation in 1967 (32 Federal Register [FR] 4001, March 11, 1967) and was grandfathered into the ESA of 1973 as an endangered species (32 FR 4001, March 11, 1967) (Harrington, 1982). In 2009, only 387,000 Indiana bats were known to exist in its range, less than half of the population of 1967 (USFWS, 2015f). Regionally, this species is found in the central portion of the eastern U.S., from Vermont west to Oklahoma, Missouri, and Arkansas, and south and east to Georgia. In Pennsylvania, the Indiana bat is known to occur in 50 counties throughout the state (USFWS, 2015g).

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

[124] Insectivorous: “An animal that feeds on insects.” (USEPA, 2015e)

species occurs throughout the Southern Alleghenies, Susquehanna Valleys, Laurel Highlands, and Hershey/Dutch Country regions.

The threats to this species include the disturbance and intentional killing of hibernating and maternity colonies, disturbances to air flow in caves from the improper installation of security gates, habitat fragmentation[125] and degradation[126], the use of pesticides or other environmental contaminants, and White Nose Syndrome (USFWS, 2004; USFWS, 2012b). White nose syndrome is a rapidly spreading fungal disease that afflicts hibernating bats (USGS, 2015f). The greatest threats in Pennsylvania aside from white nose syndrome is reported to be development and alteration to surface habitats (PGC, 2010). Some scientists also think that Indiana bat populations may be declining due to pesticides and environmental pollution. Contaminants may be depleting their food source (insects) or they may be drinking from contaminated water sources (USFWS, 2015e).

Indiana Bat Photo credit: USFWS

Northern Long-eared Bat. The threatened northern long-eared bat is a brown furred, insectivorous bat with long ears. This bat is medium-sized, relative to other members of the genus Myotis spp., reaching a total length of 3 to 3.7 inches in length (USFWS, 2015h). The northern long–eared bat was listed as endangered in 2013 (78 FR 72058 72059, December 2, 2013) and 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, 2015h). In Pennsylvania, the northern long-eared bat is known to occur in 66 counties throughout the state (USFWS, 2015i).

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, from which pregnant females then migrate to summer areas where they roost in small colonies (USFWS, 2015h).

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. (USFWS, 2015j). 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, 2015h).

[125] Fragmentation: "A process during which larger areas of habitat are broken into a number of smaller patches of smaller total area, isolated from each other by a matrix of habitats unlike the original habitat." (USEPA, 2015e)
[126] Degradation: "The reduction of the capacity of the environment to meet social and ecological objectives, and needs." (USEPA, 2015e)

Reptiles

One federally threatened reptile species is known to occur in Pennsylvania (Table 12.1.6-4). The bog turtle (*Clemmys muhlenbergii*) is found in southeastern Pennsylvania. Information on the habitat, distribution, and threats to the survival and recovery of this species in Pennsylvania is provided below.

Table 12.1.6-4: Federally Listed Reptile Species of Pennsylvania

Common Name	Scientific Name	Federal Status [a]	Critical Habitat	Habitat Description
Bog Turtle	*Clemmys muhlenbergii*	T	No	Occurs in wetlands, meadows, and wet areas with tussock-forming vegetation, found in the Lehigh Valley region.

Source: (USFWS, 2015z)

[a] T = Threatened

Bog Turtle. The threatened bog turtle is a very small turtle, averaging 3.1 to 4.5 inches in length (USFWS, 2015k). This species is the smallest member of the Clemmys genus, and it is characterized by a light brown to ebony shell and bright yellow, orange, or red blotches on each side of the head (USFWS, 2001a). After thorough review in three status reviews conducted in 1982, 1994, and 1996, the USFWS proposed a final rule in 1997 to list the northern population of the bog turtle as threatened and southern population as threatened due to similarity of appearance, under provisions of the ESA (62 FR 59605 59623, November 4, 1997). Regionally the northern population of the bog turtle in known to occur in localized distributions from western Massachusetts and Connecticut southward to Maryland, and the southern population is known to occur from North Carolina southward to Georgia (USFWS, 2001a). In Pennsylvania it is known to occur in 15 counties in the Lehigh Valley region of the state and it is listed as endangered by the Pennsylvania Fish and Boat Commission (PGC, 2015b; USFWS, 2015k).

The bog turtles prefer habitats that are open wetlands, sedge meadows, calcareous fens, and boggy areas with cool, shallow, slow-moving water, deep and soft muck soils, and with tussock[127]-forming vegetation (USFWS, 2001a; USFWS, 2011a). For hibernation the bog turtle generally retreats back to densely vegetated areas (USFWS, 2001a). In Pennsylvania, bog turtles begin hibernation in late September or October and tend to emerge from hibernation in late March and April. Mating usually occurs in the spring or right after hibernation followed by nesting from June to July. An average of three eggs are laid by each female turtle and they hatch around mid-August and September. The bog turtle is omnivorous and it tends to mainly feed on insects but also consumes slugs, worms, frogs, plants, and carrion (PFBC, 2011).

Current threats to this species are habitat loss and fragmentation from development. Additionally, this species is under threat of vegetation succession and invasion of nonnative plants, such as purple loosestrife (*Lythrum salicaria*), which out-complete native wetland plants that provided food or nesting sites for this species. The illegal collection of bog turtles has also

[127] Tussock: A small area of grass that is thicker or longer than the grass growing around it.

been a major threat to the bog turtles throughout the state and in locations in which they are known to occur (PFBC, 2015c).

Birds

One federally endangered bird species is known to occur in Pennsylvania (Table 12.1.6-5). The piping plover (*Charadrius melodus*) is found in northwestern Pennsylvania in Lake Erie. Information on the habitat, distribution, and threats to the survival and recovery of this species in Pennsylvania is provided below.

Table 12.1.6-5: Federally Listed Bird Species of Pennsylvania

Common Name	Scientific Name	Federal Status [a]	Critical Habitat	Habitat Description
Piping Plover	*Charadrius melodus*	E	No	Wide open sandy beaches, mudflats, lagoons, and salt marshes; found in northwestern Pennsylvania in Lake Eire

Source: (USFWS, 2015z)

[a] E = Endangered

Piping Plover. The endangered piping plover is a sand-colored migratory shorebird approximately 6.5 to 7 inches in length with a wingspan up to 19 inches and weighs between 1.5 to 2.3 ounces. The piping plover occurs in Northern Great Plains, along the Atlantic Coast, and in the Great Lakes Area within the U.S. for approximately three to four months during the summer breeding season. It was first listed as endangered in 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. *(*50 FR 50726 50734, December 11, 1985*)*. In Pennsylvania, the piping plover only occurs Erie County (USFWS, 2015l).

This species feeds in the intertidal zone of ocean beaches, ocean washover areas, mudflats, sand flats, wrack lines, and the shorelines of coastal ponds, lagoons, and salt marshes. They feed on worms, fly larvae, beetles, crustaceans, and other marine macroinvertebrates (USFWS, 2015l; USFWS, 2015m). The piping plover's preferred habitat is wide, open, sandy beaches with little vegetation. This species nests in small creeks or wetlands and creates shallow nests lined with pebbles or broken shells. The female would lay an average of two to four eggs and both female and male care for them until eggs hatch (USFWS, 2001b).

In Pennsylvania, the current threats to the piping plover include destruction and degradation of preferred habitat resulting from commercial, residential, and recreational development. Human presence has also contributed as a threat to the survival of this endangered species as it causes nest abandonment and exposes eggs to sun and predators. Additionally, occasional storm tides become threats to piping plovers as nest could be inundated (USFWS, 2010a).

Fish

One federally endangered fish species is known to occur in Pennsylvania as summarized in Table 12.1.6-6. The shortnose sturgeon (*Acipenser brevirostrum*) is found in southeastern

Pennsylvania in the Delaware River. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Pennsylvania is provided below.

Table 12.1.6-6: Federally Listed Fish Species of Pennsylvania

Common Name	Scientific Name	Federal Status [a]	Critical Habitat	Habitat Description
Shortnose Sturgeon	*Acipenser brevirostrum*	E	No	Fast-moving rivers and estuaries; found in the Lehigh Valley region, in the Delaware River

Source: (USFWS, 2015z)

[a] E = Endangered

Shortnose Sturgeon. The endangered shortnose sturgeon (*Acipenser brevirostrum*) is the smallest of the three eastern North American sturgeon species, growing up to 4.5 feet in length and weighing up to 50 pounds. The shortnose sturgeon are long-lived fishes with lifespans of 30 to 67 years and are among the most primitive of the bony fishes (NOAA, 2014a). This species was listed as endangered in 1967 (32 FR 4001, March 11, 1967). In Pennsylvania they occur in the Lehigh Valley region, in the counties of Bucks, Northampton, and Philadelphia occupying a variety of riverine and estuarine habitats including fast-moving rivers (NOAA, 2014a; USFWS, 2015n).

Their preferred habitats are nearshore marine, estuarine, and riverine habitats. Adult shortnose sturgeon feed on large crustaceans and mollusks; juvenile sturgeon feed on small crustaceans, mollusks, and insects. Females of this species can live up to 67 years and males approximately 30 years. They are anadromous,[128] spawning upstream in freshwater and moving downstream and offshore to marine environments along the continental shelf. Historically, the shortnose sturgeon was not sought after by the commercial fishing industry, but was often taken incidentally during attempts for Atlantic sturgeon. Current threats to this species include pollution, habitat alteration, construction of dams, and dredging (NOAA, 2014a).

Invertebrates

Six federally endangered and one federally threatened invertebrate species are known to occur in Pennsylvania as summarized in Table 12.1.6-7. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Pennsylvania is provided below.

Table 12.1.6-7: Federally Listed Invertebrate Species of Pennsylvania

Common Name	Scientific Name	Federal Status [a]	Critical Habitat	Habitat Description
Clubshell Mussel	*Pleurobema clava*	E	No	River and streams with clean, loose sand, and gravel; found in the Allegheny Forest region along the Allegheny River.
Dwarf Wedgemussel	*Alasmidonta heterodon*	E	No	Creek and river areas with slow to moderate current, gravel, and sand;

[128] 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, 2015d)

				found in Lehigh Valley region along the Delaware River.
Northern Riffleshell	*Epioblasma torulosa rangiana*	E	No	Clean, firmly packed, coarse sand and gravel in riffles and streams; found in western Pennsylvania in Allegheny forest region, along the Allegheny River and French Creek.
Rabbitsfoot Mussel	*Quadrula cylindrica*	T	Yes	Shallow area of streams and rivers with sand and gravel along the banks; found in the Allegheny forest region in French Creek and in limited areas of the Allegheny and Shenango Rivers.
Rayed Bean Mussel	*Villosa fabalis*	E	No	Small headwater creeks and wave-washed areas of glacial lakes with aquatic vegetation in the Lake Erie and Allegheny forest regions; found in Allegheny River and French Creek
Sheepnose Mussel	*Plethobasus cyphyus*	E	No	Large rivers and streams with shallow shoal habitats; found in the Allegheny forest region in the middle Allegheny River.
Snuffbox Mussel	*Epioblasma triquetra*	E	No	Small to medium sized creeks, lakes, and rivers with shoal habitats; found in the Allegheny forest region, along the Allegheny River, French Creek, Shenango River

Sources: (USFWS, 2015z; USFWS, 2015aa)

[a] E = Endangered, T = Threatened

Clubshell Mussel. The endangered clubshell mussel (*Pleurobema clava*) is a small to medium size mussel with yellow to brown shell exterior. It was federally listed as an endangered species in 1993 (58 FR 5638 5642, January 22, 1993). This species is also listed as endangered in Pennsylvania and occurs in nine counties within the state, along the Allegheny River and its tributaries. Historically, this species is known to have occurred from Michigan south to Tennessee and Illinois east to New York. This species has since been extirpated in Alabama and Tennessee (66 FR 32250 32264, June 14, 2001) (USFWS, 1997) (USFWS, 2015o).

The clubshell mussel prefers a habitats with clean, loose sand, and gravel in medium to small rivers and streams. For their reproductive cycle, they require stable, undisturbed habitat and sufficient fish hosts to complete the mussels larval. This species can live for up to 50 years (USFWS, 1997). The current threats to the clubshell mussels include water quality degradation, sedimentation from development, agricultural runoff, and pollution. Additionally, zebra mussels, a non-native species, is killing clubshells in many regions (USFWS, 2010b).

Dwarf Wedgemussel. The endangered dwarf wedgemussel (*Alasmidonta heterodon*) is a small, brown or yellowish-brown freshwater mussel that is usually less than 1.5 inches in length (USFWS, 2010c). It was federally listed as endangered in 1990 throughout its range (55 FR 9447 9451, March 14, 1990). In Pennsylvania it is known to occur in the counties of Monroe, Pike, and Wayne along the Delaware River (USFWS, 2015p).

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

Northern Riffleshell. The endangered northern riffleshell (*Epioblasma torulosa rangiana*) is a small brownish yellow to yellowish green freshwater mussel that can grow up to three inches long. It was federally listed as endangered in 1993 throughout its range (58 FR 5638 5642, January 22, 1993). It is regionally believe or known to occur in Indiana, Kentucky, Michigan, Ohio, Pennsylvania, and West Virginia. In Pennsylvania, it is believed or known to occur in three streams in the Lake Erie and Allegheny forest regions of the state, the French and LeBoeuf creeks and the Allegheny River. The preferred habitat is clean, firmly packed, coarse sand and gravel in riffles and streams. For its reproduction lifecycle, it requires a stable, undisturbed habitat, and a sufficient source of host fish. The northern riffleshell can live up to 50 years. The current threats to the survival of the northern riffleshell include dams and reservoirs as they reduce sand and gravel in habitats, as well as, affects the distribution of host fish. The non-native zebra mussels has also become a major threats as they are spreading rapidly and killing the northern riffleshell (USFWS, 2010d; USFWS, 2015q).

Rabbitsfoot Mussel. The threatened rabbitsfoot mussel (*Quadrula cylindrica cylindrical)* is a medium to large sized freshwater mussel that can grow up to six inches in length. The shell of the rabbitsfoot mussel is generally yellowish, greenish, or olive in color and turns yellowish brown with age (USFWS, 2015r). The rabbitsfoot mussel was federally listed as threatened in 2013 (78 FR 57076 57097, September 17, 2013). It has been estimated that these mussels have been eliminated from about 64 percent of its existing historical range and only about 11 of the populations that exists are considered to be large enough to be viable for long term (USFWS, 2011b; USFWS, 2015s). In Pennsylvania, these mussels are believed or known to occur in 14 counties and in the French Creek and in limited areas of the Allegheny and Shenango Rivers (USFWS, 2011b).

The rabbitsfoot is a sedentary filter feeder that obtains its oxygen and food from the water column. The rabbitsfoot prefers the shallow area of streams and rivers with sand and gravel along the banks. These mussels seldom burrow and instead use the gravel along the banks as refuge in fast moving rivers and streams. For reproduction, this species prefers a stable and undisturbed habits with a sufficient population of host fish including shiners of the genera (*Cyprinella, Luxilus, Notropis*) (USFWS, 2011b).

A critical habitat designation was recorded in 2015 at 31 stream segments where the mussels are known to occur (80 FR 24691 24774, April 30, 2015), illustrated in Figure 12.1.6-3, critical habitat for rabbitsfoot mussel is located in the Lake Erie region, along portions of French Creek, Muddy Creek, and Allegheny River. The current threats to the rabbitsfoot mussels include the loss of habitat, isolation of populations, range restrictions, sedimentation, and presence of exotic non-native species (USFWS, 2011b).

Rayed Bean Mussel. The endangered rayed bean mussel (*Villosa fabalis*) is a small, freshwater mussel, usually less than 1.5 inches long. Its shell is green, yellowish-green, or brown with greenish lines (USFWS, 2015t). The rayed bean mussel was federally listed as endangered in 2012 (77 FR 8632 8665, February 14, 2012). Its historical North American range included 115 streams and lakes, but current populations have reduced 76 percent and are only found in 31 streams and 1 lake. In the lower Great Lakes systems it is known to occur in 10 streams. The population in Pennsylvania is restricted to Allegheny River and French Creek (USFWS, 2012c).

The rayed bean mussels live in small headwater creeks and wave-washed areas of glacial lakes and are unable to live in still water. This species prefers gravel or sand and sometimes prefer roots of aquatic vegetation (USFWS, 2012c). Threats include sedimentation, dams that restrict natural flow, change in temperatures, elimination of habitats, reduction of fish populations necessary for the mussels' lifecycle, and invasive species of zebra mussel (*Dreissena polymorpha*) and round goby (*Neogobius melanostomus*) (USFWS, 2012d).

Sheepnose Mussel. The endangered sheepnose mussel (*Plethobasus cyphyus*) is a medium sized freshwater mussel that usually grows about five inches. The sheepnose shell is a light yellow to dull yellowish brown with dark ridges (USFWS, 2012e). After multiple status reviews since 2004, the USFWS listed the sheepnose mussel as endangered in 2012 (77 FR 14914 14949, March 13, 2012). This species historically occurred in most of the Mississippi River, but has been eliminated from two-thirds of location where it once occurred and now only occurs in 25 streams (USFWS, 2012e). In Pennsylvania, it is known to occur in five counties mainly in limited areas of middle Allegheny River (USFWS, 2011c; USFWS, 2015u).

The sheepnose mussels live in large rivers and streams with moderate to swift currents and feed on suspended algae, bacteria, detritus, and microscopic animals. This species prefers shallow shoal habitats above course sand and gravel. For reproduction the sheepnose prefers a stable undisturbed habitat with the presence of sauger (*Sander canadensis*), its only host fish (USFWS, 2012e). Threats include sedimentation, dams that restrict natural flow, habitat reduction, water quality degradation, contaminations of nutrients, and invasive species of zebra mussels (*Dreissena polymorpha*) (USFWS, 2011c; USFWS, 2012e).

Snuffbox Mussel. The endangered snuffbox mussel (*Epioblasma triquetra*) is a small to medium size freshwater mussel that usually grows from 1.8 to 2.8 inches. The snuffbox has a yellow, green, or brown triangular shell with green rays (USFWS, 2012f). This species was federally listed as endangered in 2012 (77 FR 8632 8665, February 14, 2012). The snuffbox total population has reduced by 62 percent from its historical range. Currently this species only occurs in 79 streams and 14 rivers compared to 210 streams and lakes in its historical range (USFWS, 2012f). The snuffbox was abundant in many portions of the Great Lakes but has been eliminated from many location and now only occurs in 11 counties in Pennsylvania mainly along the Allegheny River, French Creek, Shenango River, and other small creeks (USFWS, 2012g; USFWS, 2015v).

The snuffbox mussels live in small to medium sized creeks, lakes, and rivers and feed on suspended algae, bacteria, and dissolved organic material. This species prefers shoal habitats with swift current over sand and gravel as they usually burrow deep in sand. For reproduction a stable and undisturbed habitat is require with a sufficient population of host fish such as logperch (*Percina caprodes*) and several other darters (USFWS, 2012f; USFWS, 2012g). Current threats to this species include sedimentation, pollution and water quality degradation, dams that restrict natural flow, and invasive non-native species of zebra mussels (USFWS, 2012f).

Plants

One federally endangered and one federally threatened plant species are known to occur in Pennsylvania as summarized in Table 12.1.6-8. The northeastern bulrush (*Scirpus ancistrochaetus*) is found in central and eastern counties in Pennsylvania, while the small whorled pogonia (*Isotria medeoloides*) is found in three countries across Pennsylvania. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Pennsylvania is provided below.

Table 12.1.6-8: Federally Listed Plant Species of Pennsylvania

Common Name	Scientific Name	Federal Status [a]	Critical Habitat	Habitat Description
Northeastern Bulrush	*Scirpus ancistrochaetus*	E	No	Palustrine wetlands and vernal ponds with seasonally fluctuating water levels; found in central and eastern Pennsylvania.
Small Whorled Pogonia	*Isotria medeoloides*	T	No	Hardwood stands that include beech, birch, maple, oak, hemlock, and hickory in acidic soils; found in Centre, Chester, and Venango counties.

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

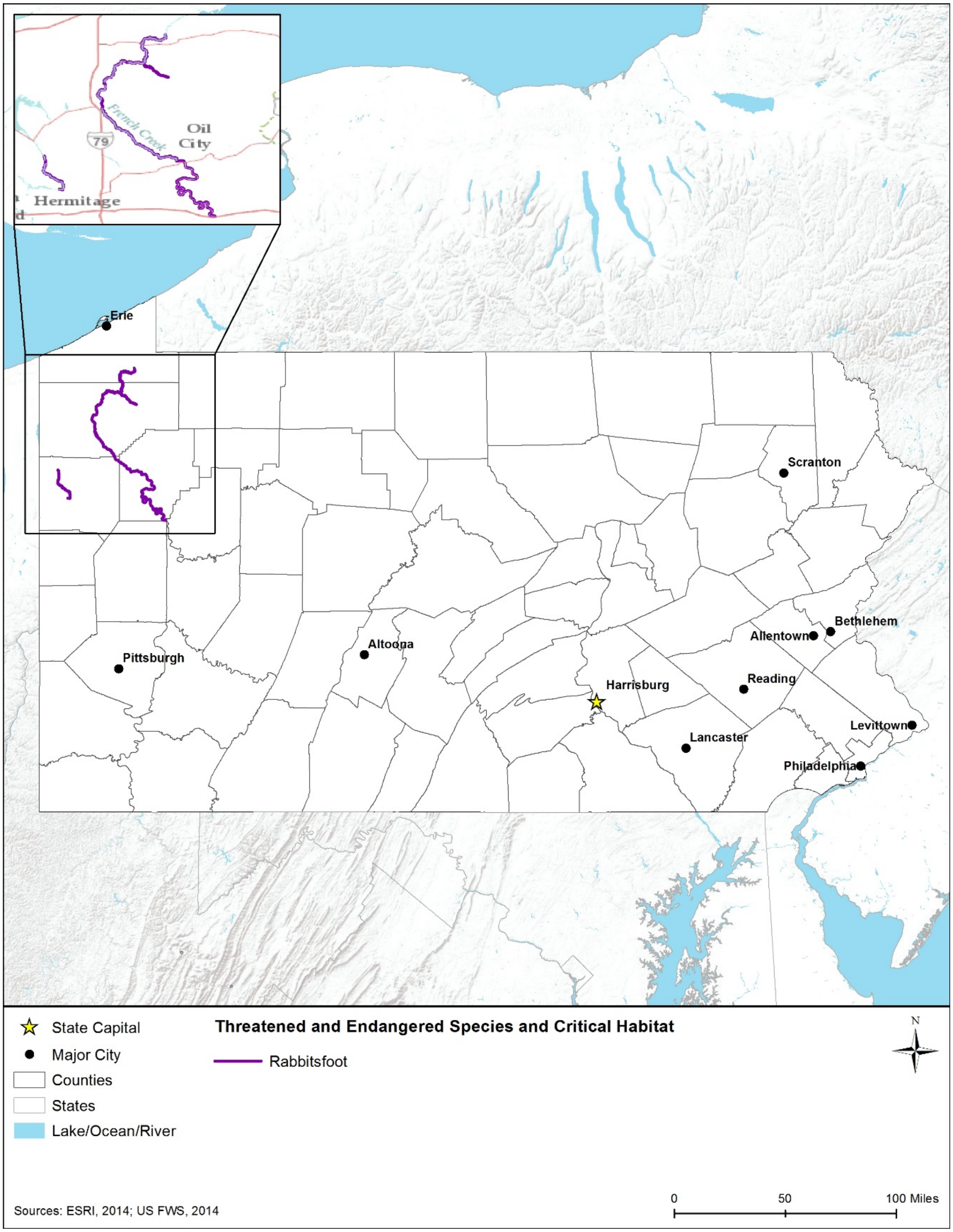


Figure 12.1.6-3: ESA Designated Critical Habitat for the Rabbitsfoot Mussel in Pennsylvania

Northeastern Bulrush. The endangered northeastern bulrush (*Scirpus ancistrochaetus*) is a plant with narrow leaves and a drooping head with chocolate-brown florets. It is a wetland plant in the sedge family that is very similar to other bulrushes, but its flowers and seeds are structurally different. This species was federally listed as endangered in 1991 (56 FR 21091, May 05, 1991). The northeastern bulrush is known to occur from Quebec south to West Virginia, with the most known occurrences in Pennsylvania (USFWS, 2010e). It is known to occur in 24 counties in central and east Pennsylvania, primarily in the Susquehanna Valleys and Hershey/Dutch Country regions of the state (USFWS, 2015w).

The northeastern bulrush occurs in palustrine wetlands and vernal ponds with seasonally fluctuating water levels. The current threats to the northeastern bulrush include alterations to the surrounding hydrology[129], either by drier or wetter conditions (USFWS, 2006; USFWS, 2010e).

Small whorled pogonia Photo credit: USFWS

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, September 9, 1982) and in 1994 was reclassified as threatened (59 FR 50852, October 6, 1994) (USFWS, 2015x). Regionally, this species is known to occur in sparse distributions in Ontario, Canada and in 18 eastern states (USFWS, 2008). In Pennsylvania, populations are most abundant in dry east or southeast facing hillsides. Specific habitats are known to exist in three counties within Pennsylvania: Centre, Chester, and Venango counties (USFWS, 2012h; USFWS, 2015x).

The small whorled pogonia occurs in hardwood stands that include beech, birch, maple, oak, and hickory that have an open understory, preferring acidic soils along small streams that have a thick layer of litter (USFWS, 2008). 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).

12.1.7. Land Use, Recreation, and Airspace

12.1.7.1. Definition of the Resource

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

[129] Hydrology: "The way water moves and is distributed via precipitation, runoff, storage and evaporation." (EPA 2015)

Land Use, Recreation, and Airspace

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, 2012c).

Recreational uses are activities in which residents and visitors participate. They include outdoor activities, such as hiking, fishing, boating, athletic events (e.g., golf), and other attractions (e.g., historic monuments and cultural sites) or indoor activities, such as museums and historic sites. Recreational resources can include trails, 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, 2015). 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, 2014b). The ATO is comprised of Service Units (organizations) that support the operational requirements.

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

12.1.7.2. Specific Regulatory Considerations

Appendix C summarizes numerous federal laws and regulations that, to one degree or another, affect land use in Pennsylvania. However, most site-specific land use controls and requirements are governed by local county, city, and village laws and regulations. Furthermore, many land use controls and requirements are implemented and enforced under the umbrella of land use planning, often with the help and support of state authorities. The Pennsylvania Municipalities Planning Code provides guidance to municipalities about land use planning, master planning, zoning, and the planning process. Also, the Pennsylvania DEP is responsible for coordinating land use across Commonwealth agencies, and issues permits associated with comprehensive planning and zoning ordinances, grants, multi-municipal planning, and agricultural land preservation (Pennsylvania DEP, 2015c).

Because the nation's airspace is governed by federal laws, there are no specific Pennsylvania state laws that would alter the existing conditions relating to airspace for this Draft PEIS. However, Pennsylvania Consolidated Statutes (CS) (Title 74 Transportation, Chapter 55 Legal Status of Air Navigation and Chapter 57 Obstructions to Aircraft Operation) and Commonwealth of Pennsylvania regulations (Title 67 Transportation, Article IV Air Transportation, Chapter 479 Obstruction to Aircraft) do have laws/regulations pertaining to the operation and safety of aircraft with regard to obstructions (Pennsylvania General Assembly, 2015b) (Commonwealth of Pennsylvania, 2015a).

12.1.7.3. Land Use and Ownership

For the purposes of this analysis, land use in Pennsylvania has been classified into three primary land use groups: forest and woodlands[130], agricultural[131], and developed[132]. Land ownership within Pennsylvania has been classified into four main categories: private, federal, state, and tribal.

Land Use

Forest and woodlands is comprised of the largest portion of land use with 61 percent of Pennsylvania total land occupied by this category (Table 12.1.7-1 and Figure 12.1.7-1). Agricultural land is the second largest area of land use with 24 percent of the total land area. Developed land accounts for approximately 12 percent of the total land area (USGS, 2012d).

[130] Forest and woodlands: Areas characterized by tree cover (natural or semi-natural woody vegetation, generally greater than 6 meters tall); tree canopy accounts for 25-100 percent of the cover. (USGS, 2012d).
[131] Agricultural: Areas characterized by herbaceous vegetation that has been planted or is intensively managed for the production of food, feed, or fiber; or is maintained in developed settings for specific purposes. Herbaceous vegetation accounts for 75-100 percent of the cover (USGS, 2012d).
[132] Developed: Areas characterized by a high percentage (30 percent or greater) of constructed materials (e.g., asphalt, concrete, buildings, etc.) (USGS, 2012d).

Table 12.1.7-1: Pennsylvania Land Use

Land Use	Square Miles	Percent of Land
Forest and Woodland	28,480	61%
Agricultural Land	10,670	24%
Developed Land	5,593	12%
Surface Water	1,311	3%

Sources: (USGS, 2012d) (U.S. Census Bureau, 2015s)

Forest and Woodland

Forest and woodland areas occur throughout Pennsylvania and are interspersed with agricultural and developed areas. The Allegheny Plateau, located in the northern and western portions of the state, is dominated by forest and woodland areas comprised of mixed hardwood and softwood species common to the Mid-Atlantic and Northeast regions (USGS, 2012d). Most forest and woodland areas throughout Pennsylvania are privately owned (approximately 70 percent), and approximately 13 percent are publicly owned through the state forest system, comprised of approximately 2.2 million acres of forest and woodland areas managed by the Pennsylvania DCNR Bureau of Forestry (Pennsylvania DCNR, 2015z).

National Forests

The Allegheny National Forest is the only National Forest in Pennsylvania and is located in the northwestern portion of the state. It is over 500,000 acres in size with some disconnected tracts of land located across four counties. The Allegheny River flows in the National Forest to the Kinzua Dam, forming the Allegheny Reservoir. The forest is comprised of mixed pine-hardwood forest types, and is managed for multiple uses, including oil and gas, timber production, and various types of recreation activities (e.g., camping, hiking, boating, all-terrain vehicle use, scenic driving, and winter sports). The Allegheny National Forest is located near the Kinzua Bridge State Park in Pennsylvania and the Allegheny State Park in New York. Together, these resources offer a mix of ATV, biking, cross-country skiing, hiking, horse, heritage, shopping, snowmobile, and water trails, as well as other recreation opportunities (USFS, 2016).

State Forests

The DCNR Bureau of Forestry manages 20 state forests throughout Pennsylvania, totaling over 2.2 million acres of forest and woodland area. These forests are managed for multiple-use purposes using an ecosystem management approach, including general recreation (e.g., hiking and wildlife viewing), timber production, oil and gas operations, hunting, forest research/educational purposes, watershed protection, and wildlife habitat (Pennsylvania DCNR, 2015z).

Private Forest and Woodland

Approximately 19,539 square miles, or 70 percent, of Pennsylvania's total forestland is owned by private landowners (USGS, 2012d). 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, suburban neighborhoods, and state forests. For additional information regarding forest and woodland areas, see Section 12.6, Vegetation and Section 12.11, Visual Resources.

Agricultural Land

Agricultural land exists in every region of the state, with the largest concentrations in southeast Pennsylvania and the Lake Erie region (Figure 12.1.7-1). Approximately 24 percent of the total land area in Pennsylvania is classified as agricultural land (Table 12.1.7-1). In 2012, there were 59,309 farms in Pennsylvania and about 88 percent were owned and operated by small, family businesses, with the average farm size of 130 acres. Some of the state's largest agricultural uses include dairy, hay, corn, soybeans, and apples (USDA, 2012). Access the USDA Census of Agriculture website http://www.agcensus.usda.gov/Publications/2012/Full_Report/Census_by_State/Pennsylvania/ for more information by county.

Developed Land

Developed land in Pennsylvania tends to be concentrated within major metropolitan areas and surrounding cities, towns, and suburbs (Figure 12.1.7-1). Approximately 12 percent of Pennsylvania’s land area is developed. These developed areas are highly utilized for residential, commercial, industrial, recreational, and government purposes. Table 12.1.7-2 lists the top five developed metropolitan areas within the state and their associated population estimates, and Figure 12.1.7-1 shows where these areas are located within the developed land use category.

Table 12.1.7-2: Top Five Developed Metropolitan Areas

Metropolitan Area	Population Estimate
Philadelphia (PA/NJ/DE/MD)	3,760,387
Pittsburgh	1,733,853
Allentown (PA/NJ)	632,208
Harrisburg	444,474
Lancaster	402,004
Total Population of Metropolitan Areas	6,972,926
Total State Population	12,787,209

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

Land Ownership

Land ownership within Pennsylvania has been classified into four main categories: private, federal, state, and tribal (Figure 12.1.7-2).

Private Land

The majority of land in Pennsylvania is privately owned, with most of this land falling under the land use categories of agricultural, forest and woodland, and developed (Figure 12.1.7-2). Highly developed, urban, metropolitan areas transition into suburban, agriculture, shrub, and woodland areas, which then transition into more wild and remote areas. Private land exists in all regions of the state.[133]

Federal Land

The federal government manages 1,079.9 square miles (less than one percent) of land in Pennsylvania with a variety of land types and uses, including military bases, national wildlife refuges, national parks, and a national military park (Figure 12.1.7-2) (USGS, 2014e). Three federal agencies manage federal lands throughout the state (Table 12.1.7-3).

Table 12.1.7-3: Federal Land in Pennsylvania

Agency	Square Miles	Type
Department of Defense (DoD)	197.1	Military Bases and Military Housing
USFWS	16.8	National Wildlife Refuges
National Park Service (NPS)	108.6	National Historical Parks and Sites, National Recreation Area, National Memorials, National Battlefield, National Military Park, and National Heritage Areas
USFS	757.4	National Forest land

Source: (USGS, 2014e)

- The DoD owns and manages approximately 197 square miles used for military bases and military housing (DOD, 2014);
- The USFWS owns and manages approximately 16.8 square miles consisting of three National Wildlife Refuges in Pennsylvania (USFWS, 2011d) (USFWS, 2013b) (USFWS, 2015b);
- The USFS manages approximately 757.4 square miles of national forest land; and
- The NPS manages 108.6 square miles including 18[134] officially designated National Parks, 27 NNLs, and 167 national historic landmarks (NHLs (NPS, 2015k) (NPS, 2014e).

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

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

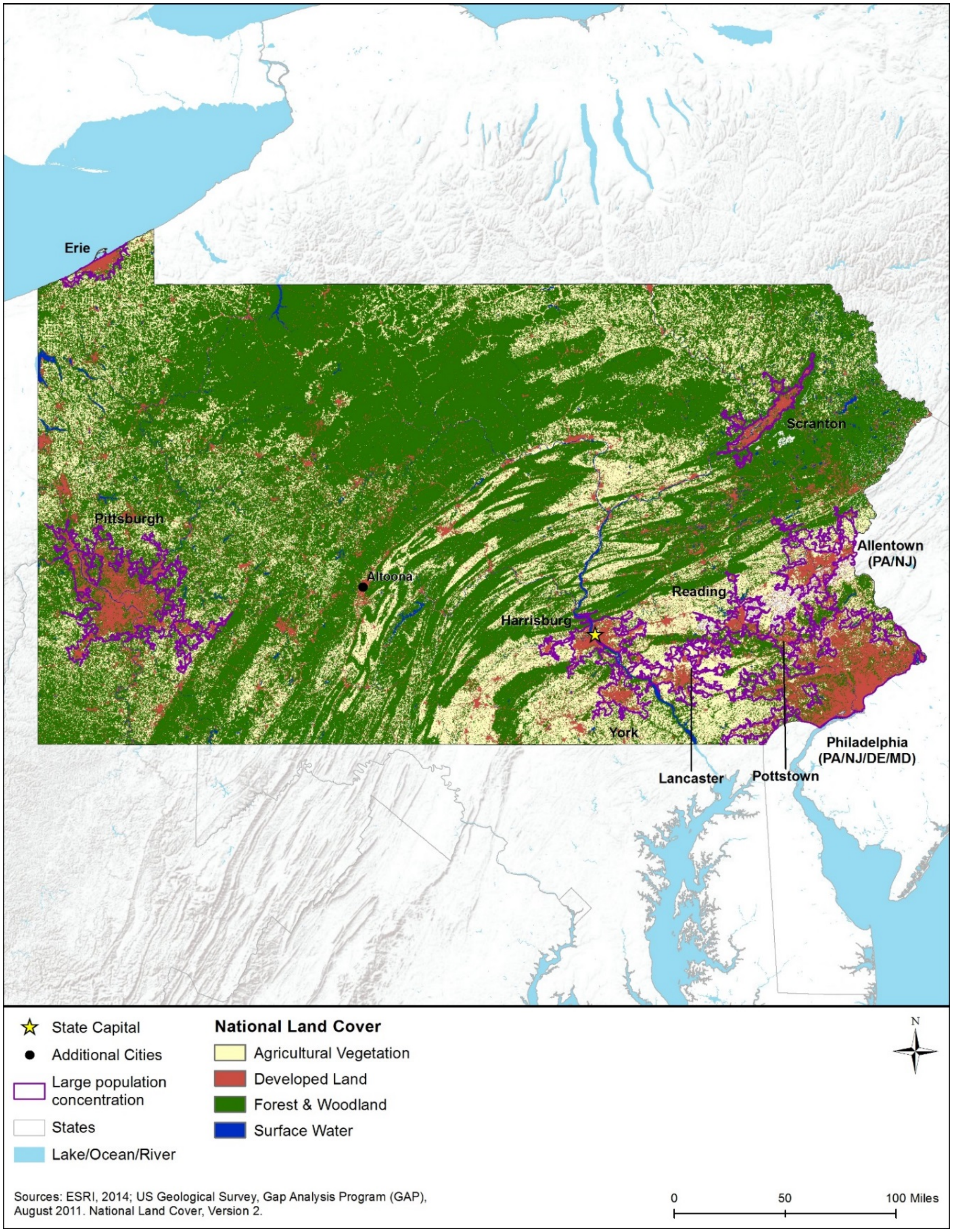


Figure 12.1.7-1: Land Use Distribution

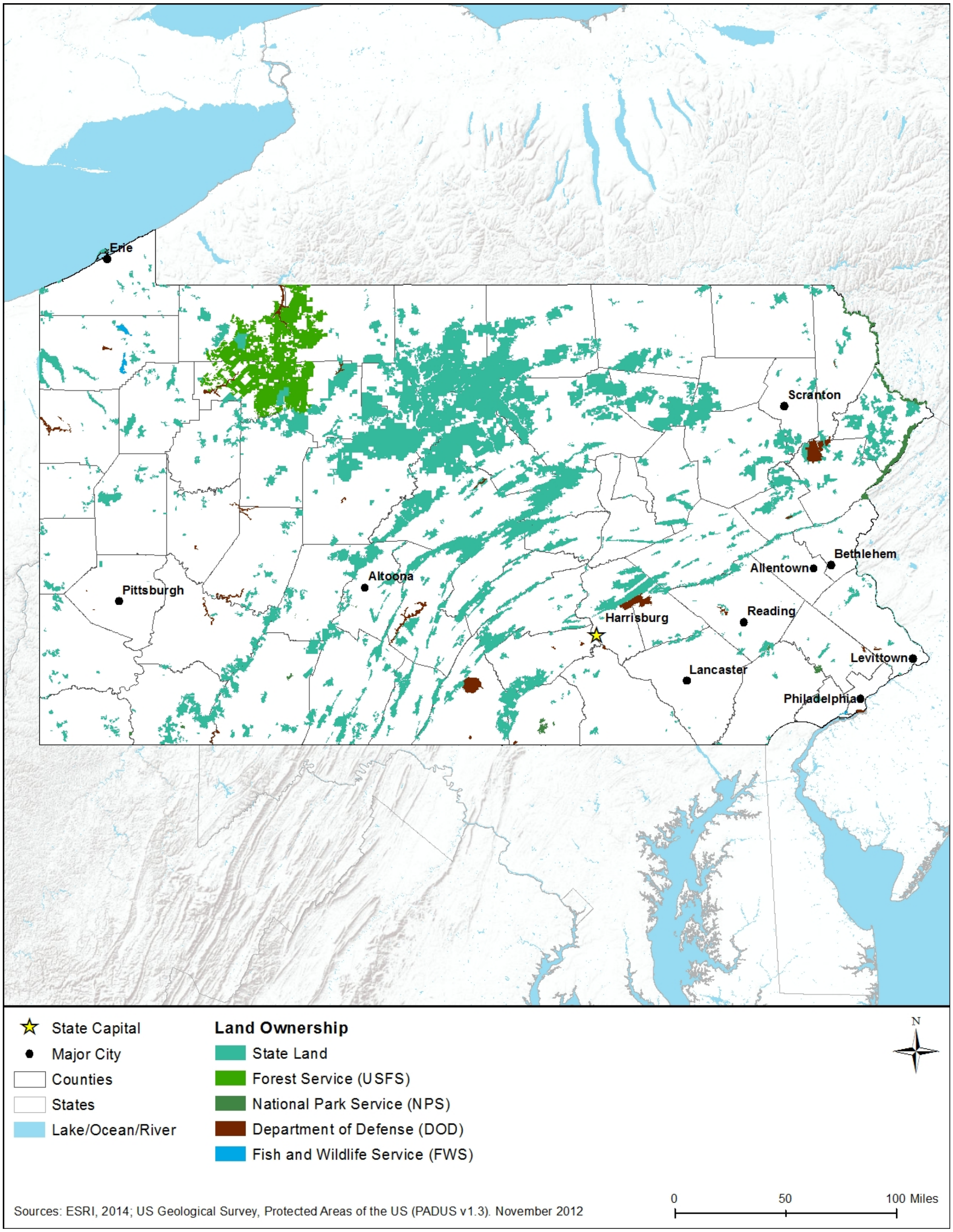


Figure 12.1.7-2: Land Ownership Distribution

State Land

The Pennsylvania state government owns and manages approximately 6,224 square miles of land (Table 12.1.7-4). This land is comprised of State Forests, State Parks, Wildlife Management Areas, Wildlife Conservation Easements, Access Areas, Wildlife Sanctuaries, and Recreation Areas (Pennsylvania DCNR, 2015z) (PGC, 2015a).

Table 12.1.7-4: State Land in Pennsylvania

Agency	Square Miles	Representative Type
DCNR Bureau of Forestry	3,438	State Forests
PGC	2,344	State Game Lands
DCNR Bureau of State Parks	442	State Parks
Total	6,224	NA

Sources: (Pennsylvania DCNR, 2015z) (PGC, 2015a)

- The DCNR Bureau of Forestry manages 20 state forests, totaling 3,438 square miles.
- The PGC manages state game lands and other wildlife areas, totaling 2,344 square miles.
- The DCNR Bureau of State Parks manages over 120 State Parks, including campgrounds, cabins, and hiking trails.

Tribal Land

There are no Native American tribes with present-day lands or reservations currently located in Pennsylvania. However, some Native American tribes in other geographic areas may have a historic connection or interest in Pennsylvania (see Section 12.1.11, Cultural Resources).

12.1.7.4. Recreation

Pennsylvania is relatively small in size with densely populated areas interspersed throughout the state. Lake Erie is a small portion of the northern border, the Appalachian Mountains run through the center, and the Delaware River makes up the eastern border of the state. On the community level, towns, cities, and counties provide an assortment of indoor and outdoor recreational facilities, including athletic fields and courts, playgrounds, picnicking areas, and public lakes (Figure 12.1.7-3).

This section discusses recreational opportunities available at various locations throughout Pennsylvania. For information on visual resources, see Section 12.11, Visual Resources, and for information on the historical significance of locations, see Section 12.14, Cultural Resources.

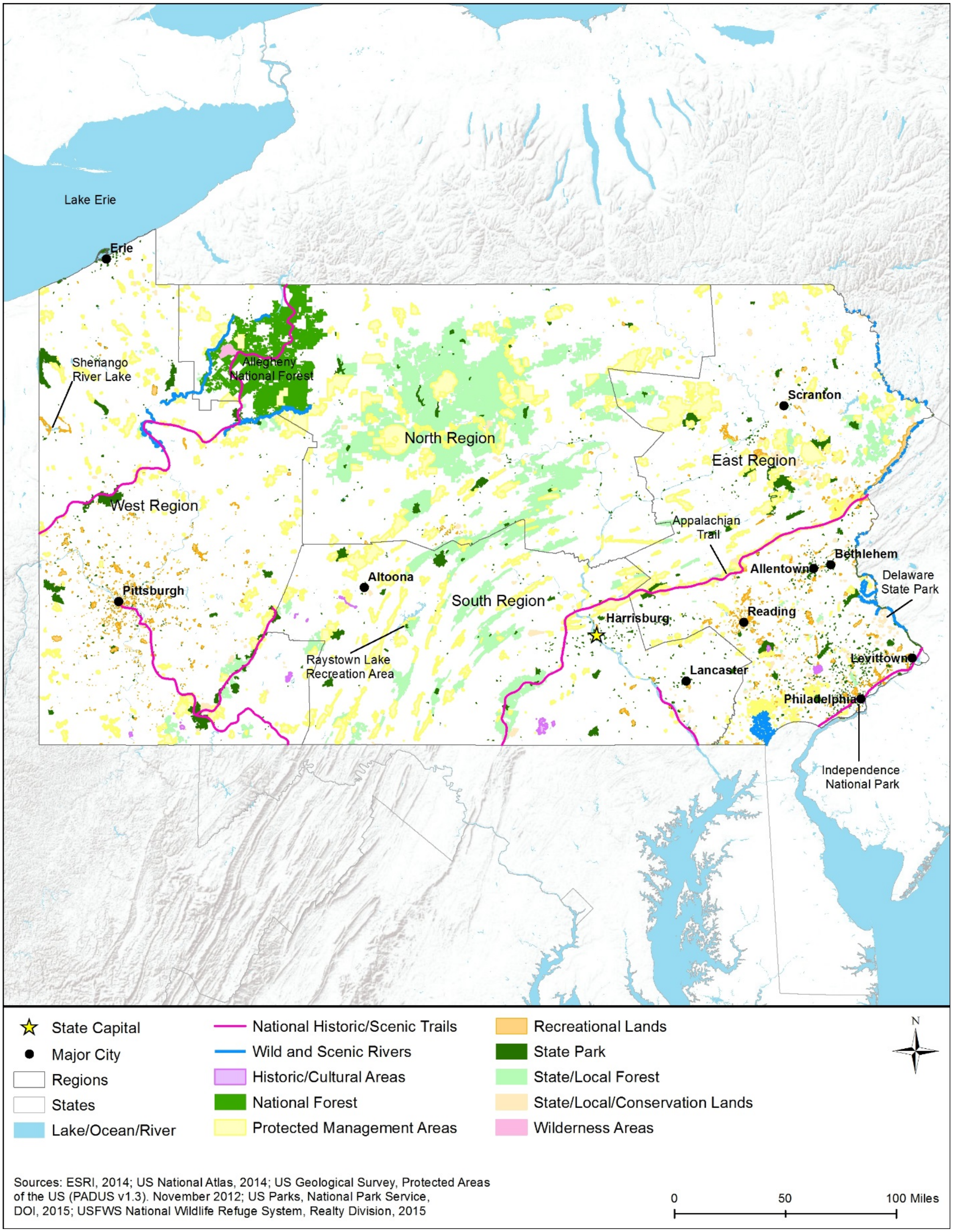


Figure 12.1.7-3: Pennsylvania Recreation Resources

West Region

The west region borders both Lake Erie and Ohio, and contains the Laurel Highlands and other parts of the Alleghany Mountain Range. The region is visited for its hiking, fishing, bicycling, and leaf peeping.

Pennsylvania's short boundary with Lake Erie is dotted with beaches, marinas, and boat ramps catering to water recreation; boating and fishing are popular activities (Pennsylvania Fish and Boat Commission, 2015b). The Shenango River Lake is a designated recreation area shared with Ohio, with boating, swimming, camping, picnicking, licensed fishing, and an area run by the PGC for wildlife protection and seasonal hunting (USACE, 2015b).

Pennsylvania has both northern and southern deciduous trees, making the area popular for leaf peeping. Notable locations in the west region include Ryerson, Hillman, Raccoon Creek, and McConnells Mill State Parks (Pennsylvania DCNR, 2015q).

North Region

Pennsylvania's north region includes the area known as the “Pennsylvania Wilds,” named for the wildlife and forested wilderness found within the area. Outdoor activities are popular within the region, which has many hiking trails and areas for wildlife viewing and seasonal hunting (Get Outdoors Pennsylvania, 2015).

The Allegheny National Forest occupies the northeastern corner of this region. Recreation within the forest includes camping, hiking, bicycling, ATV riding, horseback riding, and licensed fishing and hunting. Allegheny and Clarion Wild and Scenic Rivers, the Allegheny National Recreation Area containing the Kinzua Dam and Allegheny Reservoir, and other streams and lakes have boating, scuba diving, swimming, tubing, waterskiing, and windsurfing. Winter activities within the park include snowmobiling, cross-country skiing, and snowshoeing (USFS, 2015b). The Elk, Sproul, and Tioga State Forests have featured beginner and advanced hiking, mountain biking, equestrian, cross-country skiing, and snowmobile trails; picnic areas; campgrounds; boating; and seasonal permitted hunting and fishing (Pennsylvania DCNR, 2015p) (Pennsylvania DCNR, 2015s) (Pennsylvania DCNR, 2015u).

South Region

Pennsylvania's south region is comprised of farmland and the foothills of the Appalachian Mountains. The region is known for fishing and hunting locations as well as locations visited for their significance during the Civil War.

The Appalachian Trail cuts through Pennsylvania's south and east regions, the 229 miles is characterized as long, flat, and rocky ridges easiest in the southern portion of the state (Appalachian Trail Conservancy, 2015). The Gettysburg National Military Park is one of the areas in Pennsylvania that commemorates Civil War history; the park includes a Visitor's Center, the Soldiers' National Cemetery, campgrounds, and horseback riding trails (NPS, 2015n).

Raystown Lake Recreation Area is designed as a multi-purpose area. Containing the largest lake entirely in Pennsylvania, the lake is a popular location for fishing and boating; areas surrounding the lake are known for hiking, hunting, camping, and mountain bicycling (USACE, 2015a).

East Region

Eastern Pennsylvania, bordered by the Catskills and New Jersey, is characterized by the Pocono Mountains, Pennsylvania Dutch Country, and the Philadelphia metro area. Recreation in the area include fishing, hiking, and historic sight-seeing.

Characteristic of the Pocono Region, the Delaware State Park has glacial lakes, ponds, and bogs with fishing and boating. Trails are designated for hiking, horseback riding, mountain biking, ATVs, snowshoeing, and cross-country skiing (Pennsylvania DCNR, 2015o).

Independence National Park in Philadelphia contains Independence Hall, the Liberty Bell, and other buildings with historical significance from the time of the American Revolution; buildings are open for tours and reenactments provide visitors a glimpse into history (NPS, 2015o).

12.1.7.5. 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.

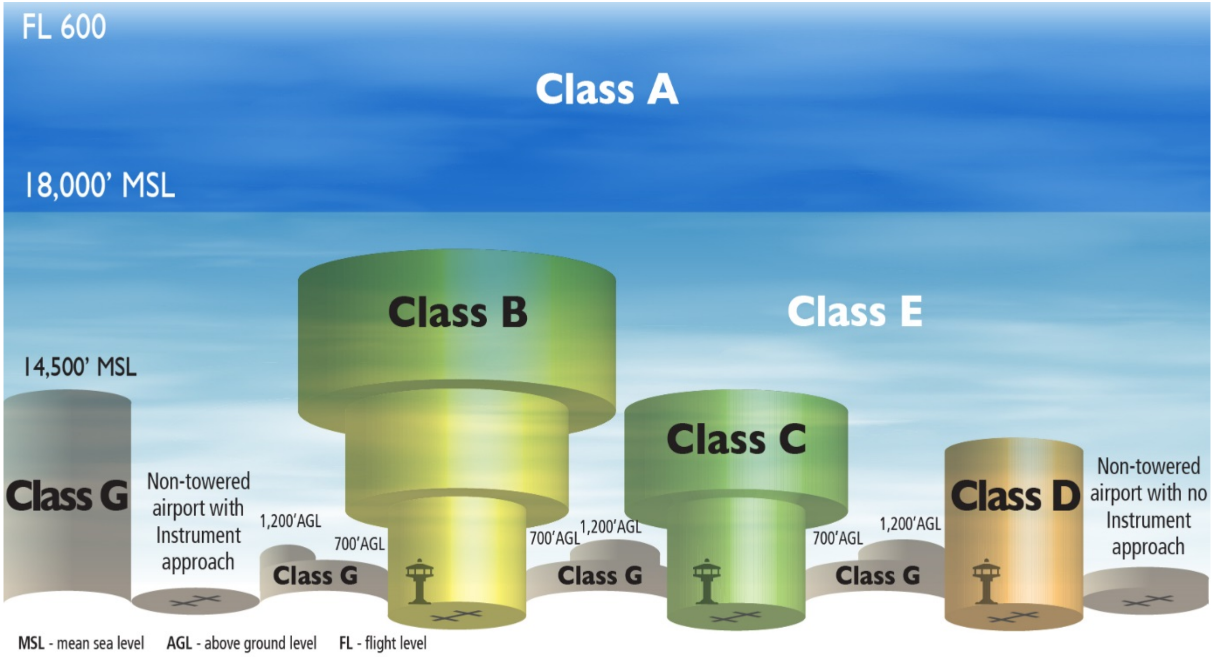
12.1.7.6. Airspace Categories

There are two categories of airspace or airspace areas.

- **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.
- **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 12.1.7-4 depicts the different classifications and dimensions for controlled airspace. Air Traffic Control (ATC)[135] service is based on the airspace classification." (FAA, 2008).

[135] ATC: Approved authority service to provide safe, orderly and expeditious flow of air traffic operations. (FAA, Federal Aviation Administration Aeronautical Information Manual, 2014)



Source: Derived from (FAA, 2008)

Figure 12.1.7-4: National Air Space Classification Profile

Controlled Airspace

- **Class A:** Airspace from 18,000 feet to 60,000 feet Mean Sea Level (MSL)[136]. 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).[137]
- **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.

[136] 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." (Sea Level 2015)
[137] IFR: Rules for the conduct of flights under instrument meteorological conditions. (FAA, 2015a)

- **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 (Table 12.1.7-5).

Table 12.1.7-5: 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 FR 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 FR 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 99.7. Regulatory prohibitions are issued by System Operations, System Operations Airspace and Aeronautical Information Manual (AIM)

SUA Type	Definition
	Office, Airspace and Rules, and disseminated via Notices to Airmen (NOTAM). Inquiries about NSAs should be directed to Airspace and Rules."

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

Other Airspace Areas

Other airspace areas, explained in Table 12.1.7-6, include Airport Advisory, Military Training Routes (MTRs), Temporary Flight Restrictions (TFRs), Parachute Jump Aircraft Operations, published Visual Flight Rules (VFR) and IFRs, and Terminal Radar Service Areas.

Table 12.1.7-6: Other Airspace Designations

Type	Definition
Airport Advisory	There are 3 types: • Local Airport Advisory – Operated within 10 statute 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 in the State of Hawaii declared national disasters for humanitarian reasons. Only those TFRs annotated with an ending date and time of "permanent" are included in this Draft PEIS, since it indicates a longer, standing condition of the airspace. Other TFRs are typically a shorter duration of for a one-time specific event.
Parachute Jump Aircraft Operations	Parachute jump area procedures are in 14 CFR Part 105, while the U.S. parachute jump areas are contained in the regional Airport/Facility Directory.
Published VFRs and IRs	These are established routes for moving around and through complex airspace, like Class B airspace. VFRs are procedures used to conduct flights under visual conditions. IFRs are procedures used to conduct flights with instruments and meteorological conditions.
Terminal Radar Service Areas	Airspace areas that are not one of the established U.S. airspace classes. These areas provide additional radar services to pilots.

Sources: (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 First Edition).

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, 2015h)

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.

Pennsylvania Airspace

The PennDOT Bureau of Aviation manages programs associated with ensuring the effective operation and development of the state's airports. The Bureau of Aviation's responsibilities are similar to those airport planning responsibilities of the FAA. PennDOT and the Bureau of Aviation work with other organizations, such as the Aviation Council of Pennsylvania, to balance the needs of airports and meeting national and state airport system goals (PennDOT, 2015b) (PennDOT, 2011). There are four FAA FSDO for Pennsylvania located at Allentown, New Cumberland, Philadelphia, and Pittsburgh (FAA, 2015f).

Pennsylvania airports are classified as those included in the State Aviation System Plan (SASP) and those that are not part of the SASP. The SASP addresses the strategic planning and future development for the state's airport system, as well as addressing key issues associated with their airports (National Association of State Aviation Officials, 2015). Figure 12.1.7-5 presents the different aviation airports/facilities located in Pennsylvania, while Figure 12.1.7-6 and Figure 12.1.7-7 present the breakout by public and private airports. There are approximately 806 airports (public and private) within Pennsylvania as presented in Table 12.1.7-7 and Figure 12.1.7-5 through Figure 12.1.7-7 (USDOT, 2015).

Table 12.1.7-7: Type and Number of Pennsylvania Airports/Facilities

Type of Airport or Facility	Public	Private
Airport	120	312
Heliport	6	340
Seaplane	2	6
Ultralight	1	16
Balloonport	0	0
Gliderport	2	1
Total	131	675

Source: (USDOT, 2015)

There are Class B, C, and controlled airports in Pennsylvania as follows:

- Two Class B –
  - Philadelphia International
  - Pittsburgh International
- One Class C –
  - Lehigh Valley International (formerly Allentown-Bethlehem-Easton)
- Fourteen Class D –
  - Beaver County Airport, Beaver Falls

  - Erie International
  - Muir Army Axillary Field, Fort Indiantown Gap
  - Capital City Airport, Harrisburg
  - Harrisburg International
  - Johnstown-Cambria County Airport, Johnstown
  - Lancaster
  - Arnold Palmer Regional Airport, Latrobe
  - Northeast Philadelphia Airport, Philadelphia
  - Allegheny County Airport, Pittsburgh
  - Reading Regional/Carl A. Spaatz Field, Reading
  - University Park
  - Wilkes-Barre/Scranton International
  - Williamsport-Lycoming County Airport, Williamsport (FAA, 2014a)

SUAs in Pennsylvania (i.e., seven restricted and one MOA) are as follows:

- Chambersburg (Restricted)
  - R-5801 – Surface to 4,000 feet MSL
  - R-5803 – Surface to 4,000 feet MSL
- Fort Indiantown Gap (Restricted)
  - R-5802A – 200 feet Above Ground Level (AGL) to 5,000 feet MSL
  - R-5802B – Surface to 13,000 feet MSL
  - R-5802C – 500 feet AGL to, but not including, 17,000 feet MSL
  - R-5802D – 17,000 feet MSL to, but not including, FL 220
  - R-5802E – FL 220 to FL 250
- Duke MOA – 8,000 feet to, but not including, FL 180 (FAA, 2015d)

Figure 12.1.7-8 depicts the SUAs in the state. There is one TFR [32126(3)] located in Maryland that extends into Pennsylvania (FAA, 2015g). MTRs in Pennsylvania, presented in Figure 12.1.7-9, consist of six Slow Routes (800, 806, 807, 808, 822, and 823) and five Visual Routes (704, 705, 707, 708, and 1757).

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, 2014b). Eighteen officially designated National Parks within Pennsylvania have to comply with this agency directive (NPS, 2015h).

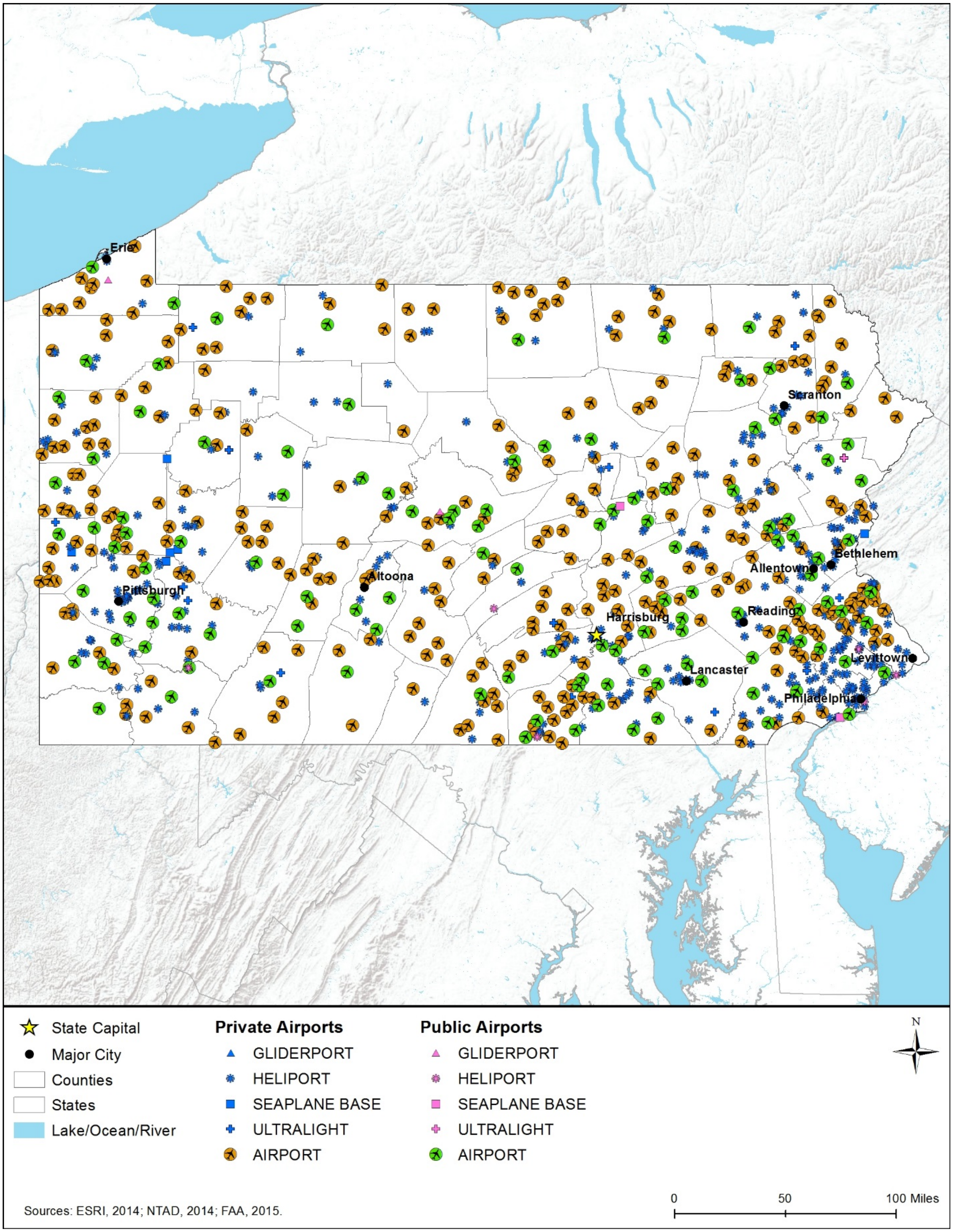


Figure 12.1.7-5: Composite of Pennsylvania Airports/Facilities

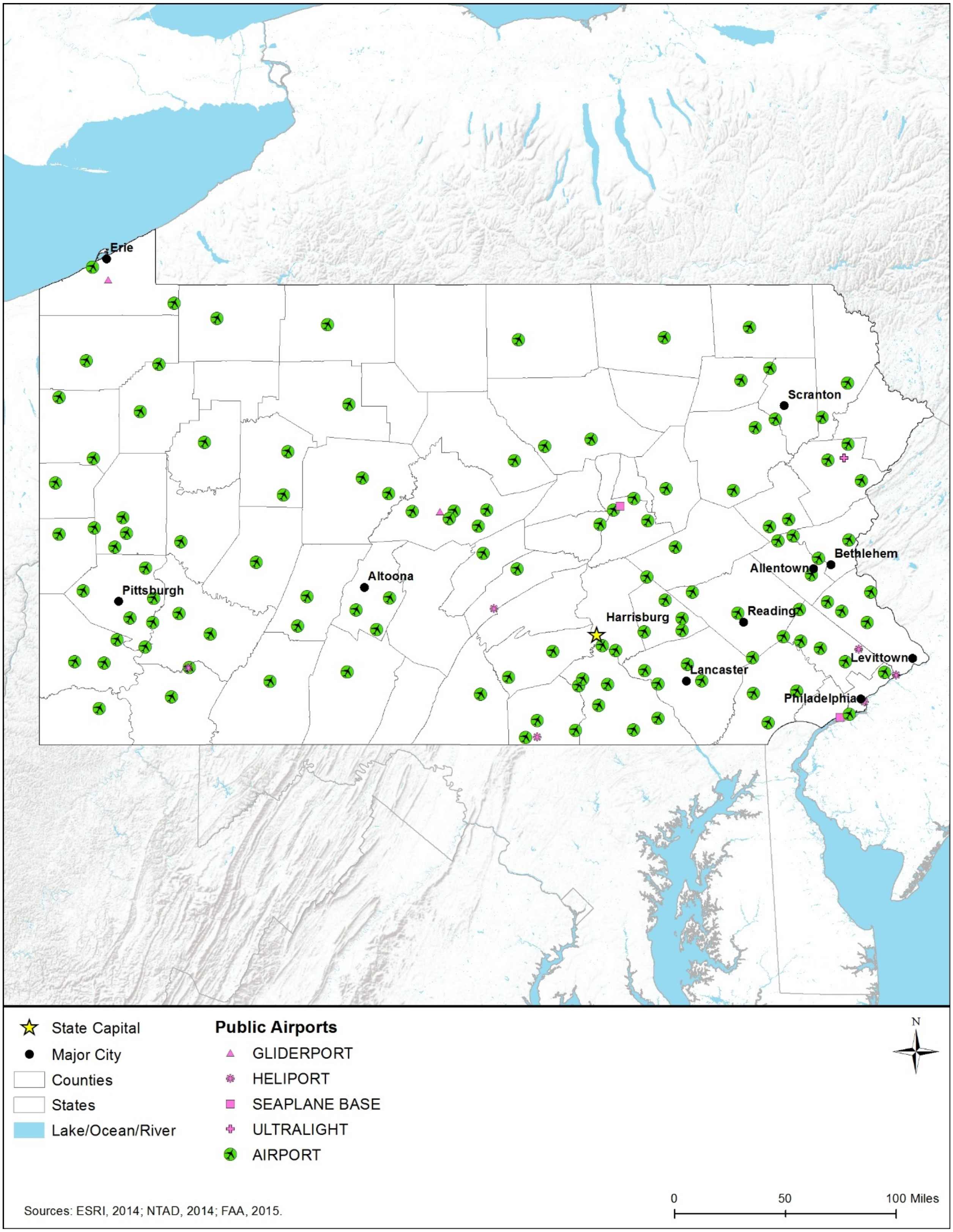


Figure 12.1.7-6: Public Pennsylvania Airports/Facilities

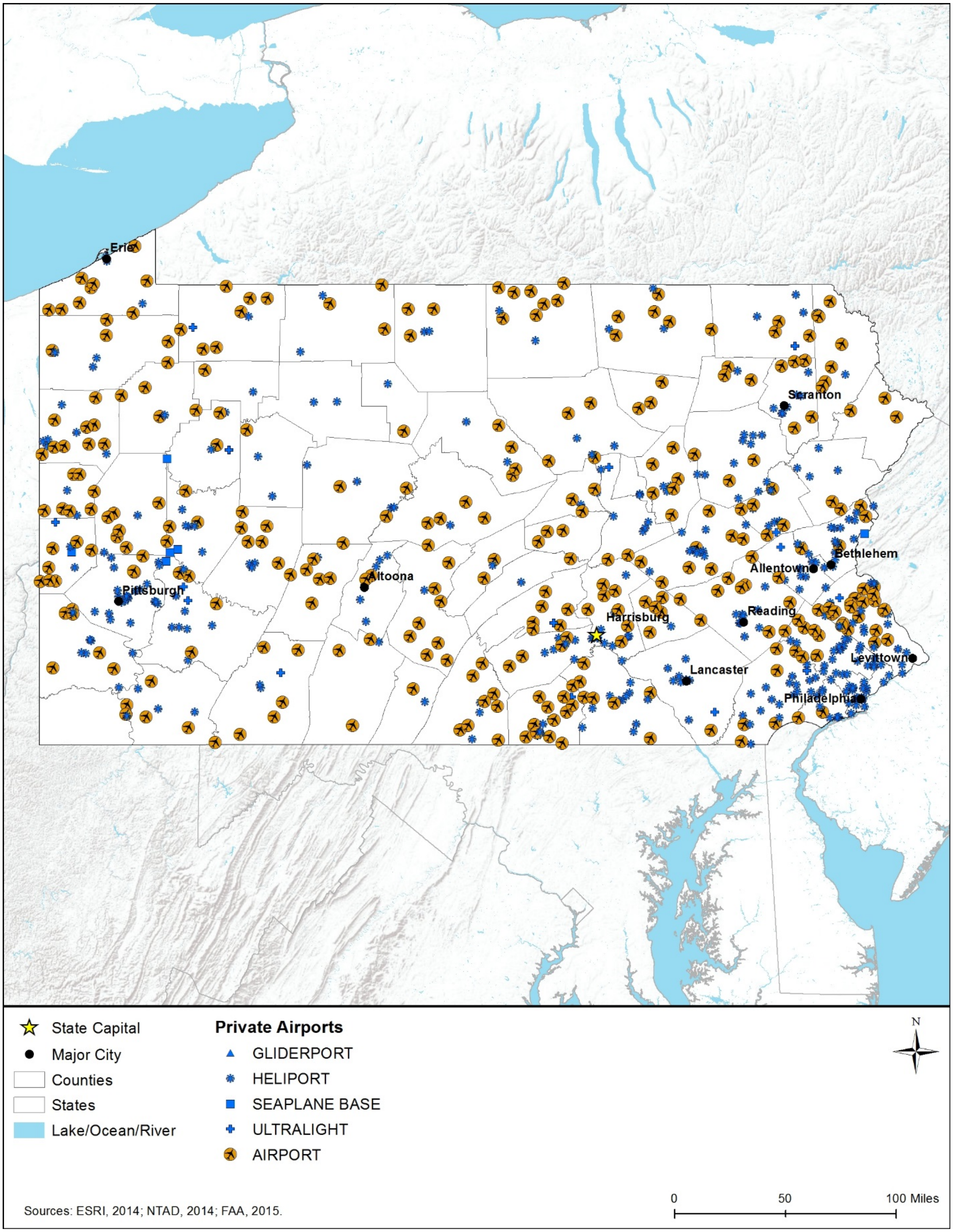


Figure 12.1.7-7: Private Pennsylvania Airports/Facilities

Obstructions to Airspace Considerations

Any proposed construction meeting the criteria of FAA regulations and state laws requires notification to the FAA and state. Pennsylvania CS, Title 74, Chapter 55, § 5501 addresses laws applicable to air navigation. Obstructions to aircraft in and around airports is addressed in Pennsylvania CS, Title 74, Chapter 57, § 5701 (a) & (b) as follows:

- "Obstructions to aircraft within approach area - A person who erects and maintains any smokestack, flag pole, elevated tank, radio station tower, antenna, building, structure, any object of natural growth or other obstruction to the operation of aircraft within an approach area that extends above an inclined plane without first obtaining prior approval thereof from the department commits a summary offense. Each day a violation of this subsection continues constitutes a separate offense.
- Structures in close proximity to airport - A person who erects a new structure or adds to an existing structure in violation of guidelines or regulations adopted by the Federal Aviation Administration of the USDOT, or who erects the structure with respect to the airport without, in either event, first obtaining prior approval from the department, commits a summary offense" (Pennsylvania General Assembly, 2015b).
- Commonwealth of Pennsylvania regulation Title 67, Article IV, Chapter 479 Obstruction to Aircraft, based on Title 74 Pennsylvania CS §§5101-6169, also defines obstructions as the following:
- "§ 479.3. Approach area obstruction.
- (a) A person who erects or maintains a smoke stack, flag pole, elevated tank, radio station tower, antenna, building, structure, object or natural growth or other obstruction to the operation of aircraft within an approach area that extends above an inclined plan, shall first obtain approval from the Department.
- (b) A person who fails to obtain approval from the Department prior to erecting or maintaining an approach area obstruction commits a summary offense under Section 5701(a) of the code (relating to Department approval).
- § 479.4. Airport obstructions.
- (a) A person who plans to erect a new structure, to add to an existing structure or to erect or maintain an object—natural or manmade—as defined in 14 CFR 77.13(a) (relating to construction or alteration requiring notice) shall first obtain approval from the Department by submitting a written notice (Form AV-57) to the Department at least 30 days prior to commencement thereof.
- (b) A person who fails to obtain the approval from the Department prescribed in this section prior to erecting a new structure, adding to an existing structure or erecting or maintaining an object in violation of 14 CFR 77.13(a) commits a summary offense under Section 5701(b) of the code (relating to Department approval)" (FAA, 2015f).

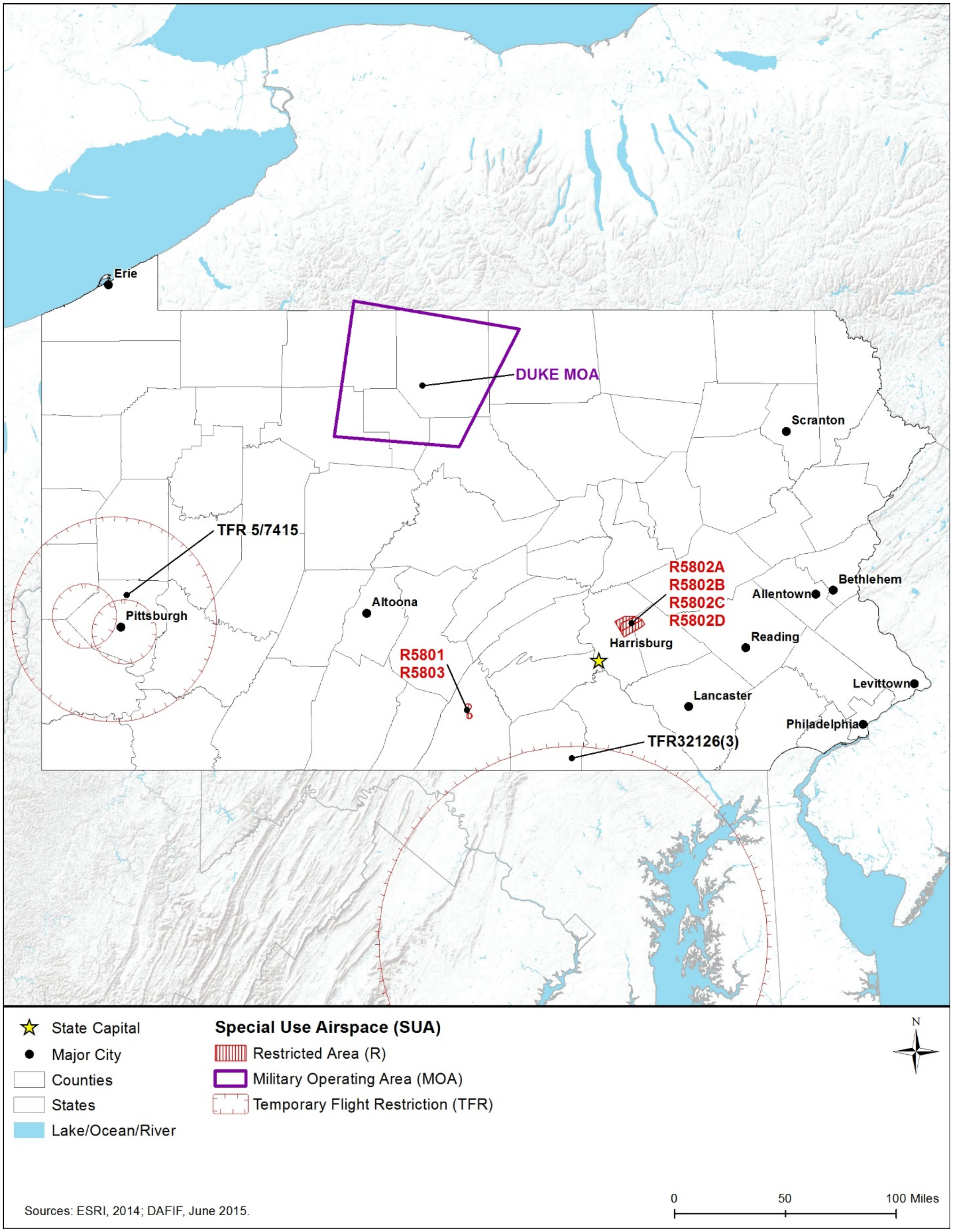


Figure 12.1.7-8: SUAs in Pennsylvania

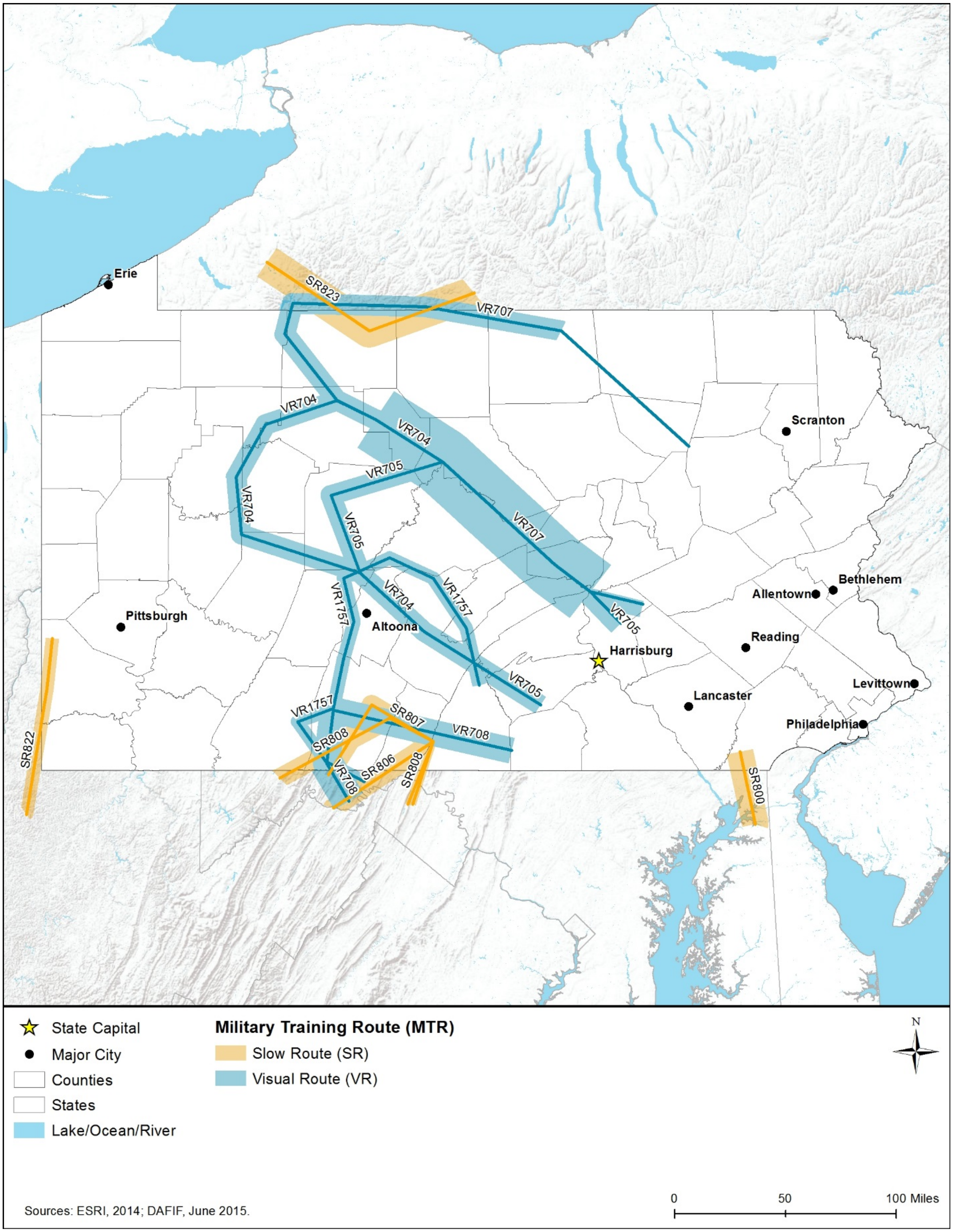


Figure 12.1.7-9: MTRs in Pennsylvania

12.1.8. Visual Resources

12.1.8.1. 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. They are the visible physical features of a landscape and may include mountain ranges, city skylines, ocean views, unique geological formations, rivers, and constructed landmarks such as bridges, memorials, cultural resources, or statues. For some, cityscapes are valued visual resources, whereas others prefer natural areas. 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 NHPA compliance. The flow of the landscape and the lack of interruptions or obstructions within vistas should be considered. 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).

12.1.8.2. Specific Regulatory Considerations

Table 12.1.8-1 presents state laws and regulations that relate to visual resources.

Table 12.1.8-1: Relevant Pennsylvania Visual Resources Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Natural resources and the public estate, Article 1 § 27 of the Constitution of Pennsylvania	Commonwealth of Pennsylvania	Requires the conservation and maintenance of "natural, scenic, historic, and esthetic values of the environment" as part of Pennsylvania's public natural resources, which are "common property to all the people."
Conservation and Natural Resources (Act 18)	DCNR	Implements Article 1 § 27 of the Constitution of Pennsylvania and establishes the Department of Conservation and National Resources to "maintain, improve and preserve state parks," manage forests, provide information on environmental resources, and administer grant and technical program that "benefit rivers conservation, trails and greenways, local recreation, regional heritage conservation and environmental education programs."
Title 37 of the Pennsylvania Consolidated Statute, Historical and Museums (The Pennsylvania History Code)	Commonwealth of Pennsylvania	Assigns the Commonwealth of Pennsylvania the trustee "for the preservation of the historic values of the environment" and entrusts responsibility for the conservation of the state's "historic and natural heritage" to the Pennsylvania Historical and Museum Commission (Commission).
Title 37 of the Constitution of Pennsylvania, Historical and Museums (The Pennsylvania History Code), Chapter 5 § 502(2)	Pennsylvania Historical and Museum Commission (Commission)	Established as a complement to the NHPA to empower the Commission to "compile, maintain, revise and publish" the Pennsylvania Register of Historic Places to include all properties "listed in or eligible for the National Register of Historic Places (NRHP)."

State Law/Regulation	Regulatory Agency	Applicability
Pennsylvania Scenic Rivers Act, Public Law 1277, Act 283 as amended by Act 110	DCNR	Institutes the Pennsylvania Scenic Rivers System to protect the "aesthetic and recreational values" of the scenic rivers and "practice sound conservation policies and practices" with the System.

The Pennsylvania Historical and Museum Commission (Commission) has developed a five-year Historic Preservation Plan that identifies a framework for action and collaboration in preserving the state's "landscapes, including open spaces, historic buildings and structures, farmlands, viewsheds and the distinct characteristics found in communities of all sizes." This Plan also incorporates strategies to ensure preservation at a local level, leveraging state and federal partnerships, bolstering advocacy, identifying, recruiting and engaging new constituents and managing a proactive statewide program (Pennsylvania Historical and Museum Commission, 2015e). Furthermore, the plan recognizes that state residents value the "conservation of natural resources and farmland and the preservation [of the] historic character of their communities" (Pennsylvania Historical and Museum Commission, 2015e).

12.1.8.3. Character and Visual Quality of the Existing Landscape

Pennsylvania's landscape is diverse, ranging from mountainous regions to urban, rural and agricultural (see Figure 12.1.7-1 in Section 12.1.7, Land Use, Recreation, and Airspace). The Appalachian and Allegheny Mountain Ranges traverse the state, Lake Erie borders the northwest coast, and the Delaware Estuary borders the southeast. A mix of high and low plateaus, valleys, uplands, lowlands, and Atlantic coastal plain characterizes the state. The visual resources of the state include gorges, valleys, mountains, waterfalls, old growth forests, wetlands, rock outcrops and boulders. (Pennsylvania DCNR, 2015k).

One aspect of importance for visual resources is to maintain the character of the area. For example, in a farm community, keeping the character of the town consistent with farm-style houses, barns, and silos would be key in maintaining the character of the community. In a more metropolitan area, there may be many different visual styles within each neighborhood, but keeping the character of the neighborhood is important to maintain if new development were to occur. Section 12.1.7 discusses land use and contains further descriptions of land cover within the state.

While the state and many municipalities have some regulation of scenic and visual resources, not all scenic areas within the state have been identified or have policy or regulations for management or protection by the state. The areas listed below have some measure of management, significance, or protection through state or federal policy, as well as being identified as a visually significant area.

12.1.8.4. Visually Important Historic Properties and Cultural Resources

Visual and aesthetic qualities of historic properties can contribute to the overall importance of a particular site. Such qualities relate to the integrity of the appearance and setting of these properties or resources. Viewsheds (the natural and manmade environment visible from one or more viewing points) can also contribute to the significance of historic properties or cultural resources. Viewsheds containing historic properties and cultural resources may be considered important because of their presence in the landscape. Figure 12.1.8-1 shows areas that are included in the NRHP that may be considered visually sensitive. In Pennsylvania, there are 3,377 NRHP listed sites, which include 1 World Heritage Site, 8 National Heritage Areas, 167 NHLs, 5 National Historical Sites, 3 National Historical Parks, 1 National Military Park, 1 National Battlefield, and 3 National Memorials (NPS, 2015i). Some State Historic Sites, State Heritage Areas, and State Historic Districts may also be included in the NRHP, whereas others are not designated at this time. See Section 12.1.11, Cultural Resources, for more information.

The NPS is required to protect all aspects of historic landscapes considered significant, such as forests, gardens, trails, structures, ponds, and farming areas using *The Secretary of the Interior's Standards for the Treatment of Historic Properties and the Guidelines for the Treatment of Cultural Landscapes* (NPS, 2015b). 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, 2015b).

Figure 12.1.8-1: Cultural and Heritage Resources that May Be Visually Sensitive

World Heritage Site

Sites are designated World Heritage sites if they reflect “the world’s cultural and natural diversity of outstanding universal value” (UNESCO, 2015b). To be included on the World Heritage List, sites must meet 1 of 10 criteria reflecting cultural, natural, or artistic significance (UNESCO, 2015c). World Heritage sites are diverse and range from archaeological remains, national parks, islands, buildings, city centers, and cities. The importance of World Heritage-designated properties can be attributed to cultural or natural qualities that may be considered visual resources or are visually sensitive at these sites. In Pennsylvania, Independence Hall in Philadelphia is a designated World Heritage site (Figure 12.1.8-2) (NPS, 2015k).

Figure 12.1.8-2: Independence Hall

Source: (NPS, 2015c)

National Heritage Areas

National Heritage Areas (NHAs) are “places where natural, cultural, and historic resources combine to form a cohesive, nationally important landscape” (NPS, 2011). These areas help tell the history of the U.S. Pennsylvania has eight National Heritage Areas (Table 12.1.8-2) (NPS, 2015e). Four of these are also recognized State Heritage Areas. The Delaware & Lehigh National Heritage Corridor consists of 165 miles that articulate the region’s history in the lumber, coal, slate, iron, and steel industries in the towns and cities along the corridor (NPS, 2015e).

Table 12.1.8-2: National Heritage Areas

National Heritage Area Name	
Crossroads of the American Revolution	Oil Region National Heritage Area*
Delaware & Lehigh National Heritage Corridor*	Path of Progress
Journey Through Hallowed Ground	Rivers of Steel National Heritage Area*
Lackawanna Heritage Valley	Schuylkill River National & State Heritage Area*

Source: (NPS, 2015e)

*Also designated State Heritage Areas.

NHLs

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, 2015g). 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. In Pennsylvania, there are 167 NHLs, including sites such as the Edgar Allen Poe House, Valley Forge, Fallingwater, and the Delaware Canal (NPS, 2015l). The majority of NHLs are located in Philadelphia; by comparison, there are over 2,500 NHLs in the U.S.

State Heritage Areas

The Pennsylvania Heritage Areas Program was established to "conserve and enhance" heritage areas and promote the state's heritage for tourism development. The Program has five goals including: "economic development, partnerships, cultural conservation, recreation and open space, and education and interpretation" (Pennsylvania DCNR, 2015i). Pennsylvania State Heritage Areas are likely to contain scenic or aesthetic components that may be considered visual resources or visually sensitive. There are 12 designated heritage areas throughout the state from rural and urban areas to mountains and rivers (Table 12.1.8-3) (Pennsylvania DCNR, 2015i). Examples of heritage areas include the Endless Mountains Heritage Region, Lumber Heritage Region, and Lincoln Highway Heritage Corridor. For additional information regarding these properties and resources, see Section 12.14, Cultural Resources. In addition, the Pennsylvania DCNR maintains an online map and information on all State Heritage Areas (Pennsylvania DCNR, 2015g).

Table 12.1.8-3: State Heritage Areas

State Heritage Area Name	
Allegheny Ridge Heritage Area	National Road Heritage Corridor
Delaware & Lehigh National Heritage Corridor	Oil Region National Heritage Area
Endless Mountains Heritage Region	PA Route 6 Heritage Corridor
Lackawanna Heritage Valley	Rivers of Steel National Heritage Area
Lincoln Highway Heritage Corridor	Schuylkill River National & State Heritage Area
Lumber Heritage Region	Susquehanna Gateway Heritage Area

Source: (Pennsylvania DCNR, 2015g)

12.1.8.5. Parks and Recreation Areas

Parks and recreation areas include State Parks, National Recreation Areas, National Scenic and Recreational Rivers, State Scenic and Recreational Rivers, State Forests and National and State Trails. Parks and recreation areas often contain scenic resources and tend to be visited partly because of their associated visual or aesthetic qualities. Figure 12.1.7-3 in Section 12.1.7, Land Use, Recreation, and Airspace, identifies parks and recreational resources that may be visually sensitive in Pennsylvania.

State Parks and Forests

State parks contain natural, historic, cultural, and/or recreational resources of significance to Pennsylvania residents and visitors. There are 120 state parks throughout Pennsylvania, most of which likely contain scenic or aesthetic areas considered to be visual resources or visually sensitive (Pennsylvania DCNR, 2015a). Table 12.1.8-4 contains a sampling of state parks and their associated visual attributes, such as Worlds End State Park (see Figure 12.1.8-3 for these parks on the map). For a complete list of state parks, visit the Pennsylvania DCNR website (Pennsylvania DCNR, 2015d).

Table 12.1.8-4: Examples of Pennsylvania State Parks and Associated Visual Attributes

State Park	Visual Attributes
Lehigh Gorge State Park	River, thick vegetation, gorge, rock outcroppings, waterfalls, abandoned railroad grade, USACE Francis E. Walter Dam, Jim Thorpe (town), remnants of the Lehigh Canal
Memorial Lake State Park	Views of Blue Mountain, views of Memorial Lake, Indiantown Run stream, shoreline, hardwood forests
Susquehannock State Park	Views of the Conowingo Reservoir, panoramic views of the Susquehanna River, views of Mountain Johnson Island, cliffs, rocky riverbed, overlooks, old homestead site remnants
Worlds End State Park	S-shaped valley, creek, views of Endless Mountains, mountain stream, state forest land

Source: (Pennsylvania DCNR, 2015d)

In addition to state parks, Pennsylvania also has 20 state forest districts showcasing a multitude of landscapes including whitewater rivers, waterfalls, mountains, plateaus, and creeks (Pennsylvania DCNR, 2015l). Table 12.1.8-5 contains a list of Pennsylvania State Forest Districts.

Table 12.1.8-5: Pennsylvania State Forest Districts

State Forest Name	
Bald Eagle	Moshanna
Buchanan	Pinchot
Clear Creek	Rothrock
Cornplanter	Sproul
Delaware	Susquehannock
Elk	Tiadaghton
Forbes	Tioga
Gallitzin	Tuscarora
Loyalsock	Weiser
Michaux	William Penn

Source: (Pennsylvania DCNR, 2015l)

U.S. National Park System and National Forests

National Parks are managed by the NPS and contain natural, historic, cultural, visual, ecological, and recreational resources of significance to the nation and are maintained for the public's use.

In Pennsylvania, there are 18[138] officially designated National Parks in addition to other NPS affiliated areas, such as National Heritage Areas. There are 3 National Historical Parks, 1 National Military Park, 1 National Battlefield, 9 National Historic Sites, 3 National Memorials, 1 National Historic Trails, 3 National Scenic Trails (NST), 1 National Recreation Area, and 3 National Heritage Areas. These parks are generally larger in size and complexity than sites (NPS, 2003). These sites, parks, and battlefields may contain aesthetic and scenic values associated with history. Locations of the above are identified on the map in Figure 12.1.8-3. Table 12.1.8-6 identifies the National Parks and affiliated areas located in Pennsylvania. For additional information regarding parks and recreation areas, see Section 12.10, Land Use, Recreation, and Airspace.

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

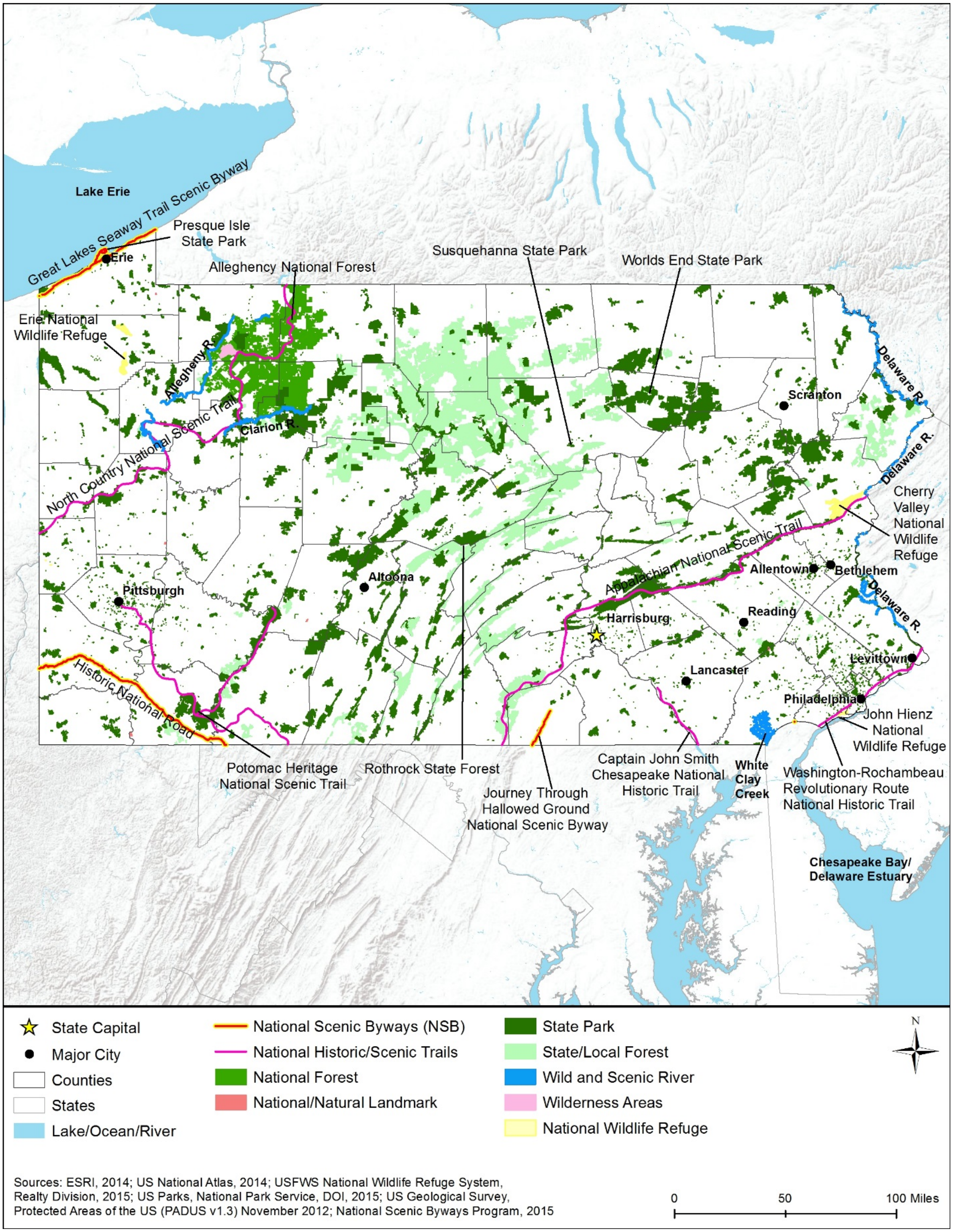


Figure 12.1.8-3: Natural Areas that May Be Visually Sensitive

Figure 12.1.8-4: Worlds End State Park

Source: (Pennsylvania DCNR, 2015n)

Figure 12.1.8-5: Allegheny National Park

Source: (Allegheny National Forest Visitors Bureau, 2015)

Table 12.1.8-6: Pennsylvania NPS Areas

Area Name	
Allegheny Portage Railroad National Historic Site	Gettysburg National Military Park
Appalachian National Scenic Trail	Gloria Dei Church National Historic Site
Captain John Smith Chesapeake National Historic Trail	Johnstown Flood National Memorial
Delaware & Lehigh National Heritage Corridor	North Country National Scenic Trail
Delaware Water Gap National Recreation Area	Oil Region National Heritage Area
Edgar Allen Poe National Historic Site	Potomac Heritage National Scenic Trail
Eisenhower National Historic Site	Rivers of Steel National Heritage Area
Hopewell Furnace National Historic Site	Schuylkill River Valley National & State Heritage Area

Area Name	
Allegheny Portage Railroad National Historic Site	Gettysburg National Military Park
Independence National Historical Park	Steamtown National Historic Site
First State National Historical Park	Thaddeus Kosciuszko National Memorial
Flight 93 National Memorial	Valley Forge National Historical Park
Fort Necessity National Battlefield	Washington-Rochambeau National Historic Trail
Friendship Hill National Historic Site	

Source: (NPS, 2015k)

State Historic Sites, Resources and Parks

The Pennsylvania Historical and Museum Commission lists 23 sites, museums, and parks under its purview. The two Historic Parks include Washington Crossing Historic Park commemorating the location where George Washington traversed the Delaware River during the American Revolution, and Somerset Historical Center, which "interprets the rural life of Southwestern Pennsylvania." Other sites and museums include the Erie Maritime Museum & Flagship Niagara, Railroad Museum of Pennsylvania, Graeme Park and Old Economy Village. (Pennsylvania Historical and Museum Commission, 2015z)

State and Federal Trails

State-designated trails include the industrial heritage trail, military history trail, historic homes trail, rural farm and village history trail, as well as greenway trails, hiking trails, and water trails. The Industrial Heritage Trail is associated with the “iron, coal, oil and lumber workers [who] built businesses and communities that left legacies on the trail” (Pennsylvania Historical and Museum Commission, 2015c). The Military History Trail follows the paths of Revolutionary War heroes and link sites with military significance across the state (Pennsylvania Historical and Museum Commission, 2015d). The Historic Homes Trail includes homes and properties of the state’s past (Pennsylvania Historical and Museum Commission, 2015x). The Rural Farm and Village History Trail follows pastoral landscapes through history (Pennsylvania Historical and Museum Commission, 2015f).

Pennsylvania has six greenway trails, which the state defines as “corridors connecting natural areas” (Pennsylvania DCNR, 2015e). The state has miles of hiking trails that are recreational and provide a variety of terrain and views of the Pennsylvania wilderness (Pennsylvania DCNR, 2015m). Lastly, the state provides recreational water trails for canoes, kayaks, and small-motorized watercraft. These water trails include visual resources that reflect the diversity of geology, ecology and communities in the state (Pennsylvania Fish & Boat Commission, 2015a).

Designated under Section 5 of the National Trails System Act (16 U.S.C. 1241-1251, as amended), NSTs are defined as extended trails that "provide for maximum outdoor recreation potential and for the conservation and enjoyment of the nationally significant scenic, historic, natural, or cultural qualities of the areas though which they pass” (NPS, 2012c). There are four NSTs within Pennsylvania (see Figure 12.1.8-3): Appalachian NST, North Country NST, Potomac Heritage NST, and Washington-Rochambeau NST, all administered by the NPS. The Appalachian NST is a 2,185-mile trail through the Appalachian Mountains. The North Country NST is a 3,200-mile-long trail extending from eastern New York to North Dakota. The Potomac Heritage NST is a network of trails that links the Potomac and Ohio River basins along George Washington's exploratory route. The Washington-Rochambeau Revolutionary Route NST also passes through the state. (NPS, 2014f)

12.1.8.6. 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.

National Forests

The USDA National Forests contain natural, historic, cultural, visual, ecological, and recreational resources of significance to the nation. In Pennsylvania, there is one National Forest: Allegheny National Forest (Allegheny National Forest Visitors Bureau, 2015). Figure 12.1.8-3 displays the forest on the map.

State Forest Preserves and Conservation Areas

Pennsylvania has two state forest preserves and three conservation areas (one of which is a forest preserve). A Pennsylvania Conservation Area is "land donated to the Bureau of State Parks and managed for the purposes of preserving open space, conserving natural resources, and providing opportunities for passive, non-motorized, low density outdoor recreation and environmental education activities" (Pennsylvania DCNR, 2015n). The Pennsylvania DCNR Boyd Big Tree Preserve Conservation Area is comprised of 1,025 acres, the Joseph E. Ibberson Conservation Area is 803 acres, and the Varden Conservation Area is 444 acres (Pennsylvania DCNR, 2015d) White Clay Creek is a 2,072-acre area and possesses "outstanding scenic, wildlife, recreational and cultural value"; it is also a National Wild and Scenic River (Pennsylvania DCNR, 2015m).

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. Four rivers, including the upper, middle and lower portions of the Delaware River (Figure 12.1.8-3), have been designated National Wild and Scenic Rivers in Pennsylvania (see Figure 12.1.8-3) (National Wild and Scenic Rivers System, 2015h). The three other rivers include the Allegheny, Clarion, and White Clay Creek. The Pennsylvania Scenic Rivers Act designates scenic rivers as those that are "wild, scenic, pastoral, recreational and modified recreational" and preserves wild, scenic, and pastoral rivers, in part, for their "aesthetic values" (Pennsylvania DCNR, 2015f).

Figure 12.1.8-6: Upper Delaware River

Source: (National Wild and Scenic Rivers System 2015)

Pennsylvania recognizes 13 rivers as scenic (see Table 12.1.8-7) (Pennsylvania DCNR, 2015).

Table 12.1.8-7: State Scenic Rivers

State Scenic River Name	
Schuylkill River	Bear Run
Stony Creek	Tucquan Creek
Lehigh River	Lower Brandywine
West (Northwest) French Creek	Yellow Breeches Creek
Lick Run	Tulpehocken Creek
Octoraro Creek	Pine Creek
Le Tort Spring Run	

Source: (Pennsylvania DCNR, 2015)

National Wildlife Refuges and State Wildlife Management Areas

National Wildlife Refuges 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, 2015b). There are three National Wildlife Refuges in Pennsylvania (Table 12.1.8-8) including the John Heinz National Wildlife Refuge at Tinicum, an urban refuge within both the Delaware Estuary and the city of Philadelphia (Figure 12.1.8-3). This National Wildlife Refuge is comprised of approximately 1,000 acres of "woods, pond, marsh, and meadow" and is a habitat for species including migratory birds (USFWS, 2015a). Visual resources within the National Wildlife Refuge include water bodies such as marshes, creeks and ponds, fields, mud flats, wildlife and plants.

Table 12.1.8-8: National Wildlife Refuges

National Wildlife Refuge Name	
Cherry Valley National Wildlife Refuge	John Heinz National Wildlife Refuge and Tinicum
Erie National Wildlife Refuge	

Source: (USFWS, 2015b)

The PGC "owns and manages, for wildlife and recreation, nearly 1.5 million acres of state game lands" in the state (PGC, 2013). For additional information on wildlife refuges and management areas, see Section 12.1.6, Biological Resources.

NNLs

NNLs are sites designated by the U.S. Secretary of the Interior that "contain outstanding biological and/or geological resources, regardless of land ownership, and are selected for their outstanding condition, illustrative value, rarity, diversity, and value to science and education" (NPS, 2014a). These landmarks may be considered visual resources or visually sensitive. In Pennsylvania, 27 NNLs exist entirely or partially within the state (Table 12.1.8-9). Some of the natural features located within these areas include Pine Creek Gorge, one of the best examples of a deep gorge; largest "flying spit"[139] in the Great Lakes; and a box huckleberry that is one of the oldest organisms in the world (NPS, 2012a), (Jennings, 2015).

Figure 12.1.8-6: Pine Creek Gorge

Source: (NPS, 2012b)

[139] A large deposit of sand carried by wind and water across a lake.

Table 12.1.8-9: Pennsylvania NNLs

NNL Name	
Bear Meadows Natural Area	Nay Aug Park Gorge and Waterfall
Box Huckleberry Site	Nottingham Park Serpentine Barrens
Cook Forest	Pine Creek Gorge
Ferncliff Peninsula Natural Area	Presque Isle
Ferncliff Wildflower and Wildlife Preserve	Reynolds Spring and Algerine Swamp Bogs
Florence Jones Reineman Wildlife Sanctuary	Snyder-Middleswarth Natural Area
Hawk Mountain Sanctuary	Susquehanna Water Gaps
Hearts Content Scenic Area	Tamarack Swamp
Hemlocks Natural Area	Tannersville Cranberry Bog
Hickory Run Boulder Field	The Glens Natural Area
John Heinz National Wildlife Refuge at Tinicum	Tionesta Scenic and Research Natural Areas
Lake Lacawac	Titus and Wattsburg Bogs
McConnell’s Mill State Park	Wissahickon Valley
Monroe Border Fault	

Source: (NPS, 2015k)

12.1.8.7. Additional Areas

State and National Scenic Byways

National Scenic Byways are resources designated specifically for scenic or aesthetic areas or qualities which would be considered visual resources or visually sensitive. The USDOT, Federal Highway Administration, manages the National Scenic Byways Program (FHWA, 2015e). Pennsylvania has three designated National Scenic Byways: the Great Lakes Seaway Trail (518 miles), the Historic National Road (824 miles), and Journey Through Hallowed Ground Byway (180 miles) (see Figure 12.1.8-3) (FHWA, 2015a).

Similar to National Scenic Byways, Pennsylvania Byways are designated PennDOT byways that "highlight…cultural, historical, recreational, archaeological, scenic and natural qualities." There are 19 State Byways identified in Section 12.1.1.3 (Visit PA, 2015).

Coastal Areas

Pennsylvania coastal areas include 77 miles of Lake Erie shoreline (Figure 12.1.8-3) and 112 miles along the Delaware River Estuary, which are managed by the Pennsylvania DEP to protect these lands from adverse impacts on coastal resources (see Figure 12.1.8-3). Program policies include efforts for the “preservation, restoration and enhancement of coastally significant historic sites and structures within the coastal zone” and to “meet the public need for boating, fishing, walking, picnicking, sightseeing and other recreational pursuits associated with the waterfront.” (Pennsylvania DEP, 2015aa).

Figure 12.1.8-7: Lake Erie Shoreline

Source: (Pennsylvania DCNR, 2015j)

12.1.9. Socioeconomics

12.1.9.1. Definition of the Resource

The NEPA (see Section 1.8) 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.

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 Nationwide Public Safety Broadband Network (NPSBN). This socioeconomics section provides some additional, broad context, including data and discussion of state and local government revenue sources that FirstNet may affect.

Environmental justice is a related topic that specifically addresses the presence of minority populations (defined by race and Hispanic ethnicity) and low-income populations, in order to give special attention to potential impacts on those populations, per Executive Order (EO)12898 (see Section 1.8). This PEIS addresses environmental justice in a separate section (Section 12.1.10). This PEIS also addresses the following topics, sometimes included within socioeconomics, in separate sections: Land Use, Recreation, and Airspace (Section 12.1.7), infrastructure and public services (Section 12.1.1, Infrastructure), and aesthetic considerations (Section 12.1.8, Visual Resources).

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 U.S. 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.

12.1.9.2. 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.

12.1.9.3. Communities and Populations

This section discusses the population and major communities of Pennsylvania (PA). It 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 12.1.9-1 presents the 2014 population and population density of Pennsylvania in comparison to the east region[140] and the nation. The estimated population of Pennsylvania in 2014 was 12,787,209. The population density was 286 persons per square mile (sq. mi.), which is lower than the population density of the region (312 persons/sq. mi.) and higher than the density of the nation (90 persons/sq. mi.). In 2014, Pennsylvania was the sixth largest state by population among the 50 states and the District of Columbia, 32nd largest by land area, and had the 10th greatest population density (U.S. Census Bureau, 2015j; U.S. Census Bureau, 2015s).

Table 12.1.9-1: Land Area, Population, and Population Density of Pennsylvania

Geography	Land Area (sq. mi.)	Estimated Population 2014	Population Density 2014 (persons/sq. mi.)
Pennsylvania	44,743	12,787,209	286
East Region	237,157	73,899,862	312
U.S.	3,531,905	318,857,056	90

Sources: (U.S. Census Bureau, 2015j; U.S. Census Bureau, 2015s)

Population growth is an important subject for this PEIS, given FirstNet's mission. Table 12.1.9-2 presents the population growth trends of Pennsylvania from 2000 to 2014 in comparison to the east region and the nation. The state's annual growth rate decreased by half in the 2010 to 2014 period compared to 2000 to 2010, from 0.34 percent to 0.17 percent. The state showed lower growth rates in both periods compared to the region and nation's growth rates, especially between 2010 and 2014 (0.17 percent compared to 0.50 percent in the region and 0.81 percent in the nation).

Table 12.1.9-2: Recent Population Growth of Pennsylvania

Geography	Estimated Population			Numerical Population Change		Rate of Population Change (AARC)	
	2000	2010	2014	2000 to 2010	2010 to 2014	2000 to 2010	2010 to 2014
Pennsylvania	12,281,054	12,702,379	12,787,209	421,325	84,830	0.34%	0.17%
East Region	69,133,382	72,444,467	73,899,862	3,311,085	1,455,395	0.47%	0.50%
U.S.	281,421,906	308,745,538	318,857,056	27,323,632	10,111,518	0.93%	0.81%

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

[140] The East region comprises 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.

Bureau does not prepare population projections for the states. Therefore, Table 12.1.9-3 presents projections of the 2030 population from two sources that are national in scope and use different methodologies: the University of Virginia's (UVA) 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 that the Pennsylvania's population will increase by approximately 663,000 people, or 5.2 percent, from 2014 to 2030. This reflects an average annual projected growth rate of 0.32 percent, which is higher than the historical growth rate from 2010 to 2014 of 0.17 percent. The projected growth rate of the state is lower than that of the region (0.57 percent) and the nation (0.80 percent).

Table 12.1.9-3: Projected Population Growth of Pennsylvania

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
Pennsylvania	12,787,209	13,167,735	13,732,718	13,450,227	663,018	5.2%	0.32%
Region	73,899,862	78,925,282	82,842,294	80,883,788	6,983,926	9.5%	0.57%
U.S.	318,857,056	360,978,449	363,686,916	362,332,683	43,475,627	13.6%	0.80%

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

Population Distribution and Communities

Figure 12.1.9-1 presents the distribution and relative density of the population of Pennsylvania. 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, 2015i).

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, 2015u). 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. The greatest densities are in the 10 largest population concentrations, particularly in the Pennsylvania portion of Philadelphia area, followed by the Pittsburgh area and the Pennsylvania portion of the Allentown area.

Table 12.1.9-4 provides the populations of the 10 largest population concentrations in Pennsylvania, based on the 2010 census. It also shows the changes in population for these areas between the 2000 and 2010 censuses.[141] In 2010, the largest population concentration by far was the Pennsylvania portion of the Philadelphia area, which had approximately 3.8 million people. The only other population concentration over 1 million was the Pittsburgh area, with approximately 1.7 million people. Pennsylvania had one area with population between 500,000 and 1 million (the Pennsylvania portion of the Allentown area), and seven areas with populations between 100,000 and 500,000. The smallest of these 10 areas was the Pottstown area, with a 2010 population of 107,682. It was also the fastest growing area by average annual rate of change from 2000 to 2010, with an annual growth rate of 3.88 percent. There were five other areas with a growth rate over 1.00 percent. The Pittsburgh and Scranton areas experienced population declines during this period.

Table 12.1.9-4 also shows that the top 10 population concentrations in Pennsylvania accounted for over 60 percent of the state's population in 2010. Further, population growth in the 10 areas from 2000 to 2010 amounted to 121.1 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.

[141] 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.

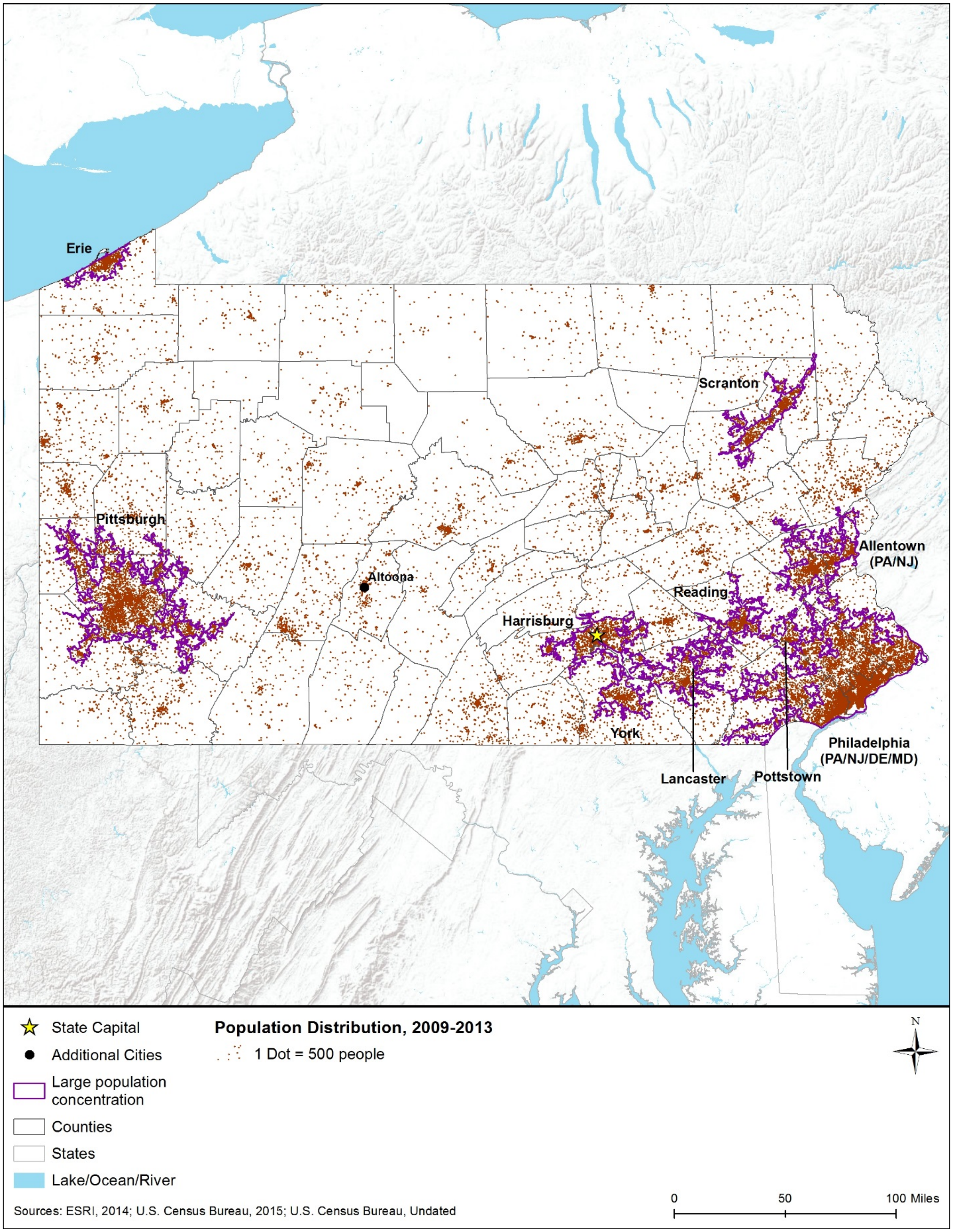


Figure 12.1.9-1: Population Distribution in Pennsylvania, 2009–2013

Table 12.1.9-4: Population of the 10 Largest Population Concentrations in Pennsylvania

Area	Population				Population Change 2000 to 2010	
	2000	2010	2009–2013	Rank in 2010	Numerical Change	Rate (AARC)
Allentown (PA/NJ) (PA Portion)	547,056	632,208	633,553	3	85,152	1.46%
Erie	194,804	196,611	197,088	9	1,807	0.09%
Harrisburg	362,782	444,474	446,230	4	81,692	2.05%
Lancaster	323,554	402,004	405,702	5	78,450	2.19%
Philadelphia (PA/NJ/DE/MD) (PA Portion)	3,573,627	3,760,387	3,779,563	1	186,760	0.51%
Pittsburgh	1,753,136	1,733,853	1,737,712	2	(19,283)	-0.11%
Pottstown	73,597	107,682	107,601	10	34,085	3.88%
Reading	240,264	266,254	266,369	7	25,990	1.03%
Scranton	385,237	381,502	379,775	6	(3,735)	-0.10%
York	192,903	232,045	232,507	8	39,142	1.86%
Total for Top 10 Population Concentrations	7,646,960	8,157,020	8,186,100	NA	510,060	0.65%
Pennsylvania	12,281,054	12,702,379	12,731,381	NA	421,325	0.34%
Top 10 Total as Percentage of State	62.3%	64.2%	64.3%	NA	121.1%	NA

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

12.1.9.4. 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 12.1.1, Infrastructure. Project-level NEPA analyses may need to examine other institutions, depending on specific locations and specific types of actions.

Economic Activity

Table 12.1.9-5 compares several economic indicators for Pennsylvania to the east region and the nation. The table presents two indicators of income[142] – 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 12.1.9-5, the per capita income in Pennsylvania in 2013 ($28,647) was $4,205 lower than that of the region ($32,852), and $463 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 12.1.9-5 shows that in 2013, the MHI in Pennsylvania ($52,005) was $8,499 lower than that of the region ($60,504), and $245 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 12.1.9-5 compares the unemployment rate in Pennsylvania to the east region and the nation. In 2014, Pennsylvania's statewide unemployment rate of 5.8 percent was slightly lower than the rate for the region (6.0 percent) and the nation (6.2 percent).[143]

Table 12.1.9-5: Selected Economic Indicators for Pennsylvania

Geography	Per Capita Income 2013	Median Household Income 2013	Average Annual Unemployment Rate 2014
Pennsylvania	$28,647	$52,005	5.8%
East Region	$32,852	$60,504	6.0%
U.S.	$28,184	$52,250	6.2%

Sources: (BLS, 2015a; U.S. Census Bureau, 2015e; U.S. Census Bureau, 2015h; U.S. Census Bureau, 2015m)

[142] 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, 2015l)

[143] The timeframe for unemployment rates change quarterly.

Figure 12.1.9-2 and Figure 12.1.9-3 show how MHI in 2013 (U.S. Census Bureau, 2015e) and unemployment in 2014 (BLS, 2015a) varied by county across the state. These maps also incorporate the same population concentration data as Figure 12.1.9-1 (U.S. Census Bureau, 2015u). Following these two maps, Table 12.1.9-6 presents MHI and unemployment for the 10 largest population concentrations in the state. The table reflects survey data taken from 2009 to 2013. Thus, its figures are not directly comparable to those on the maps. Nonetheless, both the maps and the table help portray differences in income and unemployment across Pennsylvania.

Figure 12.1.9-2 shows that, in general, Pennsylvania's counties with a MHI above the national median were located in the southeastern portions of the state, plus four other counties across the state (two bordering the Pittsburgh area). Most of the remainder of the state and one county in the Philadelphia area had MHI levels below the national average. Table 12.1.9-6 shows that MHI in most of the southeastern population concentrations was above the state average. MHI was lowest in the Scranton, Erie, and Reading areas.

Figure 12.1.9-3 presents variations in the 2014 unemployment rate across the state, by county. It shows that counties with unemployment rates below the national average (that is, better employment performance) were located throughout much of the state, especially in the northwestern, southwestern, and southeastern portions, plus some counties in the center of the state. Counties with unemployment rates above the national average were also located throughout the state, especially in the west-central and northeast areas. When comparing unemployment in the population concentrations to the state average (Table 12.1.9-6), five areas had 2009–2013 unemployment rates that were higher than the state average (9.0 percent). These areas were the Pennsylvania portion of the Allentown area, the Erie area, the Pennsylvania portion of the Philadelphia area, the Reading area, and the York area.

Detailed employment data provides useful insights into the nature of a local, state, or national economy. Table 12.1.9-7 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 higher in Pennsylvania than in the east region and the nation. The percentage of government workers was considerably lower in the state than in the region and nation. Self-employed workers were a similar percentage to the region and somewhat lower compared to the nation.

By industry, Pennsylvania has a mixed economic base. Most of the industries in the state had comparable employment percentages (within two percentage points) to the region and the nation. One exception was the "manufacturing" industry, which accounted for 12.2 percent of workers in Pennsylvania compared to 8.5 percent in the region. The other exception was the "professional, scientific, management, administrative, and waste management services" industry, which had 9.9 percent of Pennsylvania's workers, compared to 12.3 percent for the region.

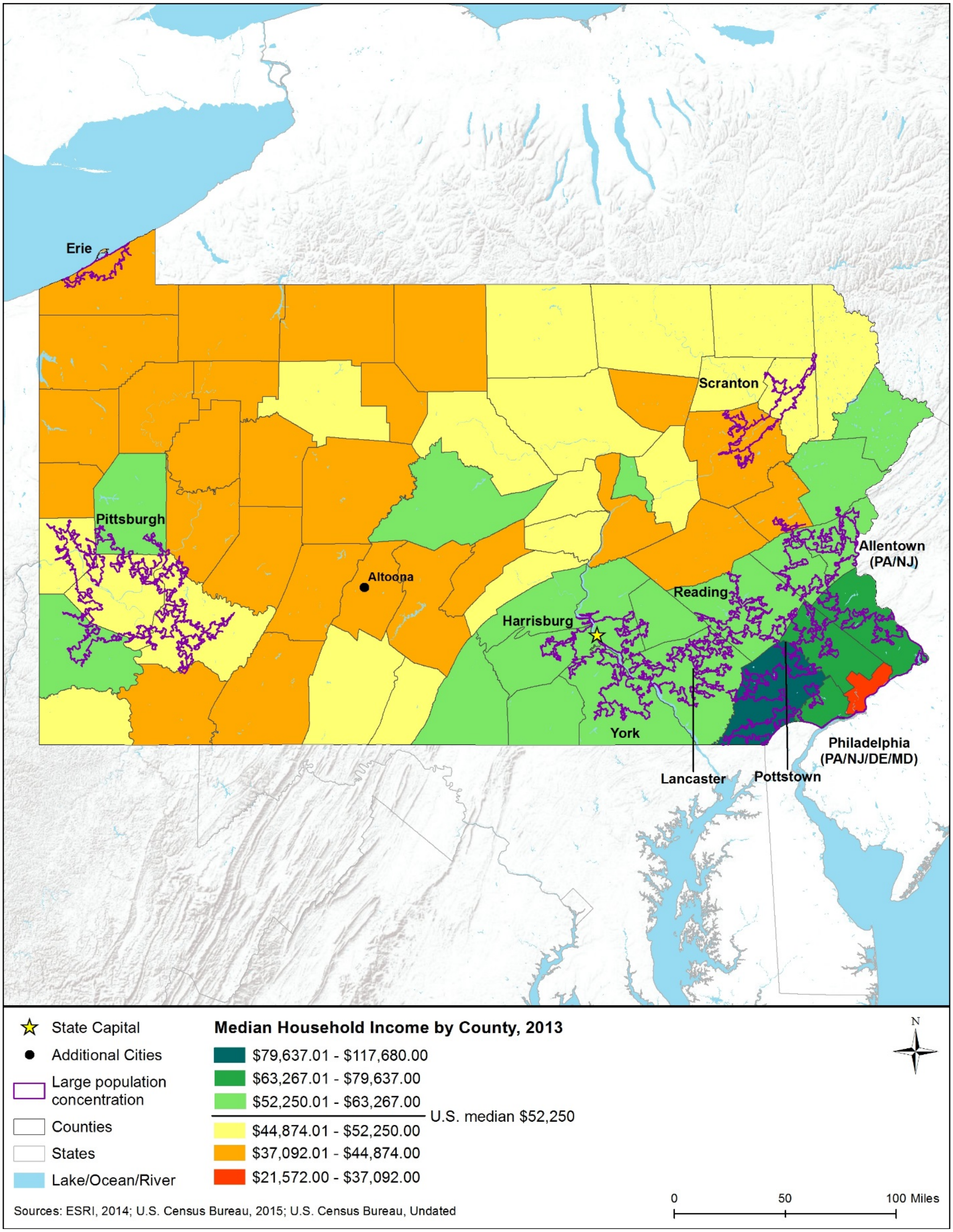


Figure 12.1.9-2: Median Household Income in Pennsylvania, by County, 2013

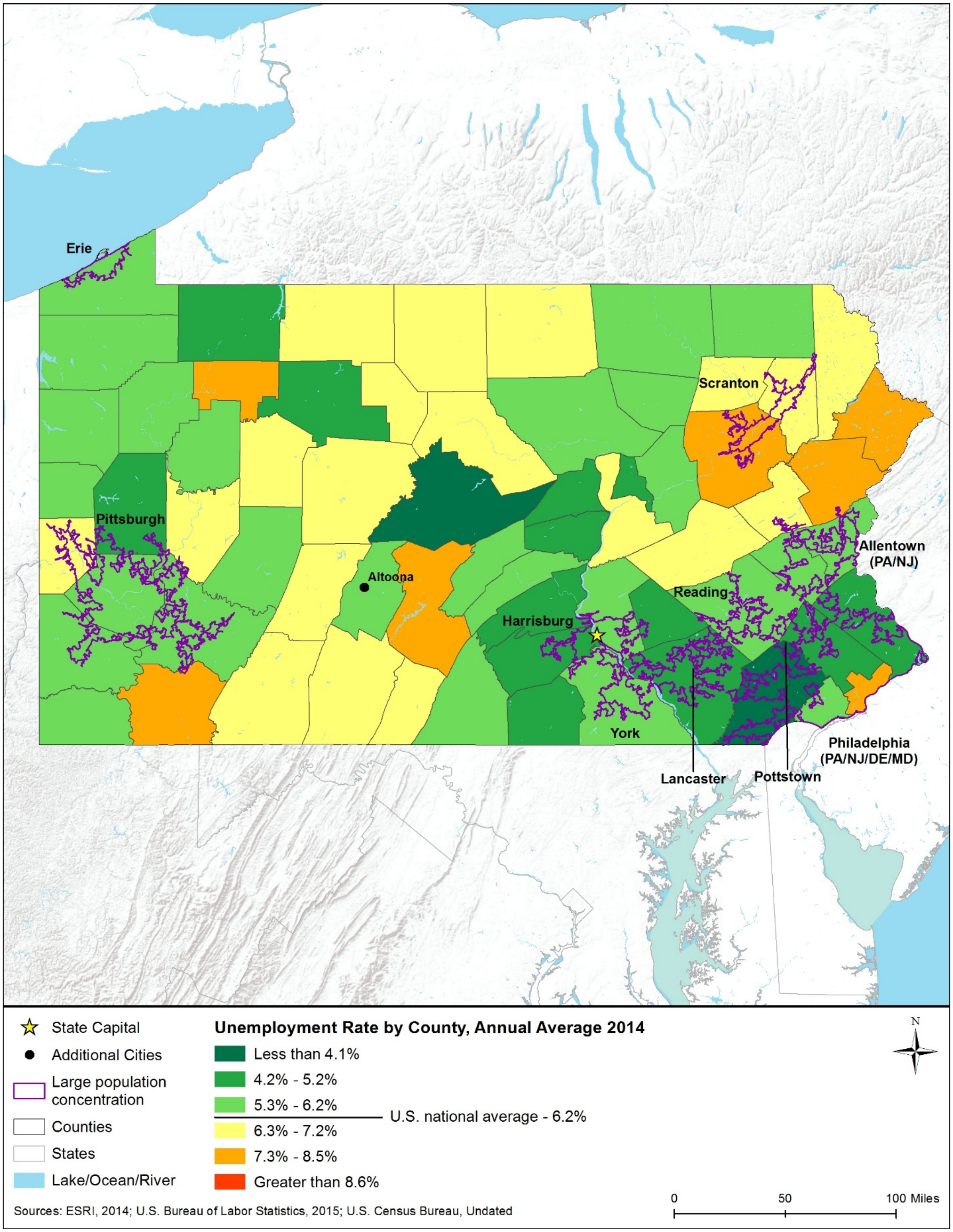


Figure 12.1.9-3: Unemployment Rates in Pennsylvania, by County, 2014

Table 12.1.9-6: Selected Economic Indicators for the 10 Largest Population Concentrations in Pennsylvania, 2009–2013

Area	Median Household Income	Average Annual Unemployment Rate
Allentown (PA/NJ) (PA Portion)	$55,456	9.6%
Erie	$43,514	9.7%
Harrisburg	$57,858	7.0%
Lancaster	$54,969	8.2%
Philadelphia (PA/NJ/DE/MD) (PA Portion)	$57,541	10.5%
Pittsburgh	$51,564	7.7%
Pottstown	$64,948	8.7%
Reading	$48,558	10.7%
Scranton	$43,226	8.3%
York	$53,661	10.2%
Pennsylvania (statewide)	$52,548	9.0%

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

Table 12.1.9-7: Employment by Class of Worker and by Industry, 2013

Class of Worker and Industry	Pennsylvania	East Region	U.S.
Civilian Employed Population 16 Years and Over	5,987,761	35,284,908	145,128,676
Percentage by Class of Worker			
Private wage and salary workers	83.9%	79.3%	79.7%
Government workers	10.7%	15.1%	14.1%
Self-employed in own not incorporated business workers	5.2%	5.4%	6.0%
Unpaid family workers	0.2%	0.1%	0.2%
Percentage by Industry			
Agriculture, forestry, fishing and hunting, and mining	1.5%	0.9%	2.0%
Construction	5.7%	5.8%	6.2%
Manufacturing	12.2%	8.5%	10.5%
Wholesale trade	2.8%	2.5%	2.7%
Retail trade	11.9%	11.1%	11.6%
Transportation and warehousing, and utilities	5.0%	4.6%	4.9%
Information	1.7%	2.3%	2.1%
Finance and insurance, and real estate and rental and leasing	6.5%	7.3%	6.6%
Professional, scientific, management, administrative, and waste management services	9.9%	12.3%	11.1%
Educational services, and health care and social assistance	25.7%	25.6%	23.0%
Arts, entertainment, and recreation, and accommodation and food services	8.5%	8.9%	9.7%
Other services, except public administration	4.6%	4.9%	5.0%
Public administration	4.0%	5.5%	4.7%

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

Table 12.1.9-8 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 12.1.9-7 for 2013.

Table 12.1.9-8: Employment by Relevant Industries for the 10 Largest Population Concentrations in Pennsylvania, 2009–2013

Area	Construction	Transportation and Warehousing, and Utilities	Information	Professional, Scientific, Management, Administrative and Waste Management Services
Allentown (PA/NJ) (PA Portion)	5.1%	5.2%	2.1%	9.7%
Erie	3.7%	3.1%	1.6%	6.7%
Harrisburg	3.9%	5.4%	1.6%	11.0%
Lancaster	6.7%	4.2%	1.5%	7.9%
Philadelphia (PA/NJ/DE/MD) (PA Portion)	4.9%	4.4%	2.2%	12.6%
Pittsburgh	4.8%	5.3%	2.0%	11.2%
Pottstown	5.9%	5.7%	2.1%	10.8%
Reading	4.5%	4.4%	1.4%	8.8%
Scranton	4.7%	5.0%	2.0%	7.3%
York	5.4%	4.7%	1.6%	9.1%
Pennsylvania (statewide)	5.7%	5.1%	1.8%	9.7%

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

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 12.1.9-9 compares Pennsylvania to the east region and nation on several common housing indicators.

As shown in Table 12.1.9-9, in 2013 Pennsylvania had a similar percentage of housing units that were occupied (88.7 percent) compared to the region (88.4 percent) or nation (87.5 percent). Of the occupied units, Pennsylvania had a somewhat higher percentage of owner-occupied units (68.9 percent) than the region (62.8 percent) or nation (63.5 percent). Pennsylvania had a higher percentage of detached single-unit housing (also known as single-family homes) in 2013 (57.0 percent) compared to the region (52.7 percent) and lower than the nation (61.5 percent). The vacancy rate among rental units was higher in Pennsylvania (5.8 percent) than in the region (5.5 percent) and lower compared to the nation (6.5 percent).

Table 12.1.9-9: Selected Housing Indicators for Pennsylvania, 2013

Geography	Total Housing Units	Housing Occupancy & Tenure				Units in Structure
		Occupied Housing	Owner-Occupied	Homeowner Vacancy Rate	Rental Vacancy Rate	1-Unit, Detached
Pennsylvania	5,565,354	88.7%	68.9%	1.6%	5.8%	57.0%
East Region	31,108,124	88.4%	62.8%	1.6%	5.5%	52.7%
U.S.	132,808,137	87.5%	63.5%	1.9%	6.5%	61.5%

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

Table 12.1.9-10 provides housing indicators for the largest population concentrations in the state by 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 12.1.9-10 shows that during this period the percentage of occupied housing units ranged between 89.6 to 95.1 percent across these population concentrations, which is consistent with the state percentage (89.1 percent).

Table 12.1.9-10: Selected Housing Indicators for the 10 Largest Population Concentrations in Pennsylvania, 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
Allentown (PA/NJ) (PA Portion)	257,148	93.3%	68.3%	1.8%	6.2%	49.0%
Erie	85,448	92.0%	63.2%	1.9%	6.3%	61.5%
Harrisburg	196,736	92.6%	65.9%	2.0%	6.0%	51.1%
Lancaster	164,655	95.1%	67.3%	1.0%	4.2%	50.3%
Philadelphia (PA/NJ/DE/MD) (PA Portion)	1,556,817	90.8%	65.2%	2.0%	7.9%	34.3%
Pittsburgh	821,664	89.9%	67.4%	1.8%	5.0%	64.4%
Pottstown	43,393	94.7%	76.0%	1.6%	5.5%	62.3%
Reading	108,166	92.7%	66.5%	1.9%	5.8%	43.5%
Scranton	174,561	89.6%	63.1%	2.4%	4.1%	59.7%
York	95,977	93.2%	69.6%	2.0%	5.2%	54.2%
Pennsylvania (statewide)	5,565,653	89.1%	69.8%	1.8%	6.1%	57.1%

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

Property Values

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

Table 12.1.9-11 provides indicators of residential property values for Pennsylvania and compares these values to values for the east region and nation. The figures on median value of owner-occupied units are from the Census Bureau's ACS, based on owner estimates of how much their property (housing unit and land) would sell for if it were for sale (U.S. Census Bureau, 2015h).

The table shows that the median value of owner-occupied units in Pennsylvania in 2013 ($164,200) was lower than the corresponding values for the east region ($249,074) and the nation ($173,900).

Table 12.1.9-11: Residential Property Values in Pennsylvania, 2013

Geography	Median Value of Owner-Occupied Units
Pennsylvania	$164,200
East Region	$249,074
U.S.	$173,900

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

Table 12.1.9-12 presents residential property values for the largest population concentrations in the state. The table reflects survey data taken from 2009 to 2013. Thus, its figures are not directly comparable to the more recent data in the previous table. However, it does show variation in property values for population concentrations across the state and compared to the state average for the 2009 to 2013 period. Half of the 10 areas had median values higher than the state median value of $164,700, with the highest median value occurring in the Pennsylvania portion of the Philadelphia area ($241,400). All other areas had property values below the state value. The lowest values were in the same four areas – Erie, Pittsburgh, Reading, and Scranton – that had the lowest MHIs (Table 12.1.9-6).

Table 12.1.9-12: Residential Property Values for the 10 Largest Population Concentrations in Pennsylvania, 2009–2013

Area	Median Value of Owner-Occupied Units
Allentown (PA/NJ) (PA Portion)	$194,000
Erie	$107,300
Harrisburg	$170,100
Lancaster	$179,900
Philadelphia (PA/NJ/DE/MD) (PA Portion)	$241,400
Pittsburgh	$127,200
Pottstown	$208,200
Reading	$151,700
Scranton	$118,500
York	$158,900
Pennsylvania (statewide)	$164,700

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

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 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 12.1.9-13 presents total and selected state and local government revenue sources as reported by Census Bureau's 2012 Census of Governments. It provides both total dollar figures (in millions of dollars) and figures per capita (in dollars), based on total population for each geography. The per capita figures are particularly useful in comparing the importance of certain revenue sources in the state relative to other states in the region and the nation. State and local governments may obtain some additional revenues related to telecommunications infrastructure.

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

Table 12.1.9-13 shows that the state government in 2012 received nearly the same per capita total revenue as other state governments in the nation but less than regional state governments. Local governments in Pennsylvania received less total revenue on a per capita basis than their counterparts in the region and nation. The Pennsylvania state government had less per capita intergovernmental[144] revenue from the federal government compared to the region and nation while Pennsylvania local governments received revenue that was comparable to the region and nation. State and local governments in Pennsylvania obtained lower levels of property taxes per

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

capita than their counterparts in the region and nation. General sales taxes were similar on a per capita basis for the Pennsylvania state government, and lower for Pennsylvania local governments, compared to their counterparts in the region and nation. For the Pennsylvania state government, selective sales taxes and public utility taxes were higher on per capita basis than for counterparts in the region or the nation. Selective sales taxes and public utility taxes were lower for Pennsylvania local governments compared to others in the region or nation. Individual and corporate income tax revenues, on a per capita basis, were lower for the Pennsylvania state government compared to other state governments in the region, and similar to others in the nation. Individual income tax revenue per capita was higher for Pennsylvania local governments than counterpart governments in the region and nation.

Table 12.1.9-13: State and Local Government Revenues, Selected Sources, 2012

Type of Revenue	Pennsylvania		Region		U.S.	
	State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount
Total Revenue ($M)	$78,467	$62,178	$522,354	$431,898	$1,907,027	$1,615,194
Per capita	$6,148	$4,872	$7,132	$5,897	$6,075	$5,145
Intergovernmental from Federal ($M)	$20,440	$3,023	$135,435	$20,289	$514,139	$70,360
Per capita	$1,601	$237	$1,849	$277	$1,638	$224
Intergovernmental from State ($M)	$0	$20,331	$0	$120,274	$0	$469,147
Per capita	$0	$1,593	$0	$1,642	$0	$1,495
Intergovernmental from Local ($M)	$187	$0	$9,810	$0	$19,518	$0
Per capita	$15	$0	$134	$0	$62	$0
Property Taxes ($M)	$38	$17,030	$2,215	$144,319	$13,111	$432,989
Per capita	$3	$1,334	$30	$1,971	$42	$1,379
General Sales Taxes ($M)	$9,167	$655	$49,123	$15,874	$245,446	$69,350
Per capita	$718	$51	$671	$217	$782	$221
Selective Sales Taxes ($M)	$7,985	$573	$38,070	$5,996	$133,098	$28,553
Per capita	$626	$45	$520	$82	$424	$91
Public Utilities Taxes ($M)	$1,337	$59	$4,314	$2,261	$14,564	$14,105
Per capita	$105	$5	$59	$31	$46	$45
Individual Income Taxes ($M)	$10,102	$4,210	$102,813	$18,838	$280,693	$26,642
Per capita	$791	$330	$1,404	$257	$894	$85
Corporate Income Taxes ($M)	$1,837	$306	$14,112	$6,733	$41,821	$7,210
Per capita	$144	$24	$193	$92	$133	$23

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

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

12.1.10. Environmental Justice

12.1.10.1. 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. 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 DOC developed an Environmental Justice Strategy in 1995, and published an updated strategy in 2013 (DOC, 2013).

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

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)

12.1.10.2. Specific Regulatory Considerations

The Pennsylvania DEP first established the Environmental Justice Work Group (EJWG) in 1999 to "assist DEP in meeting its environmental justice objectives" following an Environmental Justice case dismissed by the Supreme Court (Pennsylvania DEP, 2004a). In 2001, the EJWG developed the Environmental Justice Work Group Report, which made recommendations for five areas of activity: "improving the condition of environmentally burdened communities; the permitting process; monitoring and enforcement; DEP organizational change; ensuring implementation." In addition, the EJWG recommended creation of an Environmental Justice

Advisory Board and an office within DEP dedicated to environmental justice (Pennsylvania DEP, 2015h).

The OEJ within the DEP was established in 2002 to oversee environmental justice concerns, foster relationships and communication between DEP and communities, and enhance intra-departmental collaboration in Pennsylvania (Pennsylvania DEP, 2015v). DEP defines an environmental justice (EJ) area as "any census tract where 20 percent or more individuals live in poverty, and/or 30 percent or more of the population is minority" (Pennsylvania DEP, 2015ac). OEJ also established regional offices and regional advocates to more effectively address environmental problems in low income and minority communities in specific regions (Pennsylvania DEP, 2015ac).

In 2004, the EJWG created the Environmental Justice Public Participation Policy to "ensure that EJ communities have the opportunity to participate and be involved in a meaningful manner throughout the permitting process when companies propose permitted facilities in their neighborhood or when existing facilities expand their operations" (Pennsylvania DEP, 2015af). The policy uses community outreach, public information, and public meetings as pillars for ensuring fair and comprehensive involvement of communities throughout the permitting process for certain major permit applications (Pennsylvania DEP, 2004a). In addition, the policy grants the following for environmental justice communities:

- Informational public meeting
- Plain language summary of the proposed application
- Increased outreach and access to information on permit applications
- Intervention of an advocate to facilitate communication between industry, DEP, and the community

12.1.10.3. Environmental Setting: Minority and Low-Income Populations

Table 12.1.10-1 presents 2013 data on the composition of Pennsylvania's population by race and by Hispanic origin. All minority populations in Pennsylvania have lower percentages of individuals than the region or the nation. Minority races with population differences greater than two percentage points compared to the region and nation were Asian (3.0 percent) and Some Other Race (2.1 percent). The state's population of persons identifying as White (81.6 percent) is considerably larger than that of the east region (72.1 percent) or the nation (73.7 percent).

The percentage of the population in Pennsylvania that identifies as Hispanic (6.3 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. Pennsylvania's All Minorities population percentage (21.8 percent) is lower than that of the east region (34.0 percent) or the nation (37.6 percent). Table 12.1.10-2 presents the percentage of the population living in poverty in 2013, for the state, region, and nation. Pennsylvania (13.7 percent) is almost identical to that for the region (13.3 percent) and lower than the figure for the nation (15.8 percent).

Table 12.1.10-1: 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		
Pennsylvania	12,773,801	81.6%	11.0%	0.2%	3.0%	0.0%	2.1%	2.1%	6.3%	21.8%
East Region	73,558,794	72.1%	14.4%	0.3%	5.8%	0.0%	4.8%	2.7%	12.2%	34.0%
U.S.	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, 2015f)

"All Minorities" is defined as all persons other than Non-Hispanic 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 12.1.10-2: Percentage of Population (Individuals) in Poverty, 2013

Geography	Percent Below Poverty Level
Pennsylvania	13.7%
East Region	13.3%
U.S.	15.8%

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

12.1.10.4. 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 12.1.10-1 visually portrays the results of the environmental justice population screening analysis for Pennsylvania. The analysis used block group data from the Census Bureau's American Community Survey 2009-2013 5-Year Estimates (U.S. Census Bureau, 2015j) (U.S. Census Bureau, 2015n) (U.S. Census Bureau, 2015o) (U.S. Census Bureau, 2015p) and Census Bureau urban classification data (U.S. Census Bureau, 2015u).

Figure 12.1.10-1 shows that Pennsylvania has many areas with high potential for environmental justice populations. These high potential areas are distributed fairly even across the state, and occur both within and outside of the 10 largest population concentrations. This includes some of the state's sparsely populated areas in the center and west of the state. The distribution of areas with moderate potential for environmental justice populations is also fairly even across the state.

It is important to understand how the data behind Figure 12.1.10-1 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 important to note that Figure 12.1.10-1 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 12.2.10) addresses the potential for disproportionately high and adverse environmental or human health impacts on environmental justice populations.

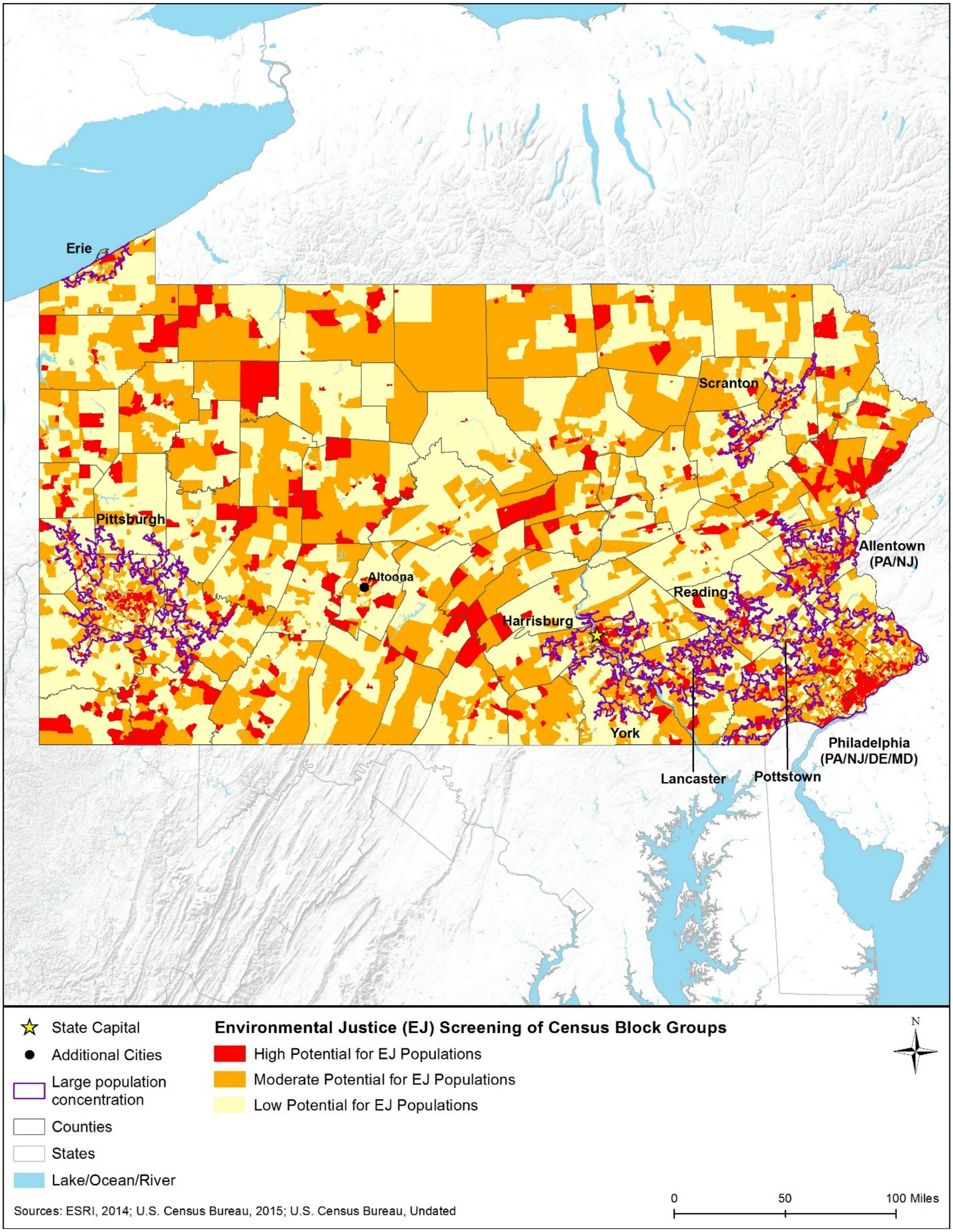


Figure 12.1.10-1: Potential for Environmental Justice Populations in Pennsylvania, 2009–2013

12.1.11. Cultural Resources

12.1.11.1. 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 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, 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 program support of public and private efforts to identify, evaluate, and protect America's historic and archeological resources (NPS, 2016b); and
- Advisory Council on Historic Preservation (ACHP) guidance for protection and preservation of sites and artifacts with traditional religious and cultural importance to Indian tribes or Native Hawaiian organizations (ACHP, 2004);

12.1.11.2. Specific Regulatory Considerations

Applicable federal laws and regulations that apply to Cultural Resources include the NHPA (detailed in Section 1.8), the American Indian Religious Freedom Act (AIRFA), ARPA, and NAGPRA. Appendix C summarizes these pertinent federal laws.

Pennsylvania has a state law that parallels the NHPA (Table 12.1.11-1). However, federal laws and regulations supersede this law. 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 12.1.11-1: Relevant Pennsylvania Cultural Resources Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Pennsylvania State History Code, Title 37	Pennsylvania State Historic Preservation Office (SHPO)	The State History Code provides for reviews of state projects by the SHPO that follow the steps in the Section 106 process. (Pennsylvania Historical and Museum Commission, 2015y)

12.1.11.3. Cultural Setting

Based on geological and archaeological evidence, the geographic area that encompasses Pennsylvania has been inhabited by human beings for at least 12,000 years (Custer, 1984; Anderson, 2001). The majority of the evidence comes from the study of archeological sites that provide information about the state's pre-European contact and historic populations, and document various cultures, traditions, and human interactions with the environment. In many cases, archeological data are the only information available about the state's early peoples and places.

Archeological sites within the state are found in a wide variety of settings, from forests and flood plains to waterways and mountaintops. Prehistoric archeological sites range from temporary fishing encampments to large permanent villages (Moeller, 1980). There are many "resource procurement sites" or areas where the activity appears to have consisted of a single action, such as a hunting site where animals were killed and butchered or waterfront site where groups of people gathered for a limited time to harvest and process fish or shellfish. Artifacts are usually found in shallow deposits, one to two feet of the surface. However, in some in cases, natural factors such as landslides, flooding, and sedimentation can bury artifacts deeper than 10 feet. Disturbed ground, such as urban areas, may contain archaeological resources within the deeper or shallower strata than in undisturbed areas (Wissler, 1947).

Archaeologists typically divide large study areas into regions. Figure 12.1.11-1 shows that Pennsylvania contains three physiographic regions: Appalachian Highlands, Atlantic Plain, and Interior Plains. In Pennsylvania, the Appalachian Highlands region is further divided into five provinces. The Appalachian Plateaus province covers move then half of the state including the western part of the state around Pittsburgh, PA, and the entire northern border with New York. The Valley and Ridge province is the next largest area, and is southwest-northeast band between Altoona, PA, and Harrisonburg, PA. The remaining three provinces: Blue Ridge, Piedmont, and New England are each in the southeast corner of the state.

12.1.11.4. Prehistoric Setting

There are three distinct periods associated with the prehistoric human populations that inhabited Pennsylvania 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 12.1.11-2 shows a timeline representing the periods of the evolving culture in this region. During early archaeological research, there was often no clear distinction between prehistoric periods in the archaeological record, due to overlaps between phases of cultural development (Ritchie, 1969). Due to advancements in radiocarbon dating techniques, dates of each period in the archaeological record have been increasingly more accurate, and there is no longer much overlap in the timeline of human occupation in North America (Pauketat, 2012). Radiocarbon dating techniques and associating artifacts discovered with similar ones previously assigned to a particular range of the archaeological record continue to become increasingly accurate (Pauketat, 2012; Haynes, Donahue, Jull, & Zabel, 1984; Haynes, Johnson, & Stafford, 1999).

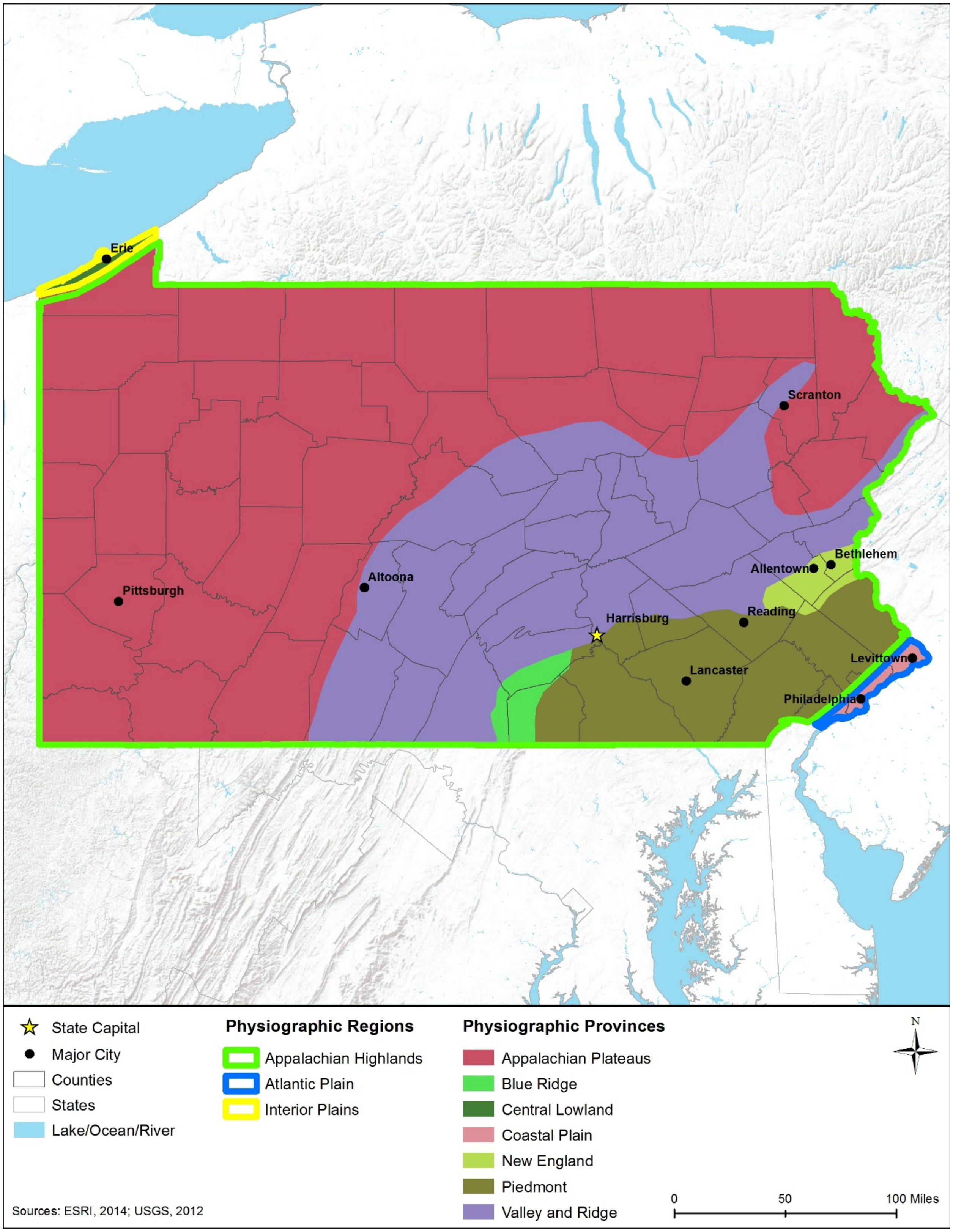


Figure 12.1.11-1: Pennsylvania Physiographic Regions

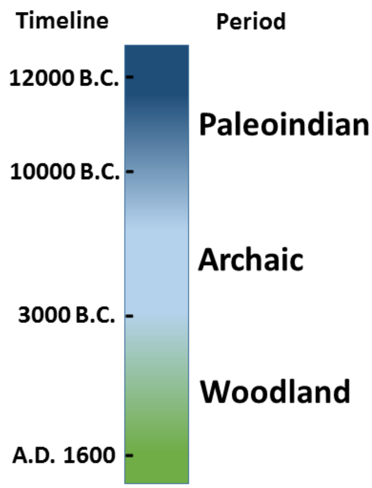


Figure 12.1.11-2: Timeline of Prehistoric Human Occupation

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

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

The Paleoindian Period (Stone Age culture) represents the earliest known human inhabitants of Pennsylvania and the Northeast region of the U.S. One of the oldest known Paleoindian sites in the country is the Meadowcroft Rockshelter site in western Pennsylvania, which began to be excavated in the 1970s (Adovasio et al., 1990). Much additional research was conducted throughout the 1980s concentrating on Paleoindian occupation within this region of North America (Rainey, 2005). Evidence of early humans is based on a variety of sources, including published site reports and technical reports that have been prepared for various state agencies. Archaeologists also use unpublished data to help better understand the people who lived during this period. The discovery of scatters of fluted points, prehistoric campsites, and other more prominent sites throughout the state allow archaeologists to help understand and protect important sites that may exist.

Published literature representing the early stages of the Paleoindian Period suggest that the inhabitants were few in numbers and their way of life is difficult to interpret and understand (Anderson, 2001). It is unclear as to precisely when people began to inhabit the region, but there have been several sites have been radiocarbon dated to about 13,000 years ago (Anderson, 2001).

Archeological evidence suggests that Paleoindians of the area were a highly nomadic and sparsely populated group of people. These nomadic hunters and gatherers used a small inventory of chipped-stone tools known as “fluted javelin head” spear points or Clovis form spear point (fluted points). They probably formed small bands in pursuit of migratory game. The archaeological record indicates that there were seasonal camps that they returned to, which may have formed the basis for more permanent settlements within the region. No skeletal remains of these people have been identified to date in the state. This group of hunters and gatherers were related to a population of inhabitants that spread into North America via a land bridge at the Bering Strait during the latter part of the last ice age (Late Pleistocene epoch) (USGS, 2012a).

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

Populations in the Early Archaic period acted similarly to Paleoindian groups in that their camps were near food resources. The spruce-pine forest of the Pennsylvania region was not productive enough to support the early peoples, causing populations to migrate into upland areas to find food. Archaeological evidence indicates these migrations were to relatively small areas, compared to Paleoindian bands, which ranged over larger territories. The human population in Pennsylvania did not substantially increase during the Early Archaic Period, most likely due to scarce food resources. Hunting was most likely the dominant form of subsistence. (Commonwealth of Pennsylvania, 2015e)

The beginning of the Middle Archaic period saw a dramatic increase in food resources available to local populations. Use of tools, such as axes and spears, became more common, as well as tools used in the cultivation and processing of plant foods. Size of groups do not appear to change during this period; however, the number of groups increased substantially based on the discovery of many archaeological sites for the period, as compared to Early Archaic. (The State Museum of Pennsylvania, 2011)

At the beginning of the Late Archaic Period, population density was high considering hunting and gathering were still the primary means of subsistence. Groups of hunter/gatherers expanded to a greater size than those seen in the Middle Archaic period, though this was dependent on the season. During the warmer seasons, large bands of 100 or more people appear to have camped together. During the winter, these groups broken up and scattered, to search for scarce food sources. (Commonwealth of Pennsylvania, 2015e)

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

By the Early Woodland Period, the climate of Pennsylvania was similar to modern times. Inhabitants most likely continued moving seasonally; however, they appeared to have camped in advantageous locations for longer spans of time. The Adena culture in western Pennsylvania developed significantly during this period. The populations dwelled in houses built in small clusters. Hunting and fishing continued to be a main source of food, but wild and domesticated plant food reliance grew as well. (Commonwealth of Pennsylvania, 2015c)

The main technology that differentiates the Woodland Period from the Archaic Period is the development and use of pottery, which originated in the Southeastern United States during the late Archaic Period and spread northward to Pennsylvania and elsewhere (Sassaman, 1998). Based on the relatively few archaeological sites discovered throughout Pennsylvania and the surrounding region, the beginning of the Middle Woodland Period appears to show a sharp drop in population. However, this may be attributable to our inability to identify artifacts from the period. Carbon dating confirms the existence of populations in the area but distinguishing

Middle Period artifacts between those attributed to the Early and Late periods is difficult. Whereas little is known about this period, the Middle Woodland represents an interesting time in prehistory as populations became less nomadic and more dependent on domesticated plant foods. (Commonwealth of Pennsylvania, 2015c)

In the Late Woodland Period, most groups within the population participated in a mixed food economy, which involved hunting, fishing, gathering, and plant cultivation. Permanent settlements become much more common, and farms became larger and more dispersed. Small homes and villages continued in this time until European contact. (Commonwealth of Pennsylvania, 2015d)

12.1.11.5. Federally Recognized Tribes of Pennsylvania

According to the Bureau of Indian Affairs and the National Conference of State Legislators, there are no federally recognized Tribes in Pennsylvania (National Conference of State Legislators, 2015; U.S. Government Publishing Office, 2015). Figure 12.1.11-3 shows the general historic location of the tribes that were known to exist in this region of the U.S., but are either no longer within the state or are not federally recognized.

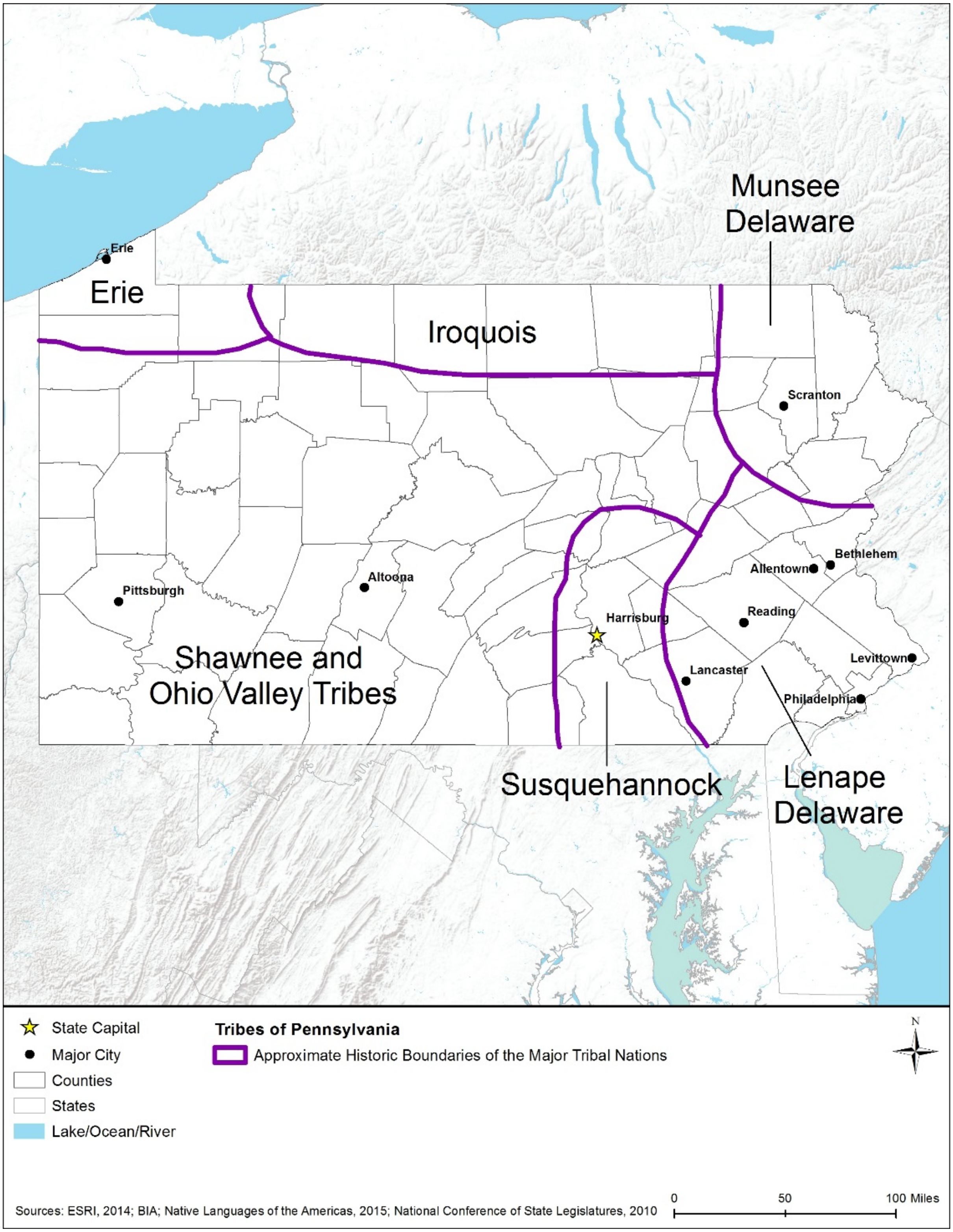


Figure 12.1.11-3: Historic Boundaries of Major Tribal Nations in Pennsylvania

12.1.11.6. Significant Archaeological Sites of Pennsylvania

There are 108 archaeological sites in Pennsylvania listed on the NRHP.

Pennsylvania State Cultural Resources Database and Tools

Pennsylvania Cultural Resources Geographic Information System (CRGIS)

Pennsylvania's Cultural Resources Geographic Information System (CRGIS) is a map-based inventory of the historic and archaeological sites and surveys stored in the files of the Bureau for Historic Preservation (BHP). Currently, there are approximately 23,000 archaeological sites and 130,000 historic properties in these files and they are used for determining potential impacts to cultural resource for project specific "areas of potential effects" (APE).[a] Access to these paper records is free and open to the public by appointment at the BHP office in Harrisburg, PA. CRGIS is a means of accessing some of these data without a trip to Harrisburg. CRGIS is a partnership between the Pennsylvania Historical & Museum Commission (PHMC) and PennDOT, with financial support from the Federal Highway Administration, the Baltimore District of the Army Corp of Engineers, and the Pennsylvania Department of Environmental Protection. Users may access CGRIS at http://phmc.info/pacrgis (Commonwealth of Pennsylvania, 2015b).

Pennsylvania Archaeological Council (PAC)

The Pennsylvania Archaeological Council (PAC) is a statewide organization of professional archaeologists dedicated to promoting Pennsylvania archaeology. PACs holds semi-annual business meetings and organizes annual symposiums to facilitate collaboration within the archaeological community. PAC has an active public education program. The organization sponsors an annual essay contest for middle school and junior high students on why archaeological sites should be preserved. It also sponsors a traveling series of poster exhibits that tour various museums, libraries and historic sites mainly in Western Pennsylvania, and maintains a speakers' bureau of professional archaeologists willing to speak to the public about archaeology. (Pennsylvania Archaeological Council, 2015)

[a] An area of potential effect (APE) "is the geographic area or areas within which an undertaking may directly or indirectly cause changes in the character of use of historic properties, if any such properties exist." (36 CFR 800.4(a)(1) (U.S. Government Publishing Office, 2015)

Table 12.1.11-2 lists the names of the sites, the city they are closest to, and type of site. The list includes both prehistoric and historic archaeological sites. A current list of NRHP sites can be found on the NPS NRHP website at http://www.nps.gov/nr/ (NPS, 2014d).

Table 12.1.11-2: Archaeological Sites on the NRHP in Pennsylvania

Closest City	Site Name	Type of Site
Alexandria	Barree Forge and Furnace	Historic
Allentown and vicinity	Lehigh Canal	Historic
Arch Spring	Isett, Jacob, House and Store	Historic
Avella	Meadowcroft Rockshelter	Prehistoric
Bally	Dale Furnace and Forge Historic District	Historic
Beale	Book Site (36 Jul)	Prehistoric
Beaver	Fort McIntosh Site	Historic - Military
Bedford	Site 36BD90	Prehistoric
Birdsboro	Boone, Daniel, Homestead Site and Bertolet Cabin	Historic
Boswell	Boswell Historic District	Historic
Brandywine Manor	Isabella Furnace	Historic
Brownsburg	Brownsburg Village Historic District	Historic
Bryn Mawr	Mill Creek Historic District	Historic
Bushkill	Minisink Archeological Site	Historic - Aboriginal
Cairnbrook	Cairnbrook Historic District	Historic
Cashtown	Carbaugh Run Rhyolite Quarry Site (36AD30)	Prehistoric
Chadds Ford	Brandywine Battlefield	Historic - Military
Chadds Ford	Chad House	Historic
Coalmont	Minersville Coke Ovens	Historic
Conestoga	Roberts Farm Site (36LA1)	Historic - Aboriginal, Prehistoric
Culp	Fort Roberdeau	Historic - Military
Dickinson	Pine Grove Furnace	Historic
Easton	Lehigh Canal: Eastern Section Glendon and Abbott Street Industrial Sites	Historic
Easton	Nicholas, Jacob, House	Historic
Elverson	Hopewell Furnace National Historic Site	Historic
Entriken	Paradise Furnace	Historic
Essington	Printzhof, The	Historic
Fayette City	Locus 7 Site	Prehistoric
Fort Hunter	Fort Hunter Historic District	Historic- Military
Gettysburg and vicinity	Gettysburg Battlefield Historic District	Historic - Military
Gibraltar	Allegheny Aqueduct	Historic
Gladwyne	Mill Creek Historic District (Boundary Increase)	Historic
Greensburg	Old Hannastown, Site of	Historic
Halifax	Clemson Island Prehistoric District	Prehistoric
Hallton	Irwintown Site	Historic
Harmony	Legionville	Historic - Military
Harrison City	Bushy Run Battlefield	Historic - Military
Holbrook	Foley, Richard T., Site (36GR52)	Historic - Aboriginal
Holicong	Holicong Village Historic District	Historic
Holtwood	Duncan Island (36LA60,61)	Prehistoric
Jackson	Shoop Site (36DA20)	Prehistoric
Jefferson Township	Francis Farm Petroglyphs Site (36FA35)	Prehistoric
Lancaster	Park Site 36La96	Historic - Aboriginal
Letort	Conestoga Town	Historic - Aboriginal

Closest City	Site Name	Type of Site
Ligonier	Fort Ligonier Site	Historic - Military
Lock Haven	Memorial Park Site	Prehistoric
Long Level	Leibhart, Byrd, Site (36YO170)	Historic - Aboriginal, Prehistoric
Long Level	Leibhart, Oscar, Site (36YO9)	Historic - Aboriginal, Prehistoric
Marietta Borough	Chickies Historic District	Historic
McAlevys Fort	Greenwood Furnace	Historic
McAlevys Fort	Monroe Furnace	Historic
Media	Ridley Creek State Park	Historic
Mercersburg	Millmont Farm	Historic
Mercersburg	Rock Hill Farm	Historic
Mill Creek Township	Sommerheim Park Archeological District	Historic, Prehistoric
Minisink Hills	Shawnee--Minisink Site	Prehistoric
Monongahela Township	Sugar Grove Petroglyph Site (36GR5)	Prehistoric
Morgantown	Joanna Furnace Complex	Historic
Morrisville	Pennsbury Manor	Historic
Muddy Creek Forks	Muddy Creek Forks Historic District	Historic
Nazareth	Jacobsburg Historic District	Historic, Military
New Florence	Squirrel Hill Site	Prehistoric
New Richmond	Brown, John, Tannery Site	Historic
Newlin Twp.	Indian Deep Farm	Historic - Aboriginal
Newtown Township	Crosley--Garrett Mill Workers' Housing, Store and Mill Site	Historic
Nicholson Township	Deffenbaugh Site (36FA57)	Prehistoric
Pequea	Shenks Ferry Site (36LA2)	Prehistoric
Perryopolis	Alliance Furnace	Historic
Philadelphia	Fort Mifflin	Historic - Military
Philadelphia	Independence National Historical Park	Historic
Philadelphia	Upper Roxborough Historic District	Historic
Philadelphia	Upper Roxborough Historic District (Boundary Increase)	Historic
Pittsburgh	Forks of the Ohio	Historic
Point Marion	Gallatin, Albert, House; Friendship Hill National Historic Site	Historic
Reitz	Shade Furnace Archeological District	Historic
Rice's Landing	Rice's Landing Historic District	Historic
Robertsdale	Robertsdale Historic District	Historic
Robesonia	Robesonia Furnace Historic District	Historic
Rockland Township	Indian God Rock Petroglyphs Site (36VE26)	Prehistoric
Rostraver Township	Household No. 1 Site (36WM61)	Prehistoric
Safe Harbor	Big and Little Indian Rock Petroglyphs	Prehistoric
Saginaw	Codorus Forge and Furnace Historic District	Historic
Saltsburg	Saltsburg Historic District	Historic
Shippensburg	Dykeman's Spring	Prehistoric
Slickville	Slickville Historic District	Historic
Smock	Smock Historic District	Historic
Spring Grove	York Iron Company Mine	Historic
Springfield	Pennsylvania Canal Guard Lock and Feeder Dam, Raystown Branch	Historic
State College	Centre Furnace Mansion House	Historic
State College	Houserville Site (36CE65)	Prehistoric
State College	Tudek Site	Prehistoric

Closest City	Site Name	Type of Site
Swatara Township	Calver Island	Prehistoric
Titusville	Pithole City, Site of	Historic
Toboyne	Lupfer, Israel and Samuel, Tannery Site and House	Historic
Turbotville	Hower-Slote House	Historic
Uniontown	Fort Necessity National Battlefield	Historic - Military
Upper Gwynedd Township	Knipe--Johnson Farm	Historic
Vintondale	Eliza Furnace	Historic
Warwick	North Warwick Historic and Archeological District	Historic, Historic - Aboriginal, Prehistoric
Washington	Murry Site	Prehistoric
Washington	Strickler Site	Historic - Aboriginal
Washington Boro	Frey--Haverstick Site (36LA6)	Historic - Aboriginal, Prehistoric
Washington Boro	Shultz-Funk Site (36LA7 and 36LA9)	Historic - Aboriginal
West Findley	Fisher Site (36GR21)	Prehistoric
Williamsport	Canfield Island Site 36LY37	Prehistoric
Williamsport	Archeological Site 36 LY 37	Prehistoric
Wingate	Fisher Farm Site	Prehistoric
York Haven	Kise Mill Bridge Historic District	Historic

Source: (NPS, 2016a)

12.1.11.7. Historic Context

In 1608, Captain John Smith sailed north up the Chesapeake from the colony of Virginia and explored portions of present day Pennsylvania as he mapped much of the Mid-Atlantic region. In 1609, Henry Hudson, while sailing for the Dutch, explored the Delaware Bay area, resulting in the Dutch claiming the region as part of the larger New Netherlands territory. Sweden was also vying to establish a colony in the new world, and became the first European country to establish a permanent settlement in Pennsylvania (near Wilmington), when "in 1643, Governor Johann Printz of New Sweden established his capital at Tinicum Island (which is) within the present limits of Pennsylvania" (Pennsylvania Historical and Museum Commission, 2015t).

The state of Pennsylvania was named for Admiral Sir William Penn, the father of William Penn, the founder of the colony. William Penn was a prominent member of English society who converted to Quakerism and helped grow its numbers. Penn petitioned King Charles II for a proprietary land grant in the new world so that the Quakers could have a place of respite from the persecution they faced in England. "The King signed the Charter of Pennsylvania on March 4, 1681, and it was officially proclaimed on April 2" (Pennsylvania Historical and Museum Commission, 2015w). Penn sent his cousin to Pennsylvania in April of 1681, and made the journey himself later that year. While Quakers were the dominant group, the population of Pennsylvania soon contained many ethnicities, with Germans (often referred to as "Pennsylvania Dutch" due to a mispronunciation of the world Deutsch), accounting for one third of the population by the time of the America Revolution (Pennsylvania Historical and Museum Commission, 2015w).

Pennsylvania was drawn into several conflicts between England and France during the 18th Century, with French fortifications being common in the western portion of the state during that time. Farming in Pennsylvania was prosperous and widespread, with industrial pursuits growing in importance as well. Iron production became particularly important beginning in the 18th Century, as access to the Delaware River allowed for the easy shipment of goods (Pennsylvania Historical and Museum Commission, 2015t). Philadelphia became a cultural and financial leader, and the University of Pennsylvania (originally founded in 1740 as the College of Pennsylvania) served as the country's only secular institution of higher education during the Colonial Era (University of Pennsylvania, 2015). Colonial delegates met in Philadelphia to draft the Declaration of Independence, and the city served as a center of revolutionary activity during the war. Following the American Revolution, the Continental Congress met in Philadelphia to draft the new constitution, and the city was named the capital of the country prior to the establishment of Washington, D.C. (Pennsylvania Historical and Museum Commission, 2015t).

Settlement of the western portions of the state increased after the American Revolution. Pennsylvania remained largely rural; however, several heavily urbanized pockets existed, including Philadelphia in the east, Harrisburg in the central portion, and Pittsburgh in the west. European immigration increased in the mid-19th Century contributing to the further diversification of the population. Pennsylvania was a free state during the Civil War, and served a critical role during the conflict, with several major battles occurring in the state, of which the Battle of Gettysburg is most famous. Pennsylvania also produced goods for the Union army, including rifles, artillery, and ships (Pennsylvania Historical and Museum Commission, 2015k).

Following the Civil War, Philadelphia's prowess began to wane as New York City came to dominate economic activity in the country. Industrialists like Andrew Carnegie grew Pennsylvania's railroad and steel industries during the second half of the 19th Century, and the U.S. Steel Corporation and Bethlehem Steel Corporation led the steel industry. This growth was facilitated by the railroad system that, while it remained large, had reached its peak by the outset of World War I (WWI). During WWI, Pennsylvania aided in sustaining maritime transport and the production of coal and other raw materials. After being set back by the Great Depression, World War II (WWII) saw yet another spike in industrial production, with factories supporting the demand for military goods (Pennsylvania Historical and Museum Commission, 2015v).

During the mid-20th Century, Pennsylvania fell from being the second most populated state in the county to its current position at sixth. This was due in large part to the loss of industry that has occurred since WWII. While farming has declined over the past half a century, agriculture remains an important part of the state's economy and cultural heritage. Suburbanization has occurred in many areas, furthering the decline of many of the state's major cities (Pennsylvania Historical and Museum Commission, 2015p).

Pennsylvania has 3,377 NRHP listed sites, as well as 167 NHLs (NPS, 2014g). Pennsylvania contains 7 National Heritage Areas (NHA), one of which is shared with neighboring Maryland, and 12 State Heritage Areas (SHA), five of which cross over and are recognized as NHAs (NPS, 2015f) (Pennsylvania DCNR, 2015g) (NPS, 2014g). Figure 12.1.11-4 shows the locations of

NHAs and NRHP sites within Pennsylvania, while Figure 12.1.11-5 shows the location of SHAs.[145]

[145] See Section 12.1.7 for a more in-depth discussion of additional historic resources as they relate to recreational resources.

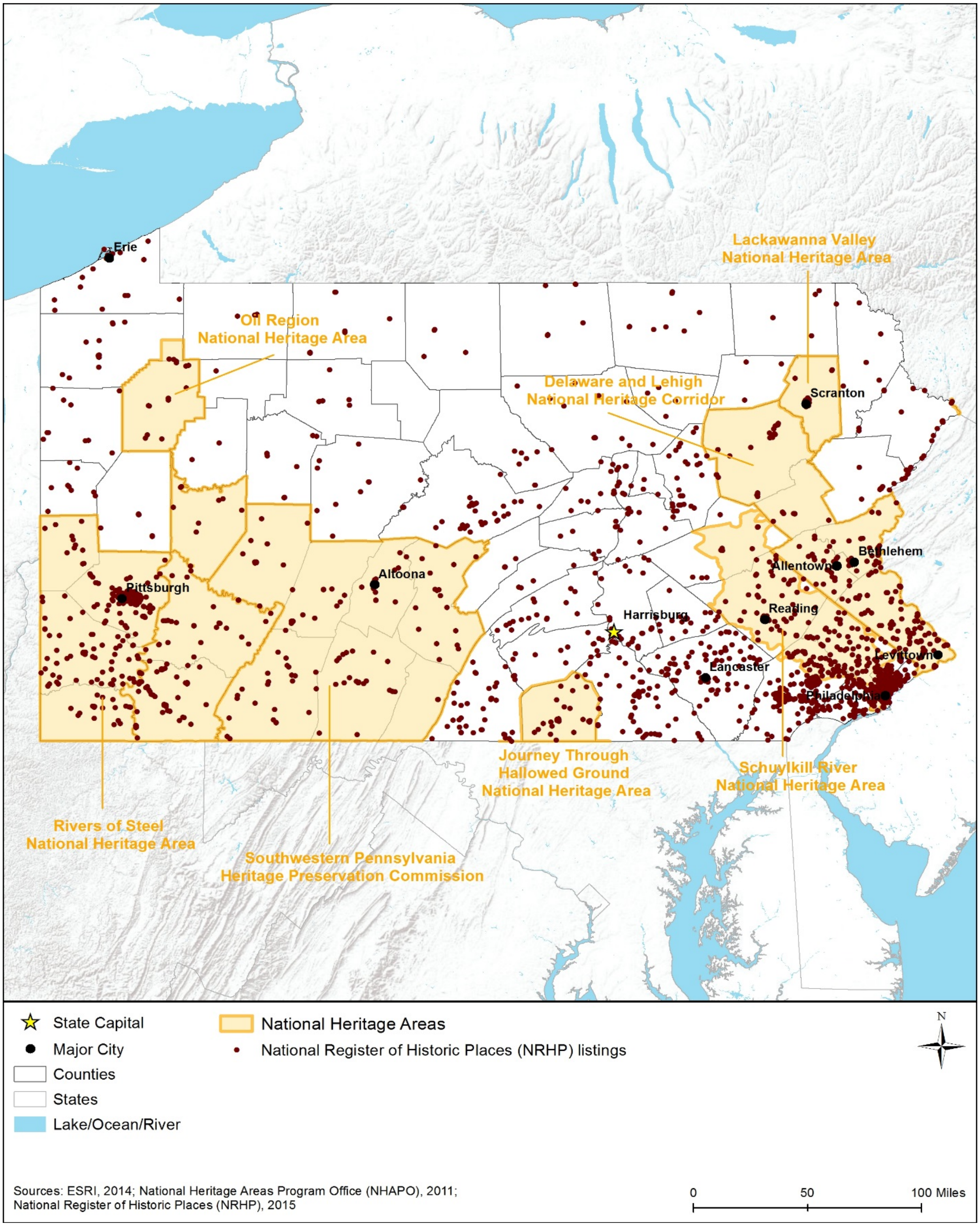


Figure 12.1.11-4: National Heritage Areas (NHA) and NRHP Sites in Pennsylvania

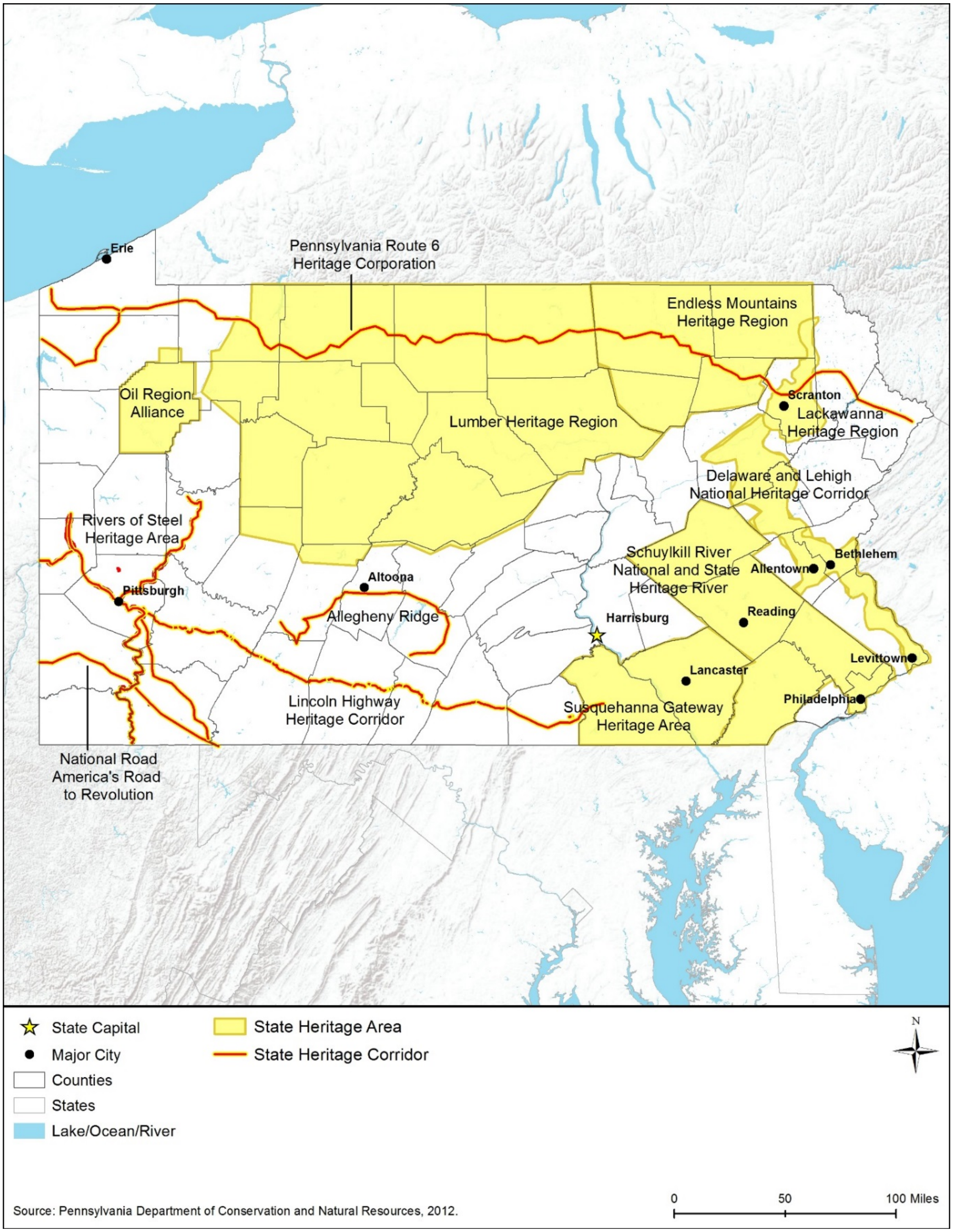


Figure 12.1.11-5: State Heritage Areas in Pennsylvania

12.1.11.8. Architectural Context

The earliest European buildings in Pennsylvania were likely log structures built by Swedish and Finnish settlers in the southeastern portion of the state. "The Lower Swedish Cabin, which dates from circa 1640 and is along the Darby Creek in Drexel Hill, Delaware County" is an existing example of this building type (Pennsylvania Historical and Museum Commission, 2015o). These buildings are significant, as the Swedes and Finns are credited with bringing log construction to America. In rural areas, log structures were built well into the 19th Century (Pennsylvania Historical and Museum Commission, 2015o).

As England took control of Pennsylvania in the late 17th Century, Post Medieval English structures were built. These included architectural features such as steeply pitched roofs, casement windows, and large central chimneys. Existing buildings of this type are rare and found primarily in southeastern Pennsylvania (Pennsylvania Historical and Museum Commission, 2015u). Pennsylvania German building traditions are also common in southeastern Pennsylvania, but can be found throughout the state. These houses features steeply pitched roofs, asymmetrical plans, and were built often of stone and brick or wood. Two existing examples of this building type are the Christian Stauffer House and the Ephrata Cloister, both of which are in Lancaster County (Pennsylvania Historical and Museum Commission, 2015s).

During the 18th Century, Georgian architecture became popular and brought an increased emphasis on symmetry. Stone construction was common due to its availability and has become synonymous with Pennsylvania architecture, especially in rural examples (Pennsylvania Historical and Museum Commission, 2015h). Following the American Revolution, the Federal style became popular, with houses becoming taller, details lighter, and roofs shallower. Greek Revival was very popular during the second quarter of the 19th Century and lasted through the middle of the 19th Century (Pennsylvania Historical and Museum Commission, 2015j). Additional revival styles became popular in the middle of the 19th Century, including Gothic Revival and Italianate. "Another infrequently seen, but remarkably unique style of building of the Romantic era is the Octagon. The Octagon Mode was advanced through an 1849 pattern book which promoted it as a healthful and sensible innovation in building design" (Pennsylvania Historical and Museum Commission, 2015r).

During the latter part of the 19th Century, additional Victorian Era styles became popular, including "Second Empire, Romanesque Revival, Victorian Gothic, Queen Anne, Stick/Eastlake, Shingle, Renaissance Revival and Chateauesque" (Pennsylvania Historical and Museum Commission, 2015n). Also in the late 19th Century and early 20th Century, Colonial Revival and Classical Revival architecture became popular, largely as a result of the 1893 Chicago Columbian Exposition. These styles "were inspired by early American buildings of Georgian, Federal, or Greek or Roman Revival styles" (Pennsylvania Historical and Museum Commission, 2015l). Innovations in building technology led to the creation of skyscrapers during the early 20th Century and would have been found in urban areas such as Pittsburgh, Philadelphia, and Harrisburg, while in residential construction, the Prairie and Craftsman styles were in vogue (Pennsylvania Historical and Museum Commission, 2015m). Following WWII, suburbanization resulted in the development of many traditionally rural areas with large housing tracts and commercial suburban development.

Pennsylvania has a wide range of building types that display many of the aforementioned architectural styles. Religious buildings are common throughout the state, with early Quaker Meetinghouses being of particular import to Pennsylvania's history. "The building form chosen by the Quakers in Pennsylvania usually had separate entrances for men and women and separate seating areas as well. Usually one or two stories in height, this Quaker meeting house form has a side gabled roof and often small gabled door hoods" (Pennsylvania Historical and Museum Commission, 2015q). Railroad buildings were common, as they facilitating economic growth, as were schools and mill buildings (Pennsylvania Historical and Museum Commission, 2015g). Barns are also extremely common throughout the state, including the bank barn, which has a strong association with Pennsylvania's agricultural history. Bank barns were built into the hillside, which allowed direct access to two levels of the barn. These are linked to Pennsylvania's German settlers (Pennsylvania Historical and Museum Commission, 2015i).

Philadelphia has always been a leader architecturally, with architects like Benjamin Henry Latrobe designing buildings throughout the city. The Bank of Pennsylvania and early portions of the University of Pennsylvania are two examples that no longer exist. Independence Hall (the Pennsylvania State House), which is a National Historical Park contributing property and a United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Site, anchors the historic portion of the city and draws numerous tourists who wish to pay homage to the signers of the Declaration of Independence and Founding Fathers (NPS, 2014g) (UNESCO, 2015a).

Pennsylvania is known for its history associated with the iron and steel industry. The first iron furnaces were built in 1716 in the southeastern portion of the state, but eventually spread as the industry grew. Western Pennsylvania, Pittsburgh in particular, came to dominate the steel industry in the mid-to-late 19th Century. Resources related to this history are common today and are significant to the development of the state (NRHP, 1991).

Figure 12.1.11-6: Representative Architectural Styles of Pennsylvania

- Top Left: Newmyer House (Pennsville, PA) – (Historic American Buildings Survey, 1933a)
- Bottom Left: Buckingham Friends Meeting House (Lahaska, PA) – (Historic American Buildings Survey, 1933b)
- Top Right: Steel Mill (Pittsburgh, PA) – (Rothstein, 1938)
- Bottom Center: Independence Hall (Philadelphia, PA) – (Highsmith, 1980)
- Bottom Right: Yoder Barn (Lobachsville, PA) – (Historic American Buildings Survey, 1933c)

12.1.12. Air Quality

12.1.12.1. 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[146] 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)[147] or micrograms per cubic meter ($\mu g/m^3$) determined over various periods of time (averaging time).[148] This section discusses the existing air quality in Pennsylvania. The USEPA designates areas within the U.S. as attainment,[149] nonattainment,[150] maintenance,[151] or unclassifiable[152] 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.

12.1.12.2. 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[153] or secondary,[154] 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, 2011). HAPs can have severe adverse impacts on human health and the environment, including increased risk of cancer, reproductive issues, or birth defects. HAPs are

[146] Topography: The unique features and shapes of the land (e.g., valleys and mountains).
[147] Equivalent to 1 milligram per liter (mg/L).
[148] 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, 2015o)
[149] Attainment areas: Any area that meets the national primary or secondary ambient air quality standard for the pollutant. (USEPA, 2015i)
[150] 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, 2015i)
[151] 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, 2015i)
[152] 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, 2015i)
[153] 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, 2014g)
[154] 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, 2014g)

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 federal NAAQS, Pennsylvania maintains its own air quality standards, the Pennsylvania Ambient Air Quality Standards (PAAAQS). Table 12.1.12-1 presents an overview of the PAAAQS as defined by the Pennsylvania DEP.

Table 12.1.12-1: Pennsylvania Ambient Air Quality Standards (PAAAQS)

Pollutant	Averaging Time	Primary Standard		Secondary Standard		Notes
		μg/m^3	ppm	μg/m^3	ppm	
Beryllium	30-Day	0.01	-	-	-	Not identified as primary or secondary.
H_2S	1-hour	-	0.1	-	-	Not identified as primary or secondary.
	24-hour	-	0.005	-	-	
Fluorides	24-hour	5	-	-	-	Not identified as primary or secondary.
CO	8-hour	-	9	-	-	Not to be exceeded more than once per year.
	1-hour	-	35	-	-	
Lead	Rolling 3-month	0.15	-	Same as Primary		Not to be exceeded.
NO_X	1-hour	-	0.1	-	-	98th percentile averaged over 3 years.
	Annual	-	0.053	Same as Primary		Annual Mean.
PM_{10}	24-hour	150	-	Same as Primary		Not to be exceeded more than once per year on average over 3 years.
$PM_{2.5}$	Annual	12	-	15	-	Annual mean, averaged over 3 years.
	24-hour	35	-	Same as Primary		98th percentile averaged over 3 years.
O_3	8-hour	-	0.075	Same as Primary		Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years.
SO_X	1-hour	-	0.075	-	-	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years.
	3-hour	-	-	-	0.5	Not to be exceeded more than once per year.

Source: (Pennsylvania DEP, 2015f)

Title V Operating Permits/State Operating Permits

Pennsylvania 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, 2015q). The overall goal of the Title V program is to "reduce violations of air pollution laws and improve enforcement of those laws" (USEPA, 2015q). The Title V Operating Permits Rule, codified on the Pennsylvania DEP website, describes the applicability of Title V operating permits (Pennsylvania DEP, 2015ag). Pennsylvania requires Title V operating permits for any major source if it emits or has the potential to emit pollutants in excess of the major source thresholds (Table 12.1.12-2). The permit issued to a facility contains both state and federal portions and incorporates a reporting schedule (USEPA, 2014h).

Table 12.1.12-2: Major Air Pollutant Source Thresholds

Any Pollutant	100 Tons per Year
Single Hazardous Air Pollutant (HAP)	10 Tons per Year
Total/Cumulative HAPs	25 Tons per Year

Source: (USEPA, 2014h)

Exempt Activities

Pennsylvania DEP requires both plan approvals (pre-construction permit authorizations) and operating permits for major air pollution sources. The following select activities, as defined by the Pennsylvania Air Quality Permit Exemptions, Document 275-2101-003, are exempt from plan approvals identified in Title 25 PA Code Chapter 127:

- "Combustion units rated at 2.5 million or less Btus per hour of heat input;
- Mobile sources;
- Other sources and classes of sources determined to be of minor significance by the [DEP]; and
- Physical changes to sources when the [DEP] has determined the physical changes to be of minor significance." (Pennsylvania DEP, 2013f)

The following select activities, as defined by the Pennsylvania Air Quality Permit Exemptions, Document 275-2101-003, are exempt from the plan approval requirements of Title 25 PA Code Chapter 127.11 and 127.12:

- "Combustion turbines rated at less than 1,000 horsepower or 10.7 gigajoules per hour;
- Internal combustion engines rated at less than 100 brake horsepower. Note Category 38 addresses oil and gas facilities;
- Portable, temporary internal combustion engines used for 14 days or less at special events (such as county fairs, circuses, and concerts);
- Portable crushers that are controlled with properly located water sprays or with fabric filters, have a rated capacity less than 150 tons per hour, operated during daylight, and located on a site for less than 60 days; provided, however, that the crushers do not process materials containing asbestos.
  - This exemption includes; associated screens and drop points; tub grinders used to mulch grubbing waste; and internal combustion engines regardless of size, with combined NOx emissions less than 100 lbs/hr, 1000 lbs/day, 2.75 tons per ozone season and 6.6 tons per year on a 12-month rolling basis for all exempt engines at the site." (Pennsylvania DEP, 2013f)

The Pennsylvania Air Quality Permit Exemptions, Document 275-2101-003, defines trivial activities as "those located within a facility, which do not create air pollution in significant amounts." The following activities are exempt from operating permits and plan approvals:

- "Combustion emissions from propulsion of mobile air contamination sources…;
- Any equipment, machine or device from which emission of air contaminant does not occur; and
- Portable electrical generators that can be moved by hand from one location to another." (Pennsylvania DEP, 2013f)

The Pennsylvania Air Quality Permit Exemptions, Document 275-2101-003 states, "An existing facility which does not have the potential to emit exceeding the Title V facility thresholds and which does not have actual emissions exceeding the levels shown below (Table 12.1.12-3) is exempt from the requirement to obtain an operating permit." (Pennsylvania DEP, 2013f)

Table 12.1.12-3: Exemption Criteria for Operating Permits

Pollutant	Potential to Emit <	Actual Emission Rate <
CO	100 Tons per Year	20 Tons per Year
NO_x	100 Tons per Year	10 Tons per Year
SO_x	100 Tons per Year	8 Tons per Year
PM_{10}	100 Tons per Year	3 Tons per Year
VOCs	50 Tons per Year	8 Tons per Year
Single HAP	10 Tons per Year	1 Ton per Year
Multiple HAPs	25 Tons per Year	2.5 Tons per Year

Source: (Pennsylvania DEP, 2013f)

The NO_x and volatile organic compound (VOC) potential to emit (PTE) thresholds are 25 tons per year for Bucks, Chester, Delaware, and Montgomery counties located in a Severe Ozone nonattainment area. Sources located in Allegheny and Philadelphia counties need to consult with their respective air quality control office because sources in those areas may be subject to different permitting requirements. (Pennsylvania DEP, 2013f)

De Minimis Emission Increases

Pennsylvania DEP may allow *de minimis* emission increases from new or existing sources as a condition of an operating permit if:

- The new or existing source would not increase emissions of a pollutant regulated under section 112 of the Clean Air Act except as specified for PM_{10} and VOC below.
- It would subject the facility to prevention of significant deterioration of air quality or new source review permit requirements.
- It would violate an applicable requirement of the Pennsylvania's Air Pollution Control Act, the Clean Air Act or the regulations promulgated under either Act. (Pennsylvania DEP, 2013f)

The maximum *de minimis* emission rate increases (in tons per year) Pennsylvania DEP can authorize in a permit are as follows:

- Four tons of carbon monoxide from a single source and 20 tons of carbon monoxide.
- One ton of NO_x from any source and 5 tons of NO_x total from the facility.
- One and six-tenths tons of SO_x from any source and 8.0 tons SO_x total from the facility.
- Six-tenths of a ton of PM_{10} from any source and 3.0 tons of PM_{10} total from the facility.
- One ton of VOCs from any source and 5 tons of VOCs total from the facility. (Pennsylvania DEP, 2013f)

Sources of Particulate Matter

The following select activities, as defined by the Pennsylvania Air Quality Permit Exemptions, Document 275-2101-003, are exempt from the plan approval requirements of Title 25 PA Code Chapter 127.11 and 127.12:

“Sources of particulate matter (not subject to NESHAPs, New Source Performance Standards, Prevention of Significant Deterioration (PSD), or major source requirements) that are controlled by a baghouse, have an emission rate which meets the limits of Chapter 123 (Standards for Containments), and are exhausted indoors and cannot be bypassed to exhaust to the outdoor atmosphere. These sources should not emit more than 0.12 ton per year of lead, 1 tons per year of a single HAP or 2.5 tons per year of a combination of HAPs. Multiple sources within this category are exempt from plan approval requirements:

- Sources that exhaust to a filter/baghouse and have particulate loading (before control) below limits specified in Chapter 123 (Standards for Containments);
- Combustion units with a rated capacity of less than 10 million Btus per hour of heat input fueled by natural gas supplied by an independent gas producer. Sources firing natural gas supplied by an independent producer shall be given the same consideration given sources that fire natural gas provided by a public utility;
- Sources of uncontrolled VOC emissions not addressed elsewhere in this exemption listing modified or newly added, such that emission increases are less than 2.7 tons per year. Facilities' claiming this exemption must provide a 15-day prior written notification to the [DEP] and limit VOC emission increases to less than 2.7 tons per year;
- Any source qualifying for exemption based on criteria contained in a general permit developed in accordance with the procedures described in § 127.601 through 127.642 [General Plan and Operating Permit approvals for sources as temporary locations]; and
- Any source granted an exemption by the [DEP] through the execution of a Request for Determination of Requirement for Plan Approval/Operating Permit form.” (Pennsylvania DEP, 2013f)

Temporary Emissions Sources Permits

Pennsylvania does not have regulations for temporary emission source permitting.

State Preconstruction Permits

Pennsylvania DEP requires facility owners or operations to obtain written approval before they begin to construct, modify, or operate a source, emissions unit, or any equipment that emits air contaminants in Pennsylvania. Written approval from DEP involves first obtaining a pre-construction permit authorization known as a Plan Approval that allows an entity to construct, install, or modify emission sources at a facility. Next, the entity must obtain an Operating Permit in order to operate the new or modified emission source at the facility. (Pennsylvania DEP, 2007)

Plan approvals are required for sources that have potential emissions that exceed the major source thresholds (Table 12.1.12-2) (Pennsylvania State of Independence commonwealth enterprise portal, 2015). Pennsylvania requires completed Plan Approvals before beginning any construction or emissions activities, unless the activities are listed as exempt in Section 3.12.2.3 of this document (Pennsylvania DEP, 2000).

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, 2013a). An action in designated nonattainment and maintenance areas would be evaluated for the emission of those particular pollutants under the General Conformity Rule through an applicability analysis. Pursuant to Title 40 CFR 93.153(d)(2) and (e), federal actions "in response to emergencies which are typically commenced on the order of hours or days after the emergency" and actions "which are part of part of a continuing response to emergency or disaster" that are taken up to 6 months after beginning response activities, will be exempt from any conformity determinations (U.S. Government Publishing Office, 2010).

The estimated pollutant emissions are compared to *de minimis*[155] levels. These values are the minimum thresholds for which a conformity determination must be performed (Table 12.1.12-4). All Pennsylvania counties lie in the Ozone Transport Region (OTR). As a result, lower *de minimis* thresholds for VOCs and NO_X could apply depending on the attainment status of a county.

Table 12.1.12-4: *De Minimis* Levels

Pollutant	Area Type	Tons per Year
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)

155 Small amount or minimal.

If an action does not result in an emissions increase above the *de minimis* levels in Table 12.1.12-4, 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 12.1.12-4, 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[156], 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 Requirements

Pennsylvania's SIP is composed of many related actions to ensure ambient air concentrations of the six criteria pollutants comply with the NAAQS. Pennsylvania's SIP is a conglomeration of separate actions taken for each of the pollutants. All of Pennsylvania's SIP actions are codified under 40 CFR Part 52 Subpart NN. A list of SIP actions and revisions can be found at http://www.dep.pa.gov/Business/Air/BAQ/Regulations/Pages/Implementation.aspx#.VsaYPnYo6Uk for all six criteria pollutants (Pennsylvania DEP, 2015y).

12.1.12.3. Environmental Setting: Ambient Air Quality

Nonattainment Areas

The USEPA classifies areas as attainment, nonattainment, maintenance, or unclassifiable for six criteria pollutants. When evaluating an area's air quality against regulatory thresholds (i.e., permitting and general conformity), maintenance areas are often combined with nonattainment, while unclassifiable areas are combined with attainment areas. Figure 12.1.12-1 and Table 12.1.12-5 present the current nonattainment areas in Pennsylvania as of January 30, 2015. Table 12.1.12-6 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 when USEPA promulgated an ambient air quality standard for that pollutant. Note certain pollutants have more

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

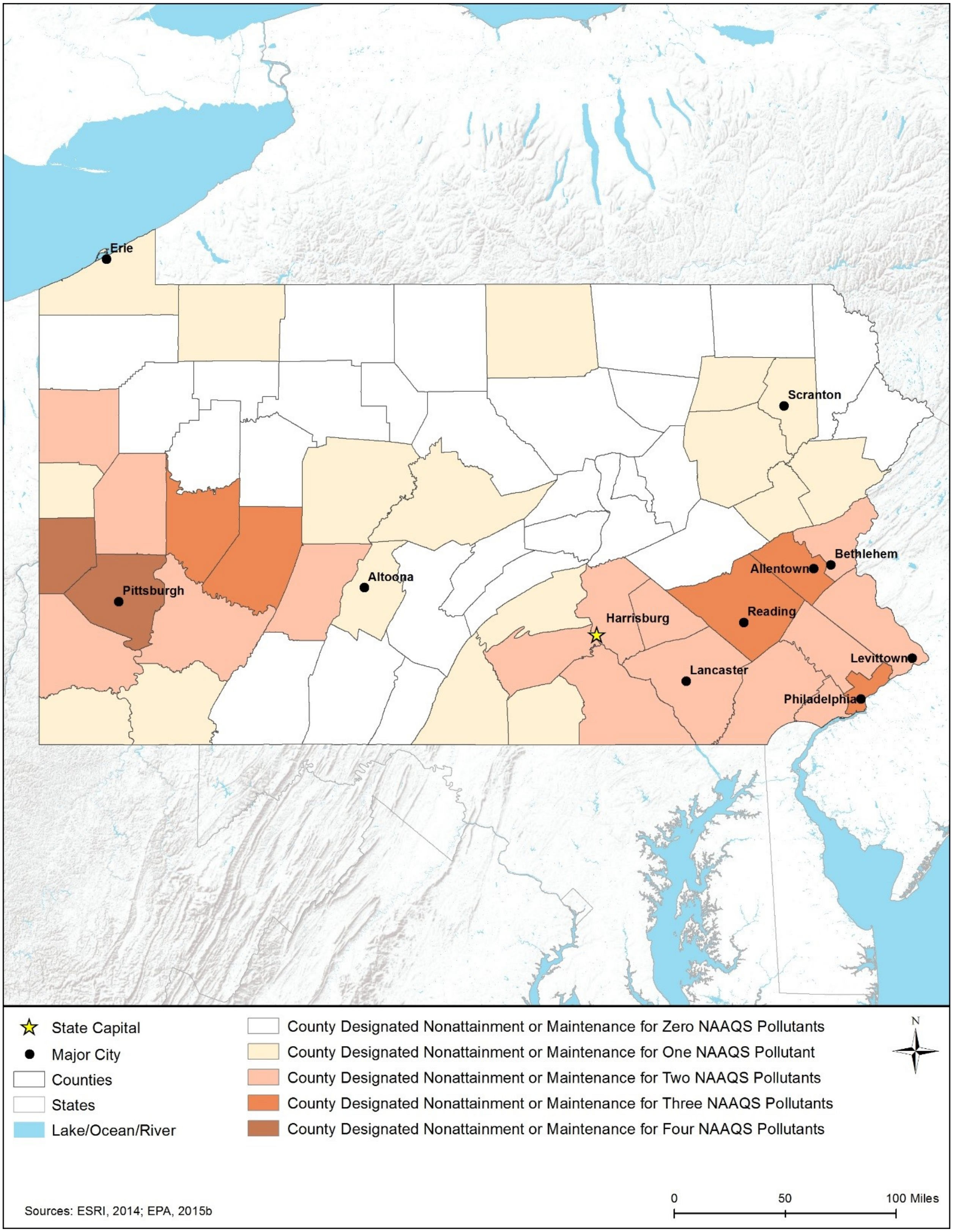


Figure 12.1.12-1: Nonattainment and Maintenance Counties in Pennsylvania

than one standard in effect (e.g., $PM_{2.5}$, O_3, and SO_x). Unlike Table 12.1.12-5, Figure 12.1.12-1 does not differentiate between standards for the same pollutant. Additionally, given that particulate matter is a criteria pollutant of concern, PM_{10} and $PM_{2.5}$ are merged in the figure and presented as a single pollutant.

Table 12.1.12-5: Pennsylvania Nonattainment and Maintenance Areas by Pollutant Standard 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
Adams								M			
Allegheny	M				M	X-4	X-4	X-4	X-5	M	X-6
Armstrong						X-4	X-4	X-4	X-5	X-6	X-6
Beaver			X-6			X-4	X-4	X-4	X-5		X-6
Berks			X-6			X-4		M	X-5		
Blair								M			
Bucks						X-4	X-4	X-4	X-5		
Butler						X-4	X-4	X-4	X-5		
Cambria						X-4	X-4	M			
Carbon								M	X-5		
Centre								M			
Chester						X-4	X-4	X-4	X-5		
Clearfield								M			
Cumberland						M	M	M			
Dauphin						M	M	M			
Delaware						X-4	X-4	X-4	X-5		
Erie								M			
Fayette								X-4	X-5		
Franklin								M			
Greene						X-4	X-4	M			
Indiana						X-4	X-4	M			X-6
Lackawanna								M			
Lancaster						X-4	X-4	M	X-5		
Lawrence						X-4	X-4				
Lebanon						M	M	M			
Lehigh							X-4	M	X-5		
Luzerne								M			
Mercer								M			
Monroe								M			
Montgomery						X-4	X-4	X-4	X-5		
Northampton							X-4	M	X-5		
Perry								M			
Philadelphia	M					X-4	X-4	X-4	X-5		
Tioga								M			
Warren										M	X-6
Washington						X-4	X-4	X-4	X-5		
Westmoreland						X-4	X-4	X-4	X-5		
Wyoming								M			
York						M	M	M			

Source: (USEPA, 2015n)

X-1 = Nonattainment Area (Extreme)

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

Air Quality Monitoring and Reporting

Pennsylvania DEP measures air pollutants at 44 remote stations as part of the Commonwealth of Pennsylvania Air Monitoring System (Pennsylvania DEP, 2015ad). DEP prepares annual Pennsylvania State Ambient Air Quality Reports containing pollutant data summarized by region. Due to the health risks associated with higher levels of criteria pollutants, DEP reports real-time pollution levels on their website for O_3, PM_{10}, $PM_{2.5}$, SO_2, CO, and NO_2.

Air Quality Control Regions

USEPA classified all land in the U.S. as a Class I, Class II, or Class III Federal Air Quality Control Region (AQCR). 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, 2013b).

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[157] 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 USEPA 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[158] (the normal useful range of USEPA-approved Gaussian plume models" (USEPA, 1992).

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

Pennsylvania does not contain any federal Class I areas; all land within Pennsylvania is classified as Class II (USEPA, 2012b). If an action is considered major source and consequently subject to PSD requirements, the air quality impact analysis need only analyze the impacts to air quality within 100 kilometers from the source (USEPA, 1992). New Jersey has one Class I area and West Virginia has two Class I areas where the 100-kilometer buffer intersects a few Pennsylvania cities. The Regional Office must notify the FLMs on any PSD-applicable action within these counties. Figure 12.1.12-2 provides a map highlighting all relevant Class I areas within the 100-kilometer radius from Pennsylvania's boarder. The numbers next to each of the highlighted Class I areas in Figure 12.1.12-2 correspond to the numbers and Class I areas listed in Table 12.1.12-6.

Table 12.1.12-6: Relevant Federal Class I Areas

No.	Area	Acreage	State
1	Otter Creek Wilderness	20,000	WV
2	Dolly Sod Wilderness	10,215	WV
3	Brigantine Wilderness	6,603	NJ

Source: (USEPA, 2012b)

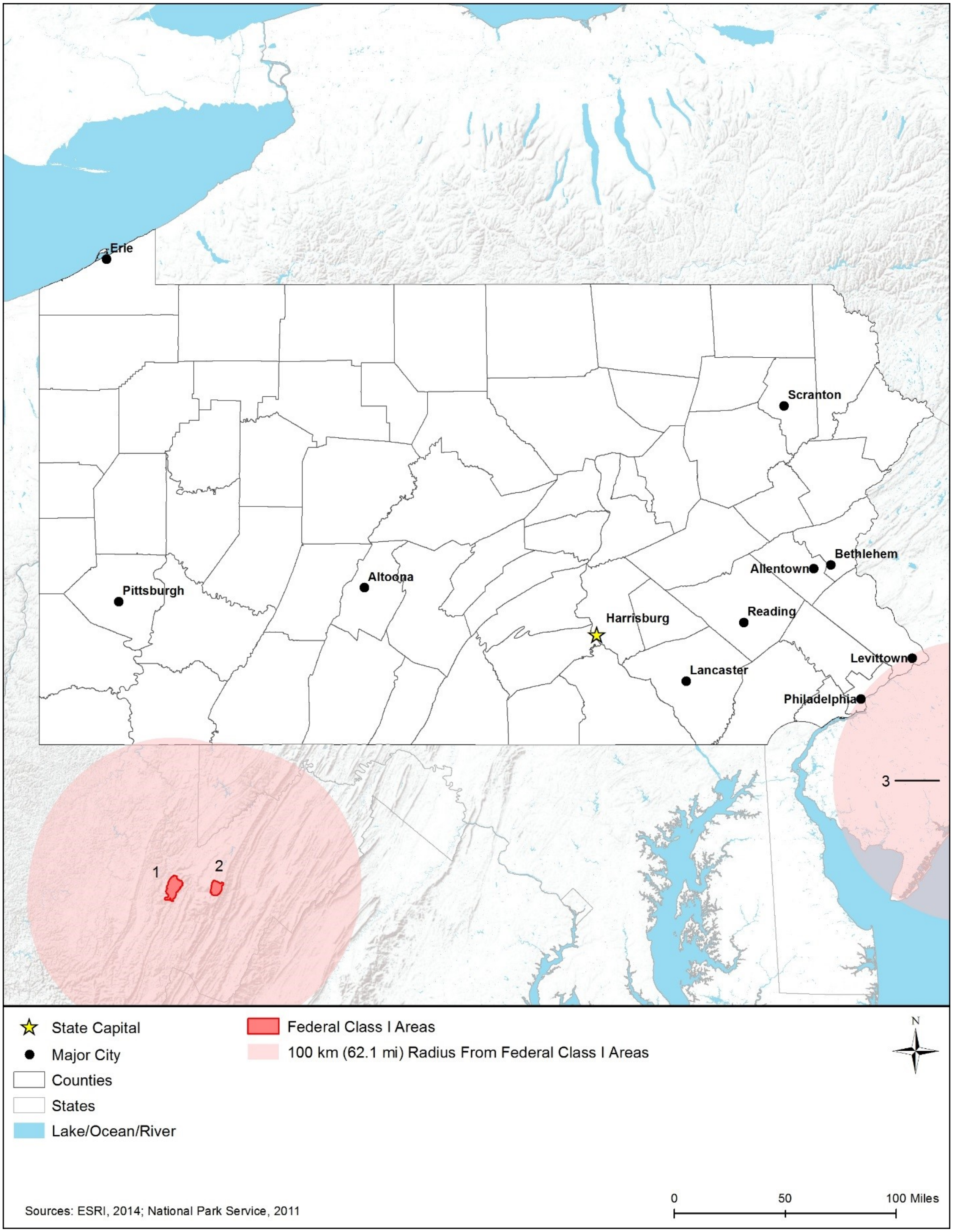


Figure 12.1.12-2: Federal Class I Areas with Implications for Pennsylvania

12.1.13. Noise

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

12.1.13.1. Definition of the Resource

Noise is caused by pressure variations that the human ear can detect and is often defined as unwanted sound (USEPA, 2012d). Noise is one of the most common environmental issues that interferes with normal human activities and otherwise diminishes the quality of the human environment. Typical sources of noise that result in this type of interference in urban and suburban surroundings includes interstate and local roadway traffic, rail traffic, industrial activities, aircraft, and neighborhood sources like lawn mowers, leaf blowers, etc.

The effects of noise can be classified into three categories:

- Noise events that result in annoyance and nuisance;
- Interference with speech, sleep, and learning; and
- Physiological effects such as hearing loss and anxiety.

Fundamentals of Noise

For environmental noise analyses, a noise metric refers to the unit that quantitatively measures the effect of noise on the environment. The unit used to describe the intensity of sound is the decibel (dB). Audible sounds range from 0 dB (“threshold of hearing”) to about 140 dB (“threshold of pain”). The normal audible frequency range is approximately 20 Hz to 20 kHz (FAA, 2015b). 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 (Occupational Safety Health Administration, 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 12.1.13-1 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 (OSHA, 2013).

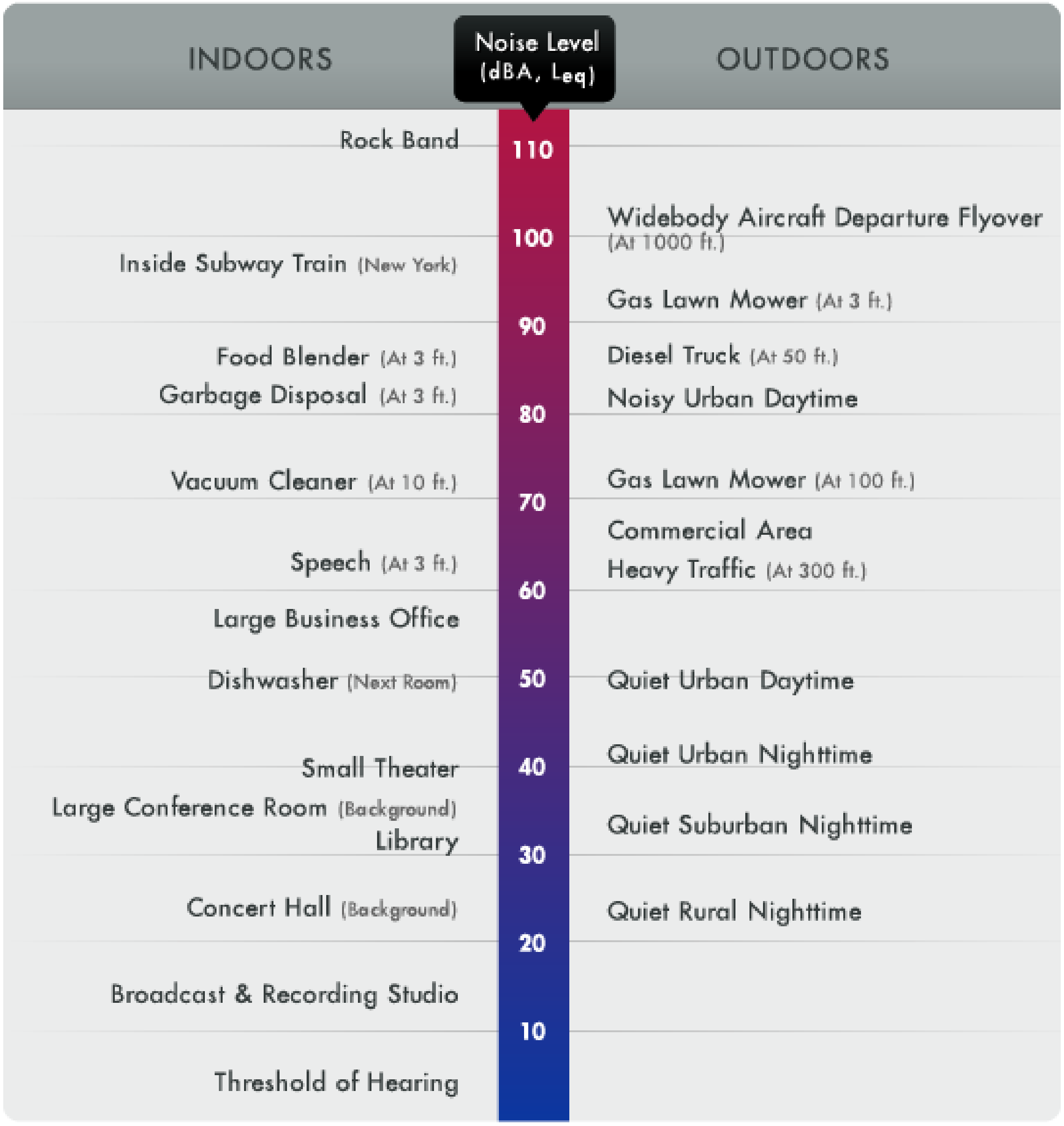


Figure 12.1.13-1: Sound Levels of Typical Sounds

Source: (Sacramento County Airport System, 2015)

Prepared by: Booz Allen Hamilton, 2005

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 causing an adverse community response.

In general, ambient noise levels are higher during the day than at night and typically this difference is about 10 dB (USEPA, 1973). Ambient noise levels can differ considerably depending on whether the environment is urban, suburban, or rural.

12.1.13.2. 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.

Pennsylvania's statewide noise laws cover noise emissions from motor vehicles, including emergency vehicles, all-terrain vehicles, and snowmobiles (Pennsylvania General Assembly, 2014). In addition, many cities and towns may have local noise ordinances to 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 Philadelphia, are likely to have different regulations than rural or suburban communities largely due to the population density and difference in ambient noise levels (FHWA, 2011). Table 12.1.13-1 summarizes Pennsylvania's relevant noise laws.

Table 12.1.13-1: Relevant Pennsylvania Noise Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Title 75-4523	Pennsylvania General Assembly	Sets the compliance standards for motor vehicle equipment.
Title 75-4535	Pennsylvania General Assembly	States applicability and exceptions for motor vehicles equipped with horns.

Source: (Pennsylvania General Assembly, 2014)

12.1.13.3. Environmental Setting: Ambient Noise

The range and level of ambient noise in Pennsylvania varies widely based on the area and environment. The population of Pennsylvania can choose to live and interact in areas that are large cities, rural communities, and national and state parks. Figure 12.1.13-1 illustrates noise values for typical community settings and events that are representative of what the population of Pennsylvania may experience on a day-to-day basis. These noise levels represent a wide range and are not specific to Pennsylvania. As such, this section describes the areas where the population of Pennsylvania 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 the Interior, 2008). The areas that are likely to have the highest ambient noise levels in the state are Philadelphia, Pittsburgh, Allentown, and Erie.

- **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 Pennsylvania, Philadelphia International (PHL), Pittsburgh International (PIT), Harrisburg International (MDT), Lehigh Valley International (ABE), Wilkes-Barre/Scranton International (AVP), University Park (UNV), Arnold Palmer Regional (LBE), Erie International/Tom Ridge Field (ERI), and Williamsport Regional (IPT) have more than 854,000 annual operations combined, with PHL accounting for approximately 419,253 operations annually (FAA, 2015a). These operations result in increased ambient noise levels in the surrounding communities. See Section 12.1.1, Infrastructure 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, 2015g). 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, 2015g). See Section 12.1.1, Infrastructure, 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 (U.S. DOT, Federal Railroad Administration, 2015). Pennsylvania has multiple rail corridors with high levels of commercial and commuter rail traffic. These major rail corridors extend from Pittsburgh to Steubenville, OH; Pittsburgh to Scranton/Wilkes-Barre; and Harrisburg to Philadelphia. There are also a number of other rail corridors that join these major rail lines and connect with other cities (PADOT, 2013). See Section 12.1.1, Infrastructure 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). Pennsylvania has 18 officially designated National Parks and 27 NNLs (NPS, 2015m). Visitors to these areas expect lower ambient noise conditions than the surrounding urban areas. See Section 12.1.8, Visual Resources, for more information about national and state parks for Pennsylvania.

12.1.13.4. 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 Pennsylvania 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 Pennsylvania.

12.1.14. Climate Change

12.1.14.1. Definition of the Resource

Climate change, according to the Intergovernmental Panel on Climate Change (IPCC), is defined as "…a change in the state of the climate that can be identified (e.g., using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or human activity." (IPCC, 2007)

Accelerated rates of climate change are linked to an increase in atmospheric concentrations of greenhouse gas (GHG) primarily caused by emissions from human activities such as burning fossil fuels to generate electricity (USEPA, 2012a). 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 (NO_x), 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[159] (MT CO_2e), which equalizes for the different global warming potential of each type of GHG. Where this document

[159] CO2e 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, 2015a)

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.

The IPCC reports that "global concentrations of these four GHGs have increased significantly since 1750" with "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 concentrations of CH_4 and N_2O have increased from pre-industrial values of about 715 and 270 parts per billion (ppb) to 1774 and 319 ppb, respectively, in 2005 (IPCC, 2007). In addition, the IPCC reports that human activities are causing an increase in various hydrocarbons from near-zero pre-industrial concentrations (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, are considered in this PEIS (see Section 12.2.14, Environmental Consequences). Existing climate conditions in the project area are described first by state and sub-region, where appropriate, and then by future projected climate scenarios. The discussion focuses 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).

12.1.14.2. Applicable Statutes and Regulations

The pertinent federal laws relevant to the protection and management of climate change are summarized in Appendix C. Pennsylvania has established goals and regulations to reduce GHG emissions to combat climate change. As shown in Table 12.1.14-1, there is one state law/ regulation, which is the primary policy driver on climate change preparedness and GHG emissions.

Table 12.1.14-1: Relevant Pennsylvania Climate Change Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Pennsylvania Climate Change Act, Act 70 (July 9, 2008)	State of Pennsylvania	Act 70 required the preparation of a Climate Change Action Plan. The Plan notes a target of a 30 percent reduction in GHG emissions below year 2000 levels by 2020. (Pennsylvania DEP, 2009)

12.1.14.3. Pennsylvania Greenhouse Gas Emissions

Estimates of Pennsylvania's total GHG emissions vary. The Department of Energy's (DOE) Energy Information Agency (EIA) collects and disseminates national-level emissions data on other GHGs such as CH_4 and NO_x, but not at the state level (EIA, 2011). The USEPA also collects and disseminates national-level GHG emissions data, but by economic sector, not by state (USEPA, 2015f). Individual states have developed their own GHG inventories, which are updated with different frequencies and trace GHG in a variety of ways.

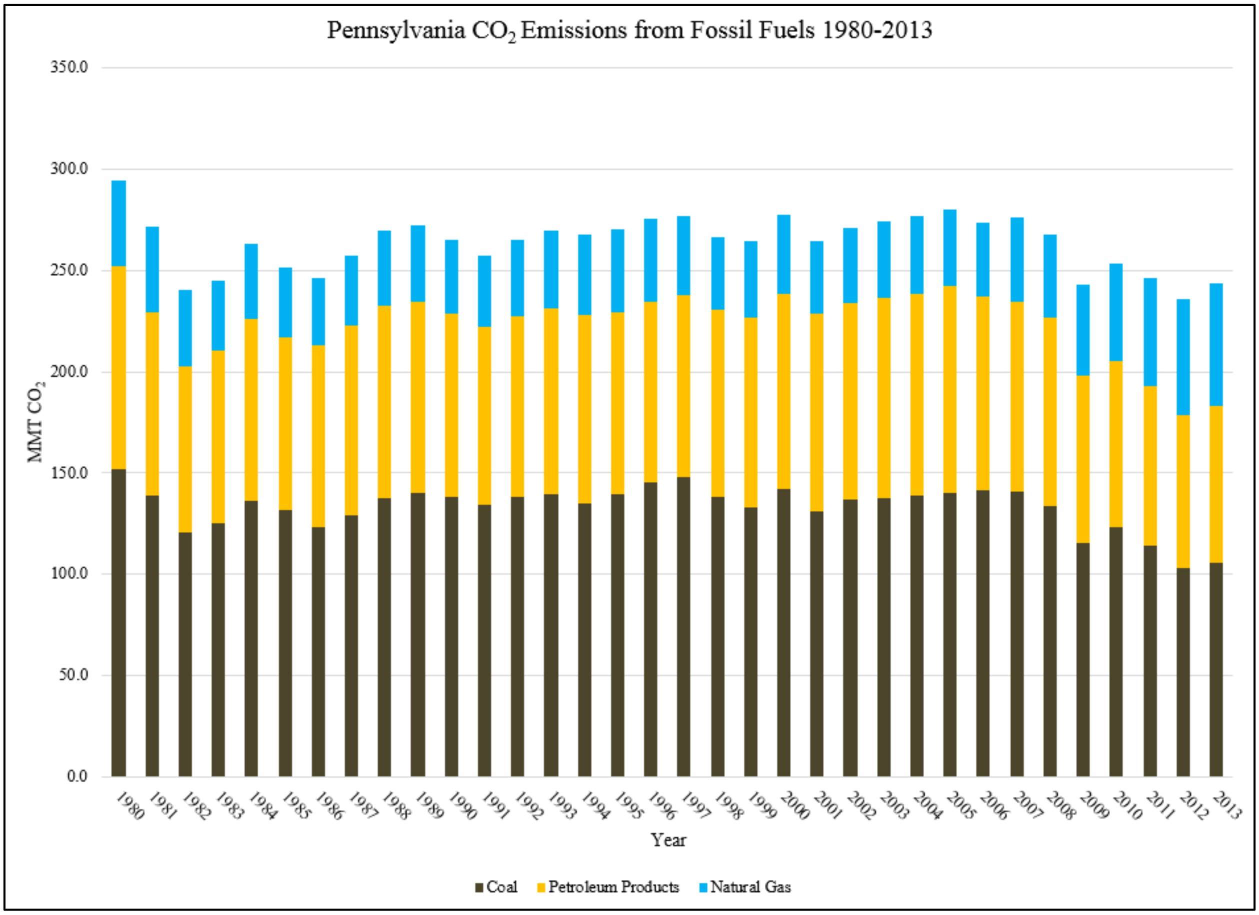
For the purposes of this PEIS, the EIA data on CO_2 emissions from fossil fuels will be used as the baseline metric to ensure consistency and comparability across the 50 states. However, if additional data sources on GHG emissions are available for a given state, including other GHGs such as CH_4, they will be described and cited.

According to the EIA, Pennsylvania is the third-highest emitter of CO_2 of all the states, emitting a total of 243.9 MMT of CO_2 from fossil fuels in 2013 (EIA, 2015c). The electric power sector is the largest emitter at nearly 50 percent of the total. Most of these emissions come from coal (Table 12.1.14-2) (EIA, 2015c). Annual emissions between 1980 and 2013 are presented in Figure 12.1.14-1. Emissions remained relatively constant between 1984 and 2005 before beginning their recent decline to 2012, and then increased in 2013. The proportion of emissions from coal, petroleum products, and natural gas has remained relatively constant during the 1984 to 2005 period. During the recent declines, natural gas-related emissions have increased and those from coal and petroleum products have decreased (EIA, 2015c). Although Pennsylvania is ranked third in the U.S. for total CO_2 emissions from fossil fuels, due to its large population, is ranked 21st in the U.S. for per capita CO_2 emissions (EIA, 2015c).

Table 12.1.14-2: Pennsylvania CO_2 Emissions from Fossil Fuels by Fuel Type and Source, 2013

Fuel Type (MMT)		**Source (MMT)**	
Coal	105.9	Residential	19.7
Petroleum Products	77.1	Commercial	10.1
Natural Gas	60.8	Industrial	49.6
		Transportation	58.6
		Electric Power	105.9
TOTAL	**243.9**	**TOTAL**	**243.9**

Source: (EIA, 2015d)



Source: (EIA, 2015d)

Figure 12.1.14-1: Pennsylvania CO_2 Emissions from Fossil Fuels by Fuel Type, 1980-2013

Total U.S. GHG emissions were 6,673 MMT (14.7 trillion pounds) in 2013 (USEPA, 2014f).

The Pennsylvania DEP commissioned Penn State University to conduct a 1990 - 1999 GHG emissions inventory in 2003 (The Pennsylvania State University, 2003). The inventory divides Pennsylvania emissions into four source sectors: transportation, residential, industrial, and commercial. All sectors have had a large impact on GHG emissions in Pennsylvania. In addition to CO_2, GHGs emitted in Pennsylvania include CH_4, NO_X and fluorinated gases such as hydrofluorocarbons (HFC) sulfur hexafluoride (SF_6) and perfluorocarbons (PFCs) (The Pennsylvania State University, 2003).

At 34.7 percent, the industrial sector accounted for the majority of these emissions in 2013. The industrial sector usually is contributed from fuel combustion to provide heating, cooking and other energy end-uses. Pennsylvania is one of the largest suppliers of coal and nuclear power on the east coast. The state is the nation's leading coal exporters with more than 20 percent of coal being exported around the world. At 51 percent in 2013, the majority of the population uses natural gas to heat their homes. The remainder of the population uses electricity and fuel oil at 21 and 18 percent respectfully (The Pennsylvania State University, 2003).

The transportation sector also has a significant impact on emissions in Pennsylvania. Motor vehicle traffic contributes to a large portion of CO_2 and increased emissions by 17 percent in 1990 to 1999. Similarly, annual vehicle miles traveled (VMT) in Pennsylvania increased by 20 percent during the same time period, with emissions steadily decreasing between 2000 and 2010 (The Pennsylvania State University, 2003). Emissions from this sector have decreased between the years 2000 and 2010 and will likely continue to decline annually. This improvement may be from falling gasoline and diesel prices or new technology that requires miles per gallon standards. In contrast, Vehicle Miles Traveled (VMT) is supposed to increase 1.4 percent a year (The Pennsylvania State University, 2003).

In 2013, energy-related CO_2 emissions have continued to decrease, even as total emissions increased Ongoing improvements in energy efficiency, a shifting economy, and a changing fossil fuel portfolio have accounted for the emissions reductions (The Pennsylvania State University, 2003) (EIA, 2015d).

12.1.14.4. 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).

Northern Pennsylvania falls into climate group (D) (see Figure 12.1.14-2). Climates classified as (D) are “moist continental mid-latitudinal climates,” with “warm to cool summers and cold winters” (NWS, 2011a). In (D) climates, the “average temperature of the warmest month is greater than 50 degrees Fahrenheit (°F), while the coldest month is less than negative 22 °F” (NWS, 2011a). Winter months in (D) climate zones are cold and severe with “snowstorms, strong winds, and bitter cold from Continental Polar or Arctic air masses” (NWS, 2011a). Whereas the majority of Pennsylvania falls into climate group (D), portions of southern Pennsylvania fall into climate group (C). In (C) climates, summers are typically warm and humid, while winters are mild (NWS, 2011a). “During the winter, the main weather feature is the mid-latitude cyclone” (NWS, 2011a). Thunderstorms are also common during summer months. Pennsylvania has four sub-climate categories, which are described in the following paragraphs (NWS, 2011a) (NWS, 2011b).

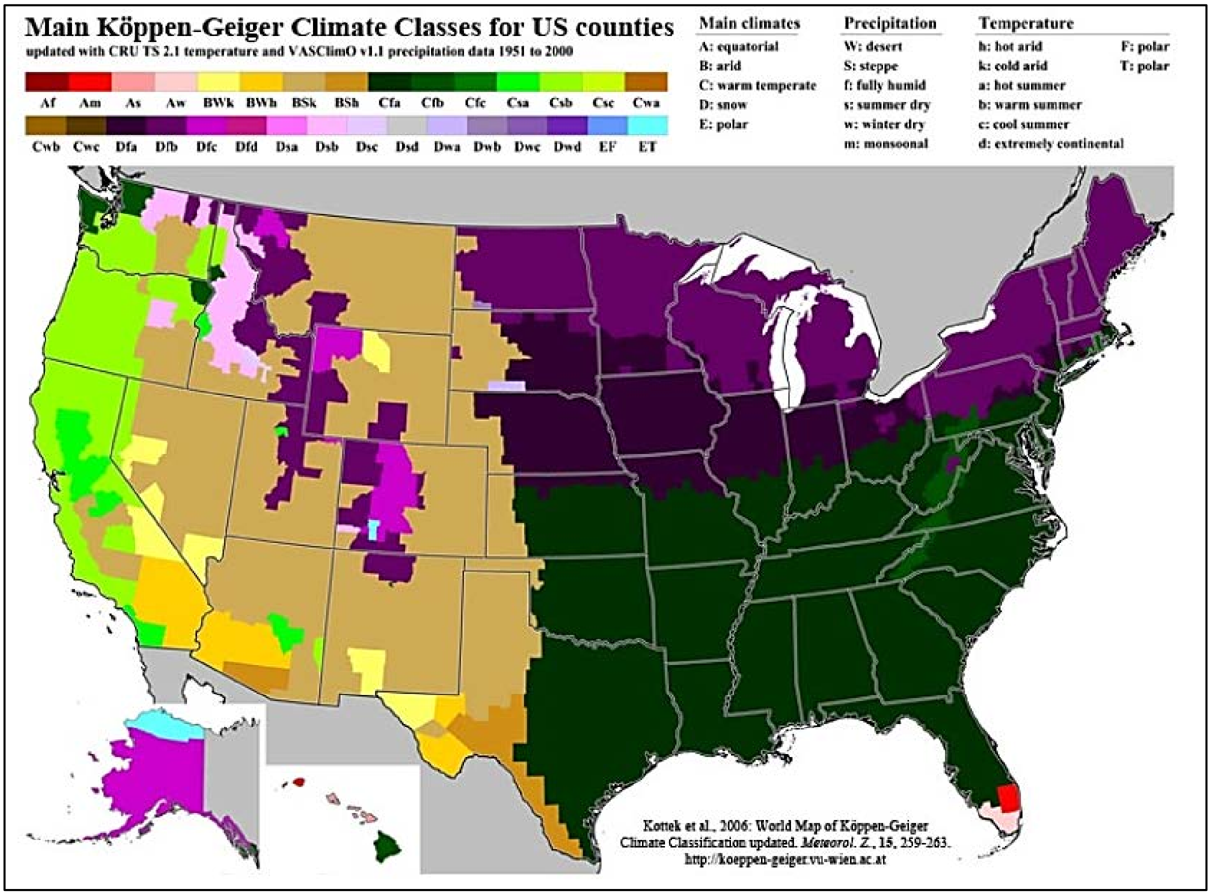


Figure 12.1.14-2: Köppen-Geiger Climate Classes for U.S. Counties

Source: (Kottek, Grieser, Beck, Rudolf, & Rubel, 2006)

Cfa – The Köppen-Geiger climate classification system classifies areas of southeastern (e.g., Philadelphia) and southwestern Pennsylvania (e.g., Pittsburgh) as Cfa. Cfa climates are generally warm, with humid summer and mild winters. Pennsylvania's secondary classification indicates year-round rainfall, but it is highly variable; thunderstorms are dominant during summer months. The tertiary classification indicates mild, hot summers with average temperatures of warm months over 72 °F. Average temperatures of the coldest months are under 64 °F (NWS, 2011a) (NWS, 2011b).

Cfb – The Köppen-Geiger climate classification system classifies areas of south and southwestern Pennsylvania, such as Johnstown, as Cfb. Climates classified as Cfb are characterized by overall mild temperatures, warm summers, and lack a dry season. The "average temperature of all months is lower than 72 °F," with at least four months averaging over 50 °F. Cfb climates are also characterized by year-round, "equally spread rainfall" (NWS, 2011b) (Kottek, Grieser, Beck, Rudolf, & Rubel, 2006) (NWS, 2011a).

Dfa – The Köppen-Geiger climate classification system classifies areas of eastern Pennsylvania, such as Allentown, as Dfa. Climates classified as Dfa are characterized by warm and humid temperatures, with hot summers and regular precipitation all year (see Figure 12.1.14-2).

Pennsylvania's Dfa climate group is a continental, mid-latitude climate. Pennsylvania's secondary classification indicates substantial precipitation during all seasons. Pennsylvania's tertiary classification indicates hot summer months, with warmer temperatures averaging above 71.6 °F (Kottek, Grieser, Beck, Rudolf, & Rubel, 2006) (NWS, 2011a) (NWS, 2011b).

Dfb – The Köppen-Geiger climate classification system classifies northeastern, northwestern, and central Pennsylvania, such as Meadville, as Dfb. Climates classified as Dfb are characterized as humid, with warm summers and snowy winters (see Figure 12.1.14-2). Pennsylvania's secondary classification indicates substantial precipitation during all seasons. Pennsylvania's tertiary classification indicates that at least four months out of the year average above 50 °F (Kottek, Grieser, Beck, Rudolf, & Rubel, 2006) (NWS, 2011a) (NWS, 2011b).

This section discusses the current state of Pennsylvania's climate with regard to air temperature, precipitation, sea level, and extreme weather events (e.g., tropical storms, tropical cyclones, and hurricanes) in Pennsylvania's four climate regions, Cfa, Cfb, Dfa, and Dfb.

Air Temperature

The highest temperature to occur in Pennsylvania was 111 °F on July 9, 1936 (NOAA, 2015g). The coldest temperature to occur in Pennsylvania was negative 42 °F on January 5, 1904 (NOAA, 2015g). The average temperature in Pennsylvania is approximately 48.1 °F (NOAA, 2015b).

The following paragraphs describe temperatures in Pennsylvania as they occur within Cfa, Cfb, Dfa, and Dfb climate classifications zones:

Cfa – Philadelphia, located in southeastern Pennsylvania, is within the climate classification group Cfa. The average annual temperature for this area is approximately 55.9 °F (NOAA, 2015c). During winter months, the average annual temperature in Philadelphia is 35.4 °F; 76.0 °F during summer months; 53.8 °F during spring months; and 58.1 °F during autumn months (NOAA, 2015c).

Cfb – Johnstown, located in southwestern Pennsylvania, is within the climate classification group Cfb. The average annual temperature for this area is approximately 47.4 °F. During winter months, the average annual temperature in Johnstown is 27.0 °F; 67.3 °F during summer months; 46.5 °F during spring months; and 49.7 °F during autumn months (NOAA, 2015c).

Dfa – Allentown, located in eastern Pennsylvania, is within the climate classification group Dfa. The average annual temperature for this area is approximately 51.2 °F. During winter months, the average annual temperature in Allentown is 30.2 °F; 71.4 °F during summer months; 49.6 °F during spring months; and 53.0 °F during autumn months (NOAA, 2015c).

Dfb – Meadville, located in northwestern Pennsylvania, is within the climate classification group Dfb. The average annual temperature for this area is approximately 48.4 °F. During winter months, the average annual temperature in Meadville is 27.2 °F; 68.4 °F during summer months; 46.5 °F during spring months; and 50.9 °F during autumn months (NOAA, 2015c).

Precipitation

Pennsylvania is a state known for "its consistency of precipitation" (Knight, 2015). In the 1990's, central areas of Pennsylvania "had one of the lowest variabilities in annual precipitation in the nation – meaning that the 40 inches of rain that fell each year did so with a high degree of reliability" (Knight, 2015). In Pennsylvania, it is rare for any reporting station "to go for an entire month without any rain," while it is very common to find stations reporting, "more than 7 inches in a month" (Knight, 2015). The greatest 24-hour precipitation accumulation to occur in Pennsylvania was on June 22, 1972 in York, with a total accumulation of 13.5 inches (NOAA, 2015g). The greatest 24-hour snowfall accumulation to occur in Pennsylvania was on March 20, 1958 in Morgantown, with a total accumulation of 38 inches (NOAA, 2015g). Pennsylvania also currently holds the "word record for rainfall in a three-hour period, with 28.70 inches of rain" tallied during the month of August 2011 in Smethport, PA (Knight, 2015). In addition to rainfall, the state also receives an abundance of snowfall. For example, during the winter of February 2010, "more than 117 inches of snow fell in the Laurel Highlands (east of Pittsburgh) establishing a new monthly record that had stood since 1890" (Knight, 2015). The average annual precipitation accumulation in Pennsylvania is approximately 41.98 inches (NOAA, 2015b).

The following paragraphs describe precipitation in Pennsylvania as it occurs within Cfa, Cfb, Dfa, and Dfb climate classifications zones:

Cfa – Philadelphia, located in southeastern Pennsylvania, is within the climate classification group Cfa. The average annual precipitation for this area is approximately 41.53 inches (NOAA, 2015c). During winter months, the average annual precipitation in Philadelphia 9.24 inches; 11.28 inches during summer months; 11.06 inches during spring months; and 9.95 during autumn months (NOAA, 2015c).

Cfb – Johnstown, located in southwestern Pennsylvania, is within the climate classification group Cfb. The average annual precipitation for this area is approximately 41.10 inches. During winter months, the average annual precipitation in Johnstown is 7.80 inches; 11.71 inches during summer months; 11.41 inches during spring months; and 10.18 inches during autumn months (NOAA, 2015c).

Dfa – Allentown, located in eastern Pennsylvania, is within the climate classification group Dfa. The average annual precipitation for this area is approximately 45.35 inches. During winter months, the average annual precipitation in Allentown is 9.31 inches; 12.95 inches during summer months; 11.09 inches during spring months; and 12.00 inches during autumn months (NOAA, 2015c).

Dfb – Meadville, located in northwestern Pennsylvania, is within the climate classification group Dfb. The average annual precipitation for this area is approximately 40.90 inches. During winter months, the average annual temperature in Meadville is 6.55 inches; 13.03 inches during summer months; 10.03 inches during spring months; and 11.29 inches during autumn months (NOAA, 2015c).

Sea Level

Pennsylvania has approximately 57 miles of coastline along the Delaware Estuary and 63 miles of shoreline along Lake Erie (NOAA, 2015c). Since 1900, sea levels along the Delaware Estuary have risen approximately 30 centimeters (or one foot) "due to both globally rising seas and subsidence in the Mid-Atlantic region" (Delaware Valley Regional Planning Commission, 2004). Currently, relative sea level rise in Pennsylvania is increasing by approximately 0.1100 inches per year (USEPA, 2014e). States such as Pennsylvania are particularly susceptible to "increased flooding and the gradual submergence of low-lying lands" (USEPA, 2014e). For example, "approximately 10 square kilometers of lands is less than one meter above high tide" (USEPA, 2014e). Pennsylvania's coast is also influenced by "relatively large tidal fluctuations," as the tide ranges from approximately 1.8 to 2.4 inches in the Delaware River and Bay region (Delaware Valley Regional Planning Commission, 2004). As global sea level continues to rise, low-lying areas of Pennsylvania will require more aggressive flood adaptation and mitigation (USEPA, 2014e).

"Compared to many other coastal states, Pennsylvania has a relatively small amount of extremely low-lying land: six square kilometers of land (mostly tidal wetlands) lie below 1.5 meters and an additional seven square kilometers of non-tidal wetlands and 25 square kilometers of dry land lie between 1.5 and 2.5 meters" (Delaware Valley Regional Planning Commission, 2004). Although Pennsylvania has a relatively low percentage of low-lying land compared to other coastal states, Pennsylvania is still susceptible to the effects of sea level rise, such as "increased flooding and the migration of the salt line further up tidal rivers and streams" (Delaware Valley Regional Planning Commission, 2004). Furthermore, "since the state has a large amount of heavily developed land below six meters (20 feet) in elevation, sea level rise poses a particularly serious long-term threat for Pennsylvania" (Delaware Valley Regional Planning Commission, 2004).

Severe Weather Events

In Pennsylvania, the most common form of severe weather is destructive flooding. For example, on May 31, 1889 a "catastrophic failure of the South Fork Dam on the Little Conemaugh River, approximately 14 miles upstream of Johnstown, PA, resulted in one of the worst natural catastrophes in the history of the U.S., creating the largest loss of life from a natural disaster not caused by a hurricane or earthquake" (National Weather Service, 2015a). Upon dam failure, "the flood wave produced a wall of water 35 feet high and a half mile wide, moving rapidly down the narrow valley at 40 miles an hour" (National Weather Service, 2015a). The Great Flood of 1889 "killed 2,209 people, destroyed 1,600 homes, and produced 17 million in damages (1889 dollars)" (National Weather Service, 2015a).

During the snowmelt floods in January 1996, "a series of major winter storms brought record snow packs to much of the state for the first half of January" (National Weather Service, 2015a). During this storm, rapid snowmelt and heavy rainfall "quickly brought large volumes of water into the rivers and streams, many of which were frozen" (National Weather Service, 2015a). As a result, flooding was reported in 57 out of 67 counties in the state (National Weather Service, 2015a).

Tropical storms and hurricanes have also lead to destructive flooding in Pennsylvania. For example, "Hurricane Irene rewrote the record books in the Delaware Valley as more than 20 inches of rain was tallied for the month of August 2011" (Knight, 2015). During August 1955, Hurricanes Connie and Diane hit eastern Pennsylvania in quick succession, leading to "the most destructive flooding in history to a large part of eastern Pennsylvania" (National Weather Service, 2015a). Hurricane Connie resulted in 6 to 10 inches of total rainfall accumulation and Hurricane Diane resulted in approximately 7 to 9 inches in a 6-hour period (National Weather Service, 2015a). Flooding from both hurricanes resulted in approximately $70 million in damages statewide (National Weather Service, 2015a).

Severe thunderstorms (including hail and wind) are also common to Pennsylvania. Between 1950 and 2004, each county in Pennsylvania experienced a minimum of 44 severe thunderstorms, with the majority of counties experiencing a minimum of 100 severe thunderstorms. In central Pennsylvania, a record-breaking 189 severe thunderstorms occurred in one single county (National Weather Service, 2015b).

Tornados also occur throughout Pennsylvania. Between 1881 and 2010, each county in Pennsylvania experienced a minimum of two tornados, although the majority of counties experienced at least 10 or more tornados. In northwestern Pennsylvania, a record-breaking 36 tornados occurred in one single county. Tornados in Pennsylvania most commonly occur in June and July (National Weather Service, 2015b).

12.1.15. Human Health and Safety

12.1.15.1. 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. RF is evaluated in Section 2.4, Radio Frequency Transmissions. Vehicle traffic and the transportation of hazardous materials and wastes are evaluated in Section 12.1.1, Infrastructure.

12.1.15.2. Specific Regulatory Considerations

Federal organizations, such as the Occupational Safety and Health Administration (OSHA), USEPA, the U.S. Department of Health and Human Services, and others protect human health and the environment. In Pennsylvania, public sector occupational safety is regulated by the Pennsylvania Department of Labor and Industry (PADLI), and the DEP regulates waste and environmental pollution. Federal OSH regulations apply to workers through either OSHA, or stricter state-specific plans, which must be approved by OSHA. Pennsylvania does not have an OSHA-approved "State Plan," so private and public sector occupational safety and health programs in the state are enforced by OSHA. Health and safety of the general public is regulated by the Pennsylvania Department of Health (PADOH).

Federal laws relevant to protecting occupational and public health and safety are summarized in Appendix C. Table 12.1.15-1 below summarizes the major Pennsylvania laws relevant to the state's occupational health and safety, hazardous materials, and hazardous waste management programs.

Table 12.1.15-1: Relevant Pennsylvania Human Health and Safety Laws and Regulations

State Law/Regulation	Agency	Applicability
Pennsylvania Code, Title 25, Part I, Subpart D, Article VII	Pennsylvania DEP	Details regulations pertaining to hazardous waste generators and handlers, management of specific waste types, and land disposal restrictions.
Laws of Pennsylvania, Act 1995-2	Pennsylvania DEP	Encourages voluntary cleanup and development of commercial and industrial properties to eliminate public health risks and environmental hazards.
Pennsylvania Code, Title 34, Part 1	Pennsylvania Department Of Labor and Industry (PADLI)	Presents standards for construction safety, flammable and combustible liquids, lifting apparatuses, and mine safety.
Pennsylvania Code, Title 25, Chapter 208	Pennsylvania DEP	Outlines safety, training, and emergency response regulations for underground mines.
Pennsylvania Abandoned Mine Reclamation Plan	Pennsylvania DEP	Describes priorities to protect public health and safety from the adverse effects of coal mining and restore land degraded by mining.

12.1.15.3. 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, using trenches, inside 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, 2015a). 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, as well as to 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[160] are examples of when trenching or confined space work is necessary. Installation of telecommunication activities involves laying conduit and limited trenching (generally 6 to 12 inches in width) would occur. 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 construction 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

[160] 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.

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 12.1.13, Noise) (OSHA, 2002). Fugitive noise may emanate beyond the telecommunication work site and impact the public living in the vicinity, observing the work, or transiting through the area.

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), or telecommunication line installers and repairers (SOC code 49-9052). Both occupations are reported under the installation, maintenance and repair occupations (SOC code 49-0000).

As of May 2014, Pennsylvania employed 7,340 telecommunication line installers and repairers, and 5,050 telecommunication equipment installers and repairers (Figure 12.1.15-1) (BLS, 2015c). In 2012, the most recent data available, Pennsylvania had 1.4 reportable cases of nonfatal occupational injuries or illnesses in the telecommunications industry per 100 full-time workers in 2012 (BLS, 2012). By comparison, there were 2.0 nonfatal occupational injuries or illnesses reported nationwide per 100 full-time workers in the telecommunications industry for 2012 (BLS, 2014a).

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). Pennsylvania has not reported any fatalities in the telecommunications industry or telecommunications occupations since 2003, when data are first available (BLS, 2015d).

Public Health and Safety

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

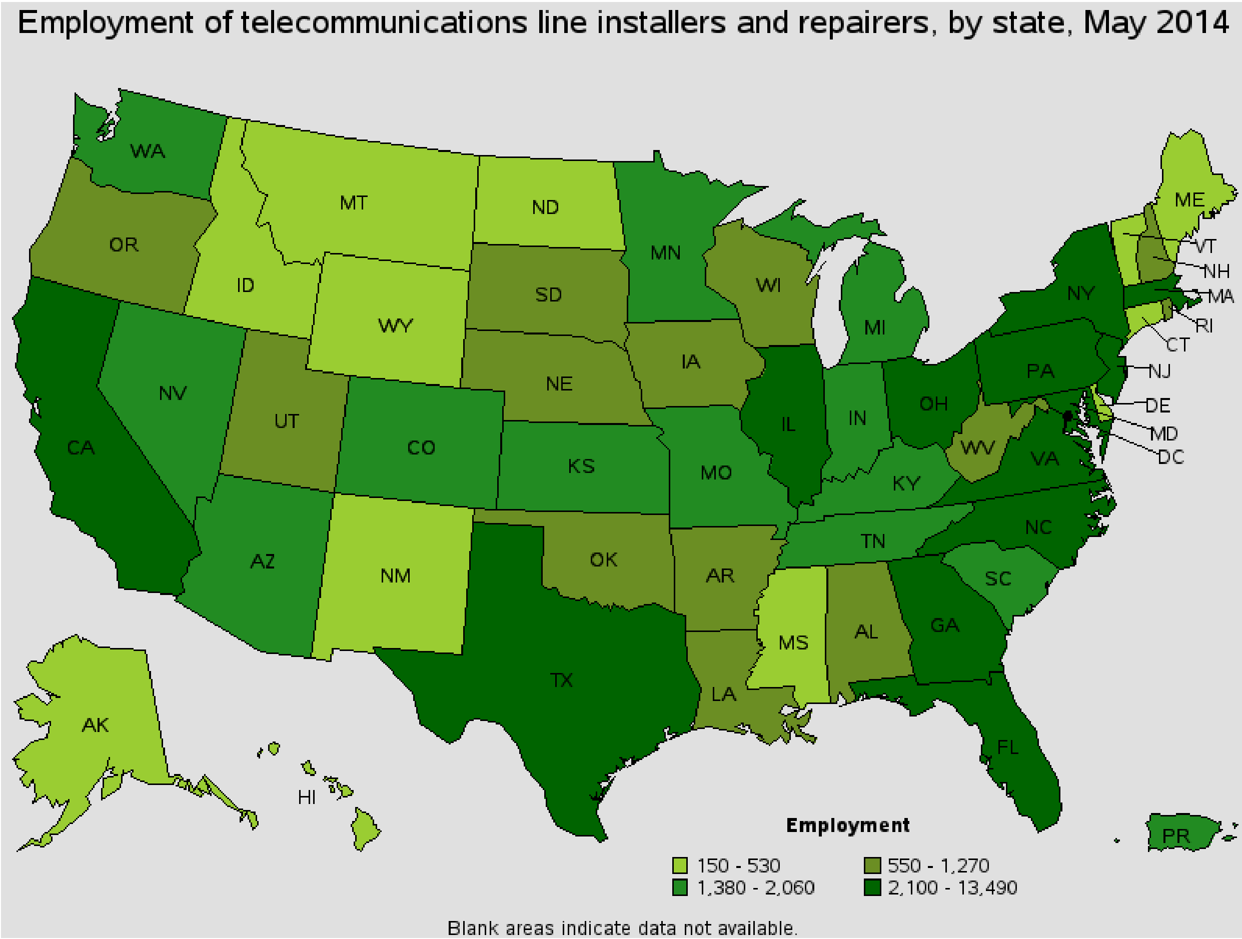


Figure 12.1.15-1: Number of Telecommunication Line Installers and Repairers Employed per State, May 2014

Source: (BLS, 2015b)

12.1.15.4. 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 (Comprehensive Environmental Response, Compensation, and Liability Act of 1980 [CERCLA]) 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.

Pennsylvania's Division of Site Remediation controls the Hazardous Sites Cleanup Act (HSCA), the state equivalent to the Superfund Program, which is responsible for conducting cleanup at sites where hazardous substances have been released (Pennsylvania DEP, 2015o). As of September 2015, Pennsylvania had 344 RCRA Corrective Action sites[161], 732 brownfields, and 97 proposed or final Superfund/NPL sites (USEPA, 2015h). Based on a September 2015 search of USEPA's Cleanups in My Community (CIMC) database, six Superfund sites still exist in Pennsylvania where contamination had been detected at an unsafe level, or a reasonable human exposure risk exists (Boarhead Farms, Crossley Farm, Kimberton Auto Service, Lower Darby Creek Area, Price Battery Site, Sharon Steel Corp) (USEPA, 2015k). Brownfield sites in Pennsylvania may enroll in the State Environmental Cleanup and Brownfields Programs, designed to remediate contaminated properties and bring them back into economic production (Pennsylvania DEP, 2015p).

In addition to contaminated properties, certain industrial facilities are permitted to release toxic chemicals into the air, water, or land. One such program through which this is permitted is the Toxics Release Inventory (TRI), administered by the USEPA under the Emergency Planning and Community Right to Know Act of 1986 (EPCRA). The TRI 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 September 2015, Pennsylvania had 1,168 TRI reporting facilities. According to the USEPA, in 2013, the most recent data available, Pennsylvania released 97,111,482 pounds of toxic chemicals through onsite and offsite disposal, transfer, or other releases, largely from the electric utilities industry. This accounted for 2.34 percent of total nationwide TRI releases, ranking Pennsylvania 9 of 56 states and territories based on total releases per square mile (USEPA, 2014a).

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 (NIH), U.S. National Library of Medicine, provides an online mapping tool called TOXMAP, which allows users to "visually explore data from the USEPA's

[161] Data gathered using the U.S. Environmental Protection Agency's Cleanups in My Community (CIMC) search on September 23, 2015, for all sites in Pennsylvania, where cleanup type equals "RCRA Hazardous Waste – Corrective Action," and excludes sites where cleanup phase equals "Construction Complete" (i.e., no longer active).

TRI and Superfund Program" (NIH, 2015). Figure 12.1.15-2 provides an overview of potentially hazardous sites in Pennsylvania.

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. Pennsylvania has not reported fatalities within the telecommunications industry or occupations since 2003, when data are first available (BLS, 2015c). By comparison, BLS reported three fatalities in 2011 and three preliminary fatalities[162] in 2014 nationwide within the telecommunications industry (NAICS code 517), due to exposure to harmful substances or environments (BLS, 2015d). 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).

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 DOH is responsible for collecting public health data resulting from exposure to environmental contamination, and provides publicly available health assessments and consultations for documented hazardous waste sites (Pennsylvania Department of Health, 2015).

[162] BLS Census of Fatal Occupational Injuries data for 2014 is for preliminary reporting only. Final data is expected to be released in spring 2016. (BLS, 2015c)

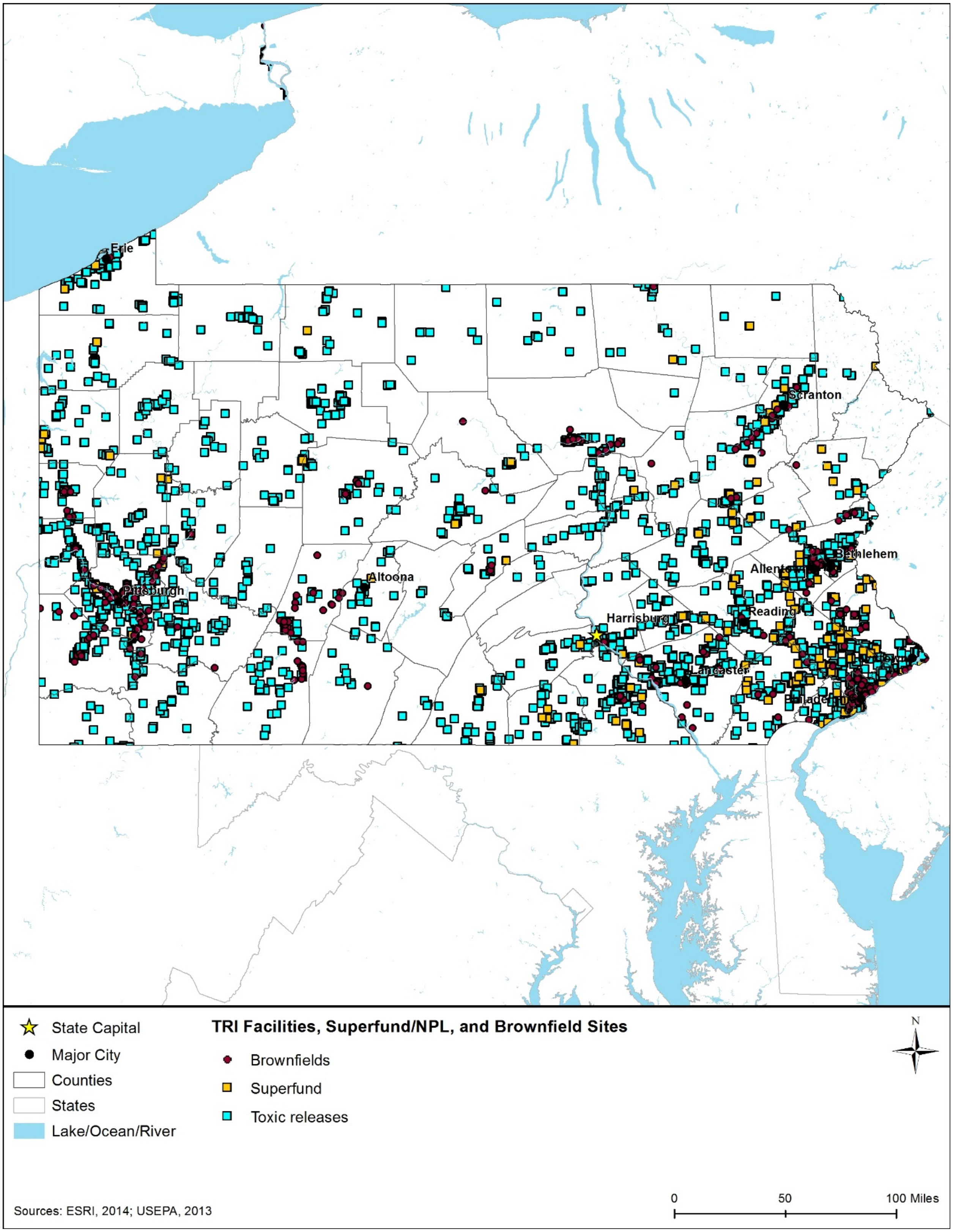


Figure 12.1.15-2: TOXMAP Superfund/NPL and TRI Facilities in Pennsylvania (2013)

Spotlight on Pennsylvania Superfund Sites: Sharon Steel Corporation

The former Sharon Steel Corporation Farrell Works Disposal Area site occupies approximately 325 acres of land located north of Pittsburgh, along the Ohio border. From the early 1900's, the area was used to dispose of slag and sludge, and starting around 1950, millions of gallons of acid. The mixture of acid, slag, and sludge contaminated soil and groundwater with metals, pesticides, polyaromatic hydrocarbons (PAHs), and PCBs. The USEPA is working with the PEDEP to implement a cleanup plan, which was signed in 2006 (U.S. Environmental Protection Agency, 2015). In a heavily populated area such as Pittsburgh, affected groundwater from presents a significant hazard to nearby residents, and contaminated soil can be dangerous to telecommunications workers operating in the vicinity of sites such as this.

Figure 11.19.4-2: Photo of Ponds on the Sharon Steel Superfund Site

Source: (USEPA, 2010)

12.1.15.5. Environmental Setting: Abandoned Mine Lands at or Near Telecommunications Sites

Another health and safety hazard in Pennsylvania includes surface and subterranean mines. In 2015, the Pennsylvania mining industry ranked 16th for non-fuel minerals (primarily crushed stone, cement, lime, sand and gravel), generating a value of $1.70B (USGS, 2016b). In 2013, the most recent data available, coal production in Pennsylvania ranked 3rd in the U.S., behind West Virginia and Kentucky, with 315 coalmining operations (82 underground and 233 surface) (EIA, 2013).

Health and safety hazards known 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 12.1.3, Geology. The Pennsylvania DEP, Bureau of Abandoned Mine Reclamation administers the Abandoned Mine Reclamation Program, and is responsible for managing AML health and safety hazards resulting from pre-1977 coal mining operations (Pennsylvania DEP, 2015z). As of 2015, there were 1,300 abandoned mines in the Pennsylvania (Federal Mining Dialogue, 2015). Figure 12.1.15-3 shows the distribution of AMLs in Pennsylvania.

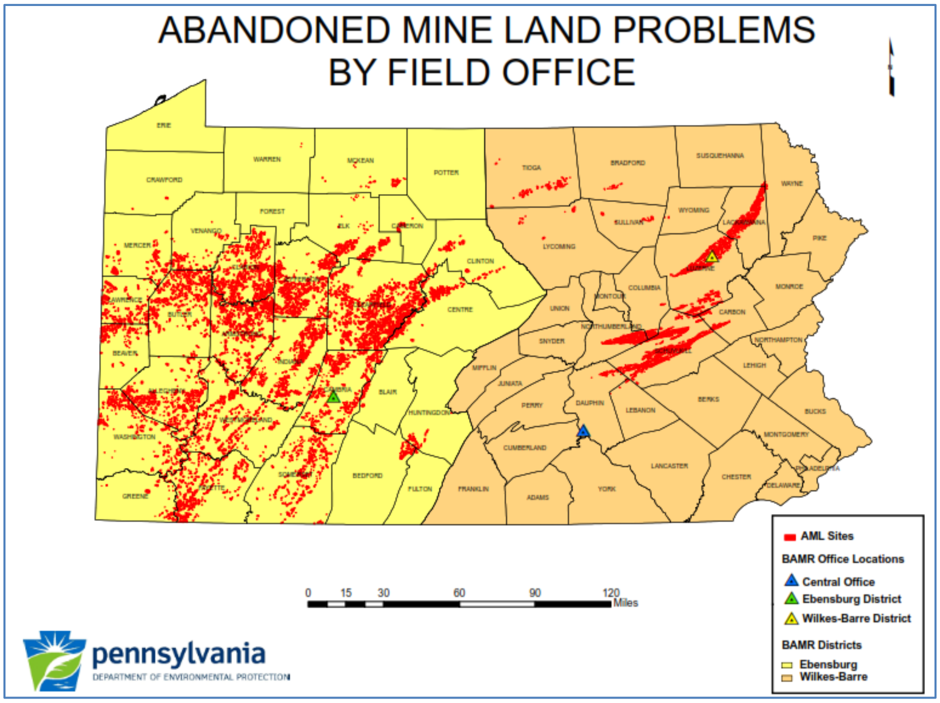


Figure 12.1.15-3: Abandoned Mine Land (2013)

Source: (Pennsylvania DEP, 2013a)

Another hazard associated with telecommunications sites near abandoned coalmines is a risk of fire. There are presently 38 active coalmine fires throughout the State of Pennsylvania (Pennsylvania DEP, 2016). Mine fires can release CO_2, CH_4, mercury, and other toxic substances (USGS, 2009).

Telecommunication Worker Occupational Health and Safety

Telecommunications sites may be on or near AMLs or coalmine fires, presenting occupational exposure risks from fire, toxic gases, and subsidence during FirstNet deployment, operation, and maintenance activities. The U.S. Department of Labor, Mine Safety and Health Administration (MSHA) is responsible reporting occupational fatalities related to mining operations. As of September 22, 2015, Pennsylvania has reported a total of 18 coal mining fatalities since 2004, with the highest fatality year being 5 fatalities in 2008 (U.S. Department of Labor, MSHA, 2015a). Between January 1 and September 24, 2015, the MSHA reported 24 mining fatalities nationwide (9 fatalities in the coal mining industry and 15 in metals/nonmetals industry) (U.S. Department of Labor, MSHA, 2015b).

Public Health and Safety

Coalmine fires generate toxic combustible gases, which can penetrate the surface through ground fractures, potentially seeping into residential structures. Additionally, the fire can consume enough sub-surface material, that risk of subsidence increases. As a result, AMLs and coalmine fires in particular, can result in evacuations of entire communities. (U.S. Department of the Interior, Office of Surface Mining Reclamation and Enforcement, 2015) In the case of the

Centralia Mine Fire, one of the longest burning coal fires in the nation, the population in the surrounding community decreased from approximately 1,100 to 1,200 before the fire started in 1962, to only 5 as of January 2013. Pennsylvania promotes a “Stay Out – Stay Alive” program to warn the general public of the hazards associated with AMLs, specifically regarding coalmine fires. Pennsylvania DEP is responsible for conducting visual surface inspections, sub-surface monitoring, and gas monitoring of coalmine fires in the state, and provides publicly available reports detailing the findings. (Pennsylvania DEP, 2016)

12.1.15.6. Environmental Setting: Natural & Manmade Disaster Sites

Natural and manmade disaster events can create health and safety risks, as well as present unique hazards, to telecommunication workers and the general 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.

Spotlight on Pennsylvania Manmade Disaster: Centralia Coalmine Fire

The Centralia Mine Fire began in 1962 during a controlled burning of a municipal waste disposal area. The fire spread uncontrollably to a subsurface coalmine underlying the disposal area, causing the closure of nearby mines and evacuation of approximately 1,100 people from Centralia Borough. It was determined to be too costly to extinguish the fire, so it was allowed to burn itself out. Presently, the fire continues to burn, and the land surrounding Centralia Borough is prone to subsidence and sinkholes (Pennsylvania DEP, 2016). Smoke and vapors emanating from the fire can rise through the ground surface, and sinkholes can cause property damage and are a danger to the public.

Figure 11.9.4-4: Emissions from Underground Coal Fire (1996)

Source: (USGS, 2009)

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, Pennsylvania DLI and BLS do not report data specific to injuries or fatalities among telecommunication workers responding to natural or manmade disasters. However, the National Response Center (NRC), managed by the U.S. Coast Guard, compiles reports for oil spills, chemical releases, or other maritime security incidents and contains incident reports related to occupational health and safety, some of which are related to telecommunications infrastructure or personnel. For example, during Hurricane Sandy, high winds and debris snapped a utility pole in half in Harrisburg, PA, spilling transformer oil onto the ground and 500 feet further into a storm drain, discharging into nearby Beaver Creek (U.S. Coast Guard, 2012). Such incidents present unique, hazardous challenges to telecommunication workers responding during natural disasters.

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 areas. Similar to telecommunication workers, the general public faces risks during these types of disasters, such as compromised transportation infrastructure and utilities and potential for exposure to unknown chemical and biologic hazards. Infrastructure damage was extensive during Hurricane Irene, with several storage tank spills due to flooding and fallen transformers. According to the NRC, an incident in Pennsylvania involved a wastewater treatment plant which overflowed due to heavy rain, causing a release of raw sewage onto the ground (U.S. Coast Guard, 2012). In 2014, Pennsylvania experienced 17 weather-related injuries and 2 fatalities (National Weather Service, 2015c). For comparison, in 2011, the year Hurricane Irene affected the northeast, there were 57 weather-related fatalities, and 92 weather-related injuries (NWS, 2013).

12.2. 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 Alternative provides a comparison to describe the effects of environmental resources of the existing conditions to the proposed Alternatives.

NEPA requires agencies to assess the potential direct and indirect impacts each alternative could have on the existing environment (as characterized earlier in this section). Direct impacts are those impacts that are caused by the Proposed Action and occur at the same time and place, such as soil disturbance. Indirect impacts are those impacts related to the Proposed Action but result from an intermediate step or process, such as changes in surface water quality because of soil erosion.

For each resource, the potential impact is assessed in terms of context of the action and the intensity of the potential impact, per CEQ regulations (40 CFR §1508.27). *Context* refers to the timing, duration, and where the impact could potentially occur (i.e., local vs. national; pristine vs. disturbed; common species vs. protected species). In terms of duration of potential impact, context is described as short or long term. *Intensity* refers to the magnitude or severity of the effect as either beneficial or adverse. Resource-specific significance rating criteria are provided at the beginning of each resource area section.

12.2.1. Infrastructure

12.2.1.1. Introduction

This section describes potential impacts to infrastructure in Pennsylvania associated with construction, deployment, and operation of the Proposed Action and alternatives. See Chapter

17, Best Management Practices (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.

12.2.1.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on infrastructure were evaluated using the significance criteria presented in Table 12.2.1-1. As described in Section 12.2, 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 infrastructure addressed in this section are presented as a range of possible impacts.

12.2.1.3. 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 deployment phases of specific projects. 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 construction. Based on the impact significance criteria presented in Table 12.2.1-1, 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, short-term maintenance would become necessary during operations.

Table 12.2.1-1: Impact Significance Rating Criteria for Infrastructure

Type of Effect	Effect Characteristics	Impact Level: Potentially Significant	Impact Level: Less than Significant with BMPs and Mitigation Measures Incorporated	Impact Level: Less than Significant	Impact Level: No Impact
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

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 construction or operation phases. During construction 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 12.2.1-1, 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 12.2.1-1, any potential impacts would be less than significant during deployment. As described above, during deployment and system optimization, existing services would 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 telecom 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.[163] 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 12.2.1-1.

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 U.S.

12.2.1.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to infrastructure and others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have no impacts to infrastructure under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be no impacts to infrastructure resources since the activities that would be

[163] 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.

conducted at these small entry and exit points are not likely to produce perceptible changes or disruption of transportation, telecommunications, or utility services.

- Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber would have no impacts to infrastructure resources because there would be no ground disturbance and no interference with existing utility, transportation, or communication systems.

- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the use of portable devices that use satellite technology would not impact infrastructure resources because there would be no change to the built or natural environment from the use of portable equipment. Installation of satellite-enabled equipment would not be expected to have any impacts to infrastructure resources, given that construction activities would occur on existing structures, would not be expected to interfere with existing equipment, and transportation capacity and safety, and access to emergency services would not be impacted.

  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN, however it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact infrastructure resources, it is anticipated that this activity would have no impact on infrastructure resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to infrastructure as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur as a result of direct interface with existing infrastructure, most notably existing telecommunication infrastructure. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to infrastructure include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of points of presence (POPs), 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. However, impacts to infrastructure resources could potentially occur as result of the construction of landings and/or facilities on shore to accept submarine cable, depending on the exact site location and proximity to existing infrastructure.

- Installation of Optical Transmission or Centralized Transmission Equipment: Installation of transmission equipment such as small boxes or huts, or access roads, could potentially impact infrastructure. Impacts could include disruption of service in transportation corridors, disruption of service to telecommunications infrastructure, or other temporary impacts.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads might result in temporary or unintended impacts to current utility services during installation or interconnection activities. Generally, however, these deployment activities would be independent and would not be expected to interfere with other existing towers and structures. In addition, installation activities would have beneficial impacts due to expansion of infrastructure at a local level. Such activities 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 cell on wheels (COWs), cell on light truck (COLTs), and system on wheels (SOWs) are comprised of cellular base stations, sometimes with expandable antenna masts, and generators that connect to utility power cables. Connecting the generators to utility power cables has the potential to disrupt electric power utility systems or cause power outages; however this is expected to be temporary and minor. Some staging or landing areas (depending on the type of technology) could require minor construction and maintenance within public road ROWs and utility corridors, heavy equipment movement, and minor excavation and paving near public roads, which have the potential to impact transportation capacity and safety as these activities could increase transportation congestion and delays. Implementation of deployable technologies could result in potential impacts to infrastructure resources in terms of infrastructure expansion, if deployment requires paving of previously unpaved surfaces or other new infrastructure build to accommodate the deployable technology. Also, beneficial impacts could be realized, as deployable technologies are used when other infrastructure is impaired in some way; so deployable technologies could provide continuity of service during emergency events. Where deployable technologies would be implemented on existing paved surfaces and the acceptable load on those paved surfaces is not exceeded, or where aerial deployable technologies may be 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. Chapter 17 discusses BMPs and mitigation measures that could be implemented, as appropriate, to further 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. 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.

12.2.1.5. Alternatives Impact Assessment

The following section assesses potential impacts to infrastructure associated with the Deployable Technologies Alternative and the No Action Alternative.[164]

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 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

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

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 road or utility ROW, or if additional maintenance-related construction activities occur within public road and utility ROWs, less than significant impacts would likely still occur to transportation systems or utility services due to the limited amount of 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated deployment or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to infrastructure as a result of deployment and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 12.1.1, Infrastructure. The state also would not realize positive, beneficial impacts to infrastructure resources described above.

12.2.2. Soils

12.2.2.1. Introduction

This section describes potential impacts to soil resources in Pennsylvania 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

12.2.2.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on soil resources were evaluated using the significance criteria presented in Table 12.2.2-1. As described in Section 12.2, 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.

Table 12.2.2-1: Impact Significance Rating Criteria for Soils

Type of Effect	Effect Characteristic	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Soil erosion	Magnitude or Intensity	Severe, widespread, and observable erosion in comparison to baseline, high likelihood of encountering erosion-prone soils	Effect that is potentially significant, but with mitigation is less than significant	Perceptible erosion in comparison to baseline conditions; low likelihood of encountering erosion-prone soil types	No perceptible change in baseline conditions
	Geographic Extent	State or territory		Region or county	NA
	Duration or Frequency	Chronic or long-term erosion not likely to be reversed over several years		Isolated, temporary, or short-term erosion that that is reversed over few months or less	NA
Topsoil mixing	Magnitude or Intensity	Clear and widespread mixing of the topsoil and subsoil layers	Effect that is potentially significant, but with mitigation is less than significant	Minimal mixing of the topsoil and subsoil layers has occurred	No perceptible evidence that the topsoil and subsoil layers have been mixed
	Geographic Extent	State or territory		Region or county	NA
	Duration or Frequency	NA		NA	NA
Soil compaction and rutting	Magnitude or Intensity	Severe and widespread, observable compaction and rutting in comparison to baseline	Effect that is potentially significant, but with mitigation is less than significant	Perceptible compaction and rutting in comparison to baseline conditions	No perceptible change in baseline conditions
	Geographic Extent	State or territory		Region or county	NA
	Duration or Frequency	Chronic or long-term compaction and rutting not likely to be reversed over several years		Isolated, temporary, or short term compaction and rutting that is reversed over a few months or less	No perceptible change in baseline conditions

NA = not applicable

12.2.2.3. 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 Pennsylvania 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 Pennsylvania that have steep slopes (i.e., greater than 20 percent) or where the erosion potential is medium to high, including locations with Aqualfs, Aquepts, Aquults, Orthents, Orthods, Udalfs, Udepts, and Udults (see Section 12.1.2.4, Soil Suborders and Figure 12.1.2-2).

Based on the impact significance criteria presented in Table 12.2.2-1, 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.

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 would 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 12.2.2-1, 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. Soils with the highest potential for compaction or rutting were identified by using the STATSGO2 database (see Section 12.1.2.4, Soil Suborders). The most compaction susceptible soils in Pennsylvania are hydric soils with poor drainage conditions, which include Aqualfs and Aquepts. These suborders constitute approximately six percent of Pennsylvania,[165] mostly found in the northwestern corner of the

[165] 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.

state (see Figure 12.1.2-2). 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 12.2.2-1, the risk of soil compaction and rutting resulting from FirstNet deployment activities would be less than significant, due to the small extent of susceptible soils in the state (see Chapter 17).

12.2.2.4. 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, 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 on 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 small-scale and short-term.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures, such as generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads, or access roads could result in impacts to soil resources. Land/vegetation clearing, excavation activities, landscape grading, and other ground disturbance activities during the installation of new wireless towers and associated structures or access roads could result in soil erosion or topsoil mixing, and heavy equipment use during these activities could result in soil compaction and rutting.

  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to soils. However, if 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described earlier, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that there would be no impacts to soil resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors, or if the acceptable load of the surface is exceeded, soil compaction and rutting impacts could result as explained above. The impacts are expected to be less than significant 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

12.2.2.5. 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 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 partners 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 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 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 12.1.2, Soils.

12.2.3. Geology

12.2.3.1. 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

12.2.3.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on geology resources were evaluated using the significance criteria presented in Table 12.2.3-1. As described in Section 12.2, 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 geology addressed in this section are presented as a range of possible impacts.

12.2.3.3. 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 12.1.3.8, Pennsylvania is not at risk to significant earthquake events. As shown in Figure 12.1.3-6, southeastern Pennsylvania is at a slightly higher risk to earthquakes than the rest of the state, though no earthquake over magnitude 6.0 on the Richter scale has ever occurred in the state. Equipment that is exposed to earthquake activity is subject to misalignment, alteration, or, in extreme cases, destruction; all of these activities could result in connectivity loss. Based on the impact significance criteria presented in Table 12.2.3-1, 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. Given the potential for minor to moderate earthquakes in parts of Pennsylvania, some amount of infrastructure could be subject to earthquake hazards, in which case BMPs and mitigation measures (see Chapter 17) would help avoid or minimize the potential impacts.

Volcanic Activity

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

Landslides

As discussed in Section 12.1.3.8, the majority of Pennsylvania is at moderate to high risk of experiencing landslide events. The highest potential for landslides in Pennsylvania is in Allegheny County in areas that are underlain by clay-stone and shale. Based on the impact significance criteria presented in Table 12.2.3-1, 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

Table 12.2.3-1: 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 fuel 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

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

subject to misalignment, alteration, or, in extreme cases, destruction; all of these activities could result in connectivity loss.

To the extent practicable, FirstNet would avoid deployment in areas that are susceptible to landslide events. However, given that several of Pennsylvania's major cities, including Pittsburgh, Altoona, and Scranton, are in areas that experience landslides with moderate to high 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 12.1.3.8, portions of Pennsylvania are vulnerable to land subsidence due to karst topography. Based on the impact significance criteria presented in Table 12.2.3-1, 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 mining areas. Equipment that is exposed to land subsidence, such as sinkholes created by karst topography or mine collapse, is subject to misalignment, alteration, or, in extreme cases, destruction. Significant long-term land subsidence, due to factors such as aquifer compaction, in coastal areas could lead to relative sea level rise[166] and inundation of equipment. All of these activities could result in connectivity loss. To the extent practicable, FirstNet would avoid deployment in known areas where subsidence is possible. However, where infrastructure is subject to landslide hazards, BMPs and mitigation measures (see Chapter 17) could be implemented to 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 12.2.3-1, impacts to mineral and fossil fuel resources is unlikely as the Proposed Action could only be potentially significant if FirstNet's deployment locations in Pennsylvania were to cause severe, widespread, observable impacts to mineral and/or fossil fuel resources. To the extent practicable, FirstNet would avoid construction in areas where these resources exist.

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 12.2.3-1, impacts to paleontological resources could be potentially significant if FirstNet's deployment locations were to cause direct impacts to

[166] 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." (USGS, 2008)

paleontological resources at specific project sites. 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) could further help avoid or minimize the potential impacts.

Surface Geology, Bedrock, Topography, Physiography, and Geomorphology

Construction activities related to the Proposed Action and Alternatives are not likely to require removal of significant volumes of terrain to reach the threshold of significance. 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 12.2.3-1, impacts could be potentially significant if FirstNet's deployment were to cause substantial and measurable degradation or alteration of surface geology, bedrock, topography, physiographic characteristics, or geomorphological processes. Construction activities related to the Proposed Action and Alternatives are likely to be minor and less than significant as the proposed activities are not likely to require removal of significant volumes of terrain and any rock ripping would likely occur in discrete locations and would be unlikely to result in large-scale changes to the geologic, topographic, or physiographic characteristics. When ground disturbance is required, BMPs and mitigation measures (see Chapter 17) could be implemented to help avoid or minimize the potential impacts.

12.2.3.4. 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

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 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 geology resources, it is anticipated that this activity would have no impact on geology 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 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 specific geologic hazards (e.g., land subsidence, landslides, or earthquakes), it is possible that they could be affected by that hazard.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to geologic resources. Land/vegetation clearing, excavation activities, landscape grading, and other ground disturbance activities during the installation of new wireless towers and associated structures or access roads could result in erosion or 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 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 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 partners would require, as practicable or feasible, to further 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

12.2.3.5. 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 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be no impacts to geologic resources (or from geologic hazards) associated with routine inspections of the Preferred 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 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 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 12.2.3, Geology.

12.2.4. Water Resources

12.2.4.1. Introduction

This section describes potential impacts to water resources in Pennsylvania 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

12.2.4.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on water resources were evaluated using the significance criteria presented in Table 12.2.4-1. As described in Section 12.2, 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 water resources addressed in this section are presented as a range of possible impacts.

Table 12.2.4-1: 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 and Safe Drinking Water Act	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

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

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
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
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 EOs on Floodplain Management (EO 11988 and EO 13690).
NA = not applicable

12.2.4.3. 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 TMDL or other strategy to reduce the input of the specific pollutant(s) restricting waterbody uses, in order to restore and protect such uses.

Most of Pennsylvania’s river and streams are in fair condition (Table 12.1.4-2, Figure 12.1.4-2). Agricultural activities, leading to siltation and abandoned mine drainage causing increased metals concentrations, are the primary water quality issues for streams. In lakes, agriculture is also the source of various water quality problems, including nutrient loading, sediments, and decreased dissolved oxygen (Pennsylvania DEP, 2014b). For example, the Lake Erie coastal zone has been impacted by runoff associated with agricultural production, increased suburban development, timber harvesting activities reducing forested areas, and erosion of bluffs (Pennsylvania DEP, 2012a). Groundwater quality within the state is suitable for drinking and daily water needs (Pennsylvania DEP, 2014b).

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, water volume flows, 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.

Construction 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 12.2.4-1, 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[167] 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 Pennsylvania 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 Pennsylvania aquifers, there is little 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 12.2.4-1, 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 12.2.4-1, 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

[167] 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).

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,[168] 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 any risk of additional impacts to floodplain degradation (see Chapter 17).

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 12.2.4-1, 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 offsite 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

[168] 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, 2014h)

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 12.2.4-1. 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 include:

- Construction of any structure in a 100-year or 500-year floodplain but is built above base flood 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.
- 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 12.1.4.7, approximately four and a half million residents draw drinking water from Pennsylvania's groundwater resources (Pennsylvania DEP, 2012a). Generally, the water quality of Pennsylvania's aquifers is suitable for drinking and daily water needs (Pennsylvania DEP, 2014b). Groundwater is an important natural resource used by industrial, commercial, agricultural, and residential uses for manufacturing, irrigation, and drinking water purposes. Once a groundwater supply is exhausted or contaminated, it is very expensive, and sometimes impossible, to replace. Water supply demand from the deployment activities is unlikely to exceed safe and sustainable withdrawal capacity rate of the local supply or aquifer.

Storage of generator fuel over groundwater or an aquifer would be unlikely to cause 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.
- Use of pesticides, herbicides, or insecticides during or after construction of a commercial, industrial, or recreational use.
- Commercial generation, treatment, storage, or disposal of hazardous wastes.

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 12.2.4-1, 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.

12.2.4.4. 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, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to water resources and others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of no impacts to potentially significant impacts depending on the deployment scenario or site-specific conditions. The impact on the water resources that could be affected would depend on the watershed, duration (chronic or short-term) and frequency (many years or a few months) the resource would be used, and the water resource's current use (sole source for drinking water, considered exceptional value for recreation, or provides critical habitat for a species).

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have no impacts to water resources under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be no impacts to water resources since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.

  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to water resources because there would be no ground disturbance.

- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact water resources because those activities would not require ground disturbance.

  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact water resources, it is anticipated that this activity would have no impact on water resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to water resources because of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including impaired water quality. The types of deployment activities that could be part of the Preferred Alternative and result in potential impacts to water resources include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs , huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to water resources. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites. The amount of impact depends on the land area affected, installation technique, and location. Trenching would not be expected to occur near or below the

existing water table (depth to water). Implementing BMPs and mitigation measures could reduce impact intensity.

- New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore or inland bodies of water would impact water resources from a short-term increase in suspended solids in the water. Site-specific impact assessment would be required to marine and shoreline environments prior to installation to fully assess potential impacts to lake or river 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 hadening 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 partners 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 deployment impacts. Impacts to surface and groundwater quality from routine operations and maintenance, such as herbicide application to control vegetation, are not expected. 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.

12.2.4.5. 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 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 on paved surfaces. Some staging or launching/landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving, however, these activities would be isolated and short term, and would likely return to baseline conditions once revegetation was complete. Additionally, project activities could result in direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites and from fuels leaking into surface or groundwater. However, spills from vehicles or machinery used during deployment tend to be associated with re-fueling operations, and as such, would likely be a few gallons or less in volume and would likely be easily contained or cleaned up. Implementing BMPs and mitigation measures identified in Chapter 17 could further avoid or reduce potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Deployable Technologies Alternative would consist of routine maintenance and inspection of the deployable technologies. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. The water resources impacts would depend on the watershed, duration (chronic or short-term) and frequency (many years or a few months) the resource would be used, and the water resource’s current use (sole source for drinking water, considered exceptional value for recreation, or provides critical habitat for a species).

It is anticipated that there would be 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, potentially impacting water quality. It is assumed that routine maintenance would not include operation of vehicles or equipment in waterbodies. Finally, if ground-based deployable technologies are parked and operated with air conditioning for extended periods 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, however, due to the limited and temporary nature of the deployable activities, it is anticipated that these potential impacts would be less than significant. Site maintenance, including mowing or herbicides, may result in less than significant effects to water quality, due to the small-scale of expected FirstNet activities in any particular location. In addition, the presence of new access roads could increase the overall amount of impervious surface in the area, and increase runoff effects on water resources, as explained above. 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 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 12.1.4, Water Resources.

12.2.5. Wetlands

12.2.5.1. Introduction

This section describes potential impacts to wetlands in Pennsylvania associated with construction/deployment and operation of the Proposed Action and alternatives. Chapter 17 identifies BMPs and mitigation measures that could be implemented as appropriate to avoid or minimize potential impacts.

12.2.5.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on wetlands were evaluated using the significance criteria presented in Table 12.2.5-1. As described in Section 12.2, 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 wetlands addressed in this section are presented as a range of possible impacts.

Table 12.2.5-1: Impact Significance Rating Criteria for Wetlands

<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">Direct wetland loss (fill or conversion to non-wetland)</td><td>Magnitude or Intensity</td><td>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</td><td rowspan="3">Effect that is potentially significant, but with mitigation is less than significant.</td><td>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)</td><td>No direct loss of wetlands.</td></tr>
<tr><td>Geographic Extent/Context</td><td>Watershed level, and/or within multiple watersheds</td><td>Watershed or subwatershed level.</td><td>NA</td></tr>
<tr><td>Duration or Frequency</td><td>Chronic and long term changes not likely to be reversed over several years or seasons</td><td>Periodic and/or temporary loss reversed over 1-2 growing seasons with or without active restoration</td><td>NA</td></tr>
<tr><td rowspan="2">Other direct effects: vegetation clearing; ground disturbance; direct hydrologic changes (flooding or draining); direct soil changes; water quality degradation (spills or sedimentation)</td><td>Magnitude or Intensity</td><td>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</td><td rowspan="2">Effect that is potentially significant, but with mitigation is less than significant.</td><td>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</td><td>No direct impacts to wetlands affecting vegetation, hydrology, soils, or water quality</td></tr>
<tr><td>Geographic Extent</td><td>Watershed level, and/or within multiple watersheds</td><td>Watershed or subwatershed level</td><td>NA</td></tr>
</table>

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, threatened and endangered species habitat, biodiversity, recreational/social value.

NA = Not Applicable

12.2.5.3. 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).

There are approximately 400,000 acres of freshwater wetlands in the state, equivalent to 1.4 percent of the state’s land area (Pennsylvania DEP, 2014b). Palustrine (freshwater) wetlands are found on river and lake floodplains across Pennsylvania, and estuarine/marine (tidal), riverine, and lacustrine wetlands comprise approximately one percent of the wetlands in the state, as shown in Section 12.1.5, Figure 12.1.5-1 and Figure 12.1.5-2.

Based on the impact significance criteria presented in Table 12.2.5-1, and given the temporary nature of most proposed activities, the deployment activities would most likely have less than significant direct impacts on wetlands.

In Pennsylvania, as discussed in Section 12.1.5, Wetlands, regulated high quality wetlands include exceptional value wetlands, threatened wetlands, and vernal pools.

The Pennsylvania Code defines exceptional value wetlands as those that are 1) habitat to threatened or endangered species; 2) hydraulically connected to threatened and endangered species habitat; 3) on or along the floodplain of state or federally designated Wild and Scenic Rivers or state designated exceptional value waters (see Section 12.1.4.4, Environmental Setting: Sensitive or Protected Waterbodies); 4) along a drinking water supply; or 5) in state forests or parks, federal wilderness areas, or NNL. (PA Code, 2011)

Pennsylvania DCNR characterizes the threat level experienced by particular types of wetlands within the state on a five-point scale of conservation status. The most threatened wetlands in Pennsylvania, are described below (Pennsylvania DCNR, 2012).

- Elm – Ash – Maple Lakeplain Forest: This wetland community, located near Lake Erie, is home to the rare pumpkin ash plant (*Fraxinus profunda*) (Pennsylvania DCNR, 2012).
- Red Maple – Magnolia Palustrine Forest: Found in southeastern Pennsylvania, this wetland community provides habitat for several rare plant species including the sweet-bay magnolia (*Magnolia virginiana*), fetter-bush (*Lyonia lucida*), and possum-haw (*Ilex decidua*) (Pennsylvania DCNR, 2012).
- Sweetgum – Willow Oak Coastal Plain Palustrine Forest: Occurring along the Delaware River estuary in Bucks County, this wetland is home to the rare willow oak (*Quercus phellos)*, swamp chestnut oak (*Quercus michauxii)*, and two varieties of sedge (Pennsylvania DCNR, 2012).
- Great Lakes Bayberry – Mixed Shrub Wetland: Occupying only Presque Isle State Park on Lake Erie, this wetland provides habitat for "77 state rare, threatened, or endangered plant species" (Pennsylvania DCNR, 2012).
- Great Lakes Bluff Seep: This wetland community, occurring along Lake Erie, provides nesting grounds for bank swallows and habitat for the rare grass-of-Parnassus (*Parnassia*), golden-fruited sedge (*Carex aurea*), rook lobelia (*Lobelia erinus*), and three rushes (Pennsylvania DCNR, 2012).
- Poison Sumac – Red-cedar – Bayberry Fen:[169] Found in northeastern Pennsylvania, these wetlands feature alkaline soils, an uncommon characteristic in the state (Pennsylvania DCNR, 2012).
- Sweet-gale – Leatherleaf Shrub Fen: These wetlands occur only in a small extent of the Pocono Mountains in the northeastern portion of Pennsylvania and provides habitat for the follow rare plants: sweet-gale (*Myrica gale*), Labrador-tea (*Ledum groenlandicum*), coastal mannagrass (*Glyceria striata*), and water bulrush (*Typha*) (Pennsylvania DCNR, 2012).
- Freshwater Tidal Mixed High Marsh: This wetland exists at the higher reaches of the intertidal zone, and is not inundated during every high tide. It is home to wild-rice (*Zizania*), showy bur-marigold (*Bidens cernua*), salt-marsh water-hemp (*Amaranthus cannabinus*), swamp beggar's-ticks (*Bidens frondosa*), river bulrush (*Scirpus fluviatilis*), Walter's barnyard grass (*Echinochloa crus-galli*), and gypsy-wort (Pennsylvania DCNR, 2012).
- Great Lakes Palustrine Sandplain: Like the Great Lakes Bayberry – Mixed Shrub Wetland, this environment is only found on Presque Isle, and is important to birds for migratory refuge, nesting, and foraging (Pennsylvania DCNR, 2012).
- River Bluff Seep: This wetland community occurs only along steep shorelines of streams draining into Lake Erie, and is habitat for rare plants including grass-of-Parnassus, golden fruited sedge, and Kalm's lobelia (*Lobelia kalmia*) (Pennsylvania DCNR, 2012).
- Riverbank Freshwater Tidal Marsh: Similar in location to the Freshwater Tidal Mixed High Marsh, this wetland occupies the full intertidal zone, approximately 6.6 feet vertically. This diverse environment is habitat to 16 rare plant species and buffers potential Delaware River estuary flooding. (Pennsylvania DCNR, 2012)

[169] Fens "are peat-forming wetlands that receive nutrients from sources other than precipitation: usually from upslope sources through drainage from surrounding mineral soils and from groundwater movement." (USEPA, 2012d)

- Sedge – Mixed Forb Fen: These wetlands are the western Pennsylvania analogue to the Poison Sumac – Red-cedar – Bayberry Fen, having similar rare sedge communities (Pennsylvania DCNR, 2012).
- Serpentine Seep: Defined by the underlying bedrock and its impacts on groundwater dissolved magnesium and metals, this seep environment occurs in southeastern Pennsylvania (Pennsylvania DCNR, 2012).
- Floodplain Scour Community: Found throughout the state along rocky riverbanks, these wetlands are habitat for 13 rare plant species, rare dragonflies and damselflies, and northern water (*Nerodia sipedon*) and copperhead snakes (*Agkistrodon contortrix*) (Pennsylvania DCNR, 2012).
- Great Lakes Sparsely Vegetated Shore: This wetland community, located along Lake Erie's shores, is home to the rare American beachgrass (*Ammophila breviligulata*), sea-rocket (*Cakile*), beach pea (*Lathyrus japonicas*), and silverweed (*Argentina anserine*)– all species that are unique to this geography (Pennsylvania DCNR, 2012).

Vernal pools are palustrine wetlands that the state has identified as wetlands of special concern. Found throughout the state, vernal pools are a type of small, temporary wetland present in forest or shrub land areas, though the pools themselves lack trees. The federally endangered northeastern bulrush (*Scirpus ancistrochaetus*) is supported by this type of ecosystem "almost exclusively" (Pennsylvania DCNR, 2015c) in Pennsylvanian vernal pools. Pennsylvania maintains a registry of vernal pools throughout the state based on information volunteered by citizens. (Pennsylvania DCNR, 2015c)

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 12.2.5-1, 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 activities that could have other direct effects to wetlands in Pennsylvania 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 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 alkaline conditions of Poison Sumac – Red-cedar – Bayberry Fens (which are high quality wetlands in Pennsylvania).
- 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:[170] Change in Function(s)[171] 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 could divert 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. Potential wetlands impacts can be further reduced by implementing BMPs and mitigation measures (see Chapter 17).

[170] 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.

[171] 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.

Examples of functions related to wetlands in Pennsylvania 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 12.2.5-1, 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 wetlands in Pennsylvania's are not considered high quality, deployment activities could have less than significant indirect impacts on wetlands in the state. Implementation of BMPs and mitigation measures could be implemented, as feasible and practicable, to reduce potential impacts to all wetlands.

In areas where high quality wetlands occur, 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.

12.2.5.4. 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 would be required to determine the exact location of all wetlands, including high quality wetlands, as well as a functional assessment by an experienced wetland delineator.

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to wetlands and others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of no impacts to potentially significant impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have no impacts to wetlands under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be no impacts to wetlands since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.

  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to wetlands because there would be no ground disturbance.

- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures, adding equipment to satellites being launches for other purposes, and the use of portable devices that use satellite technology is not likely to impact wetlands since there would be no ground disturbance.

  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact wetlands, it is anticipated that this activity would have no impact on wetlands.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to wetlands because of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct effects, other direct effects, and indirect effects on wetlands. The types of deployment activities that could be part of the Preferred Alternative and result in potential impacts to wetlands include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs , huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to wetlands. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct and indirect impacts to wetlands. The amount of impact depends on the land area affected, installation technique, proximity to wetlands, and type of wetland that could be affected (e.g., high quality). Any ground disturbance could cause direct and indirect impacts wetlands, depending on the proximity to wetlands and type of wetlands that could be affected. Implementing BMPs and mitigation measures could reduce impact intensity.

  - New Build – Submarine Fiber Optic Plant: The installation of cables in 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 additional power units, structural hardening, and physical security measures required ground disturbance, such as grading, or excavation activities, impacts to wetlands could occur near wetlands, it could cause impacts on wetlands. Implementing BMPs and mitigation measures could reduce impact intensity.

- Deployable Technologies: Implementation of deployable technologies could result in potential impacts to wetlands if deployment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. The amount of impact depends on the land area affected, installation technique, and location. Implementing BMPs and mitigation measures could reduce impact intensity. The activities could also result in other direct impacts on wetlands if fuels leak into nearby waterbodies or wetlands. Deployment of drones, balloons, blimps, or piloted aircraft could have other direct impacts on wetlands if fuels spill or other chemicals seep into nearby waterbodies or wetlands.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or underwater cables; installation of security/safety lighting and fencing; and deployment of aerial platforms. Depending on the deployment activity for this infrastructure, potential impacts to wetlands may occur. The amount of impact depends on the land area affected, installation technique, proximity to wetlands, and type of wetland that could be affected (e.g., high quality). Any ground disturbance could cause direct and indirect impacts wetlands, depending on the proximity to wetlands and type of wetlands that could be affected. These impacts are expected to be less than significant 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 partners would require, as practicable or feasible, to further avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that there could be ongoing potential other direct impacts to wetlands if heavy equipment is used for routine operations and maintenance application of herbicides occurs to control vegetation along all ROWs and near structures, depending on the proximity to wetlands. The intensity of the impact depends on the amount of herbicides used, frequency, and location of nearby sensitive wetlands. These impacts are expected to be less than significant 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 partners would require, as practicable or feasible, to further avoid or minimize potential impacts.

12.2.5.5. 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 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 partners would require, as practicable or feasible, to further 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. 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 wetlands from construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 12.1.5, Wetlands.

12.2.6. Biological Resources

12.2.6.1. Introduction

This section describes potential impacts to terrestrial vegetation, wildlife, fisheries and aquatic habitat, and threatened and endangered species in Pennsylvania 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.

12.2.6.2. 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 12.2.6-1. As described in Section 12.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to terrestrial vegetation, wildlife, and fisheries and aquatic habitat addressed in Sections 3.2.6.3, 3.2.6.4, and 3.6.2.5, respectively, are presented as a range of possible impacts.

Refer to Section 12.2.6.6 for impact assessment methodology and significance criteria associated with threatened and endangered species in Pennsylvania.

Table 12.2.6-1: 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), Migratory Bird Treaty Act (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 within Pennsylvania 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 Pennsylvania 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 disturbances are measurable but minimal as determined by individual behavior and propagation, and the potential for habituation or adaptability is high given time.	No stress or avoidance of feeding or important habitat areas. No reduced population resulting from habitat abandonment.
	Geographic Extent	Regional or site specific effects observed within Pennsylvania 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

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	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.
	Geographic Extent	Regional effects observed within Pennsylvania for at least one species. Anthropogenic disturbances that lead to exclusion from nutritional or habitat resources during migration, or lead to changes of migratory routes for endemics or a significant portion of the population or sub-population located in a small area during a specific season.		Effects realized at one location when population is widely distributed, and not concentrated in affected area.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species		Temporary, isolated, or short-term effects that are reversed within one to three years.	NA

Type of Effect	Effect Characteristic	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Reproductive Effects	Magnitude or Intensity	Population or sub-population level effects in reproduction and productivity over several breeding/spawning seasons for at least one species depending on the distribution and the management of said species. Violation of various regulations including: MMPA, MSFCMA, MBTA, and BGEPA.	Effect that is potentially significant, but with 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.
	Geographic Extent	Regional effects observed within Pennsylvania 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

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
Reproductive Effects	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.
	Geographic Extent	Regional impacts observed throughout Pennsylvania.		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

12.2.6.3. Terrestrial Vegetation

Impacts to terrestrial vegetation occurring in Pennsylvania's 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 permanent or temporary loss or disturbance of individual plants. Based on the impact significance criteria presented in Table 12.2.6-1, 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, if proposed sites with sensitive or rare regional vegetative communities are unavoidable, BMPs and mitigation measures would be recommended to minimize or avoid potential impacts.

Indirect Injury/Mortality

"Indirect effects" are effects that are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable (40 CFR 1508.8[b]). Indirect injury/mortality 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 would 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 (Kimmins, 1987).

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[172], 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 impact terrestrial vegetation because those activities would not require ground disturbance.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact biological resources, it is anticipated that this activity would have no impact on terrestrial vegetation.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to terrestrial vegetation as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct injury/mortality; vegetation and habitat loss, alteration, or fragmentation; indirect injury/mortality; and invasive species effects. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to terrestrial vegetation include the following:

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

- 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 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 partners 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 result from accidental spills from maintenance equipment or release of herbicides and because these areas would not be allowed to revert to a more natural state. If usage of heavy equipment or land clearing activities occurs off established roads or corridors as part of routine maintenance or inspections, direct or indirect injury/mortality to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species could occur to terrestrial vegetation, however impacts are expected to be less than significant due to the small-scale of expected activities. 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.

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 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 partners 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 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 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 12.1.6.3, Terrestrial Vegetation.

12.2.6.4. Wildlife

Impacts to amphibians and reptiles, terrestrial mammals, birds, and terrestrial invertebrates occurring in Pennsylvania and Pennsylvania'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 12.2.6-1, less than significant impacts would be anticipated given the anticipated small size and nature of the majority of proposed deployment activities. Although anthropogenic disturbances may be measurable but 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.

<u>Terrestrial Mammals</u>

Vehicle strikes are common sources of direct mortality or injury to both small and large mammals in Pennsylvania. Pennsylvania's mammals are attracted to roads for a variety of reasons including use as a source of minerals, preferred vegetation along roadways, areas of insect relief, and ease of travel along road corridors (Vogt, et.al., 1997). 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.

Birds

Mortalities from collisions or electrocutions with manmade 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, J., Kerlinger, P. and A. 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 resting or shelter from predators and inclement weather, or as nest trees for rearing young. The scale of this impact would be associated with the amount of tree removal and the abundance of forest-dwelling birds roosting/nesting in the area. These impacts could be particularly pronounced in IBAs within the state as these areas provide them with essential habitat that supports various life stages (Hill, 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 Pennsylvania 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 would 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 Pennsylvania's amphibian and reptile species are widely distributed throughout Pennsylvania. 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.

Environmental consequences pertaining to these reptiles are discussed in Section 12.2.6.6, Threatened and Endangered Species and Species of Conservation Concern.

Terrestrial Invertebrates

The terrestrial invertebrate populations of Pennsylvania 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 Pennsylvania 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 Pennsylvania's wildlife species below.

Terrestrial Mammals

Mammals occupy a wide range of habitats throughout Pennsylvania 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 would be avoided or minimized by BMPs and mitigation measures.

Birds

The direct removal of most migratory bird nests are prohibited under the MBTA. The USFWS can provide regional guidance on the most critical time periods (e.g., breeding season) to avoid vegetation clearing. The removal and loss of vegetation can affect avian species directly by loss of nesting, foraging, stopover, and cover habitat.

Noise disturbance and human activity, as discussed previously, could directly restrict birds from using their preferred resources. Greater human activity of longer duration would increase the likelihood that birds would avoid the area, possibly being excluded from essential resources. These impacts could be particularly pronounced if birds temporarily avoid IBAs within the state as these areas provide them with essential habitat that supports various life states (Hill, 1997).

The degree to which habitat exclusion affects birds depends on many factors. The impact to passerine[173] species from disturbance or displacement from construction activities is likely to be short-term with minor effects from exclusion. Exclusion from resources concentrated in a small migratory stop area during peak migration can have major impacts to species that migrate in large flocks and concentrate at stop overs (e.g., shorebirds). BMPs and mitigation measures, including nest avoidance during construction-related activities, would help to avoid or minimize the potential impacts to birds from exclusion of resources, as appropriate.

Reptiles and Amphibians

Important habitats for Pennsylvania's amphibians and reptiles typically consist of wetlands and, in some cases the surrounding upland forest. Impacts are expected to be less than significant. If proposed project sites were unable to avoid these sensitive areas, BMPs and mitigation measures (see Chapter 17) would be implemented to avoid or minimize the potential impacts.

Filling or draining of wetland breeding habitat (see Section 12.2.4, Water Resources) and alterations to ground or surface water flow from development associated with the Proposed Action may also have effects to Pennsylvania's amphibian and reptile populations, though BMPs and mitigation measures would help to avoid or minimize the potential impacts.

Terrestrial Invertebrates

Habitat loss and degradation are the most common causes of invertebrate species' declines; however, habitat for many common terrestrial invertebrates is generally assumed to be abundant and widely distributed across the state, therefore no significant effects to terrestrial invertebrates are expected. Impacts to sensitive invertebrate species are discussed below in Section 12.2.6.6, Threatened and Endangered Species and Species of Concern.

Indirect Injury/Mortality

Indirect injury/mortality impacts vary depending on the species, time of year and duration of deployment, though BMPs and mitigation measures would help to avoid or minimize the potential impacts.

Terrestrial Mammals

Stress from repeated disturbances during critical time periods (e.g., roosting and mating) can reduce the overall fitness and productivity of young and adult terrestrial mammals. Indirect effects could occur result to roosting bats from noise, light, or human disturbance causing them to leave their roosting locations or excluding them from their summer roosting/maternity colony roosts. For example, some bat species establish summer roosting or maternity colonies in the same general area that they return to year and after year. The majority of FirstNet deployment activities would be short-term in nature, therefore repeated disturbances would not occur.

[173]Passerines are an order of "perching" birds that have four toes, three facing forward and one backward, which allows the bird to easily cling to both horizontal and nearly vertical perches.

Depending on the project type and location, individual species may be disturbed resulting in less than significant impacts.

Birds

Repeated disturbance, especially during the breeding and nesting season, can cause stress to individuals lowering fitness and productivity. 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, 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 Pennsylvania's amphibians and reptiles, terrestrial mammals, birds, and terrestrial invertebrates are described below.

Terrestrial Mammals

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[174]. 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, though BMPs and mitigation measures would help to avoid or minimize the potential impacts.

[174] A location chosen by an animal for hibernation.

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. For example, as a group shorebirds migrating through Pennsylvania undertake some of the longest-distance migrations of all animals. Pennsylvania is located within the Atlantic Flyway, which spans more than 3,000 miles from the Arctic tundra to the Caribbean. Pennsylvania has 86 IBAs spread throughout the state that serve as important stopover areas for migratory birds (National Audubon Society, 2016). Many migratory routes are passed from one generation to the next. Impacts can vary (e.g., mortality of individuals or abandonment of stopover sites by whole flocks) depending on the species, time of year of construction/operation, and duration, but are generally expected to be less than significant. BMPs and mitigation measures would 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 Pennsylvania. 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. Wood frogs use diverse vegetation types from grassy meadows to open forests. After they emerge from dormancy, wood frogs migrate up 900 feet to breeding pools, where they breed rapidly in early spring in permanent or ephemeral water (Homan, Atwood, Dunkle, & Karr, 2010). However, Berven and Grudzien (Berven & Grudzien, 1990) found that a small percentage of juvenile wood frogs can migrate over 1.5 miles from natal ponds, suggesting juveniles may be capable of migrating relatively long distances. 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 any 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 Pennsylvania'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 Pennsylvania.

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.

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, 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.

The majority of FirstNet deployment or operation activities are likely to 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 Pennsylvania’s wildlife are described below.

Terrestrial Mammals

In the Pennsylvania, white-tailed deer are the most common nuisance mammals. They destroy native vegetation resulting in erosion and water resource concerns, and can carry/transmit disease to livestock and human beings. 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 be minimized following BMPs in Chapter 17 to reduce the introduction potential from heavy equipment or laborers.

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 Pennsylvania, 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 (PGC, 2016c). FirstNet deployment activities could result in short-term or temporary changes to specific project sites; these sites are expected to return to their natural state in a year or two. Invasive 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 Pennsylvania; although non-native reptiles and amphibians are known to occur there. 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 (USFS, 2015a). Species such as the emerald ash borer (*Agrilus planipennis*), spotted lanternfly (*Lycorma delicatula*), thousand cankers disease/walnut twig beetle (*Pityophthorus juglandis*), Asian long horned beetle (*Anoplophora glabripennis*), gypsy moth (*Lymantria dispar*), forest tent caterpillar (*Malacosoma* *disstria*), hemlock woolly adelgid (*Adelges tsugae*), and beech bark disease are of particular concern in Pennsylvania and are known to cause irreversible damage to native forests (Kimmins, 1987). 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 on wildlife resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to wildlife resources as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct injury/mortality; vegetation and habitat loss, alteration, or fragmentation; effects to migratory patterns; indirect injury/mortality; reproductive effects; and invasive species effects. The types of infrastructure 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 (see Section 12.2.4, 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 partners 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 partners 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 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 deployable 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 partners 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. Chapter 17 discusses BMPs and mitigation measures that could be implemented, as appropriate, 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 12.1.6.4, Terrestrial Wildlife.

12.2.6.5. Fisheries and Aquatic Habitats

Impacts to fisheries and aquatic habitats occurring in Pennsylvania and Pennsylvania'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 (USEPA, 2012c).

Based on the impact significance criteria presented in Table 12.2.6-1, 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 but 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 would help to avoid or minimize potential impacts to fisheries and aquatic invertebrate population survival.

Vegetation and Habitat Loss, Alteration, or Fragmentation

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 12.2.4, 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 deployment activities could result in short-term or temporary changes to specific project sites and 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, 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 could if conducted near water resources that support fish result in habitat loss, alteration and fragmentation; indirect injury/mortality; and invasive species effects.

  - New Build – Submarine Fiber Optic Plant: The installation of cables in 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 partners 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 conducted near water resources, 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 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. 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.

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 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 partners 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 partners 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 12.1.6.5, Fisheries and Aquatic Habitats.

12.2.6.6. Threatened and Endangered Species and Species of Conservation Concern

This section describes potential impacts to threatened and endangered species in Pennsylvania associated with deployment and operation of the Proposed Action and alternatives. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 17, may be implemented as appropriate to further minimize potential impacts.

Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on threatened and endangered species and their habitat were evaluated using the significance criteria presented in Table 12.2.6-2. 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 12.2.6-2, 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, fish, invertebrates, and plants with known occurrence in Pennsylvania are described below.

Terrestrial Mammals

The Indiana bat (*Myotis sodalis*) and northern long-eared bat (*Myotis septentrionalis*) are found throughout the state. Direct mortality or injury to the bat species could occur from collisions or electrocutions with manmade cables and wires, vehicle strikes, or when nests or habitat are either disturbed or destroyed. Activities also could disrupt individual hibernation status or patterns, depending on the timing of such actions. Impacts would likely be isolated, individual events given the roosting patterns and small-scale deployment of individual site-specific activities (e.g., if necessary, individual or small groupings of trees could be removed from a specific site). BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 17, may be implemented as appropriate to further minimize potential impacts.

Table 12.2.6-2: 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.	

Type of Effect	Effect Characteristic	Impact Level		
		May Affect, Likely to Adversely Affect	**May Affect, Not Likely to Adversely Affect**	**No Effect**
Behavioral Changes	Magnitude or Intensity	Disruption of normal behavior patterns (e.g., breeding, feeding, or sheltering) that could result in take of a listed species.	Minor behavioral changes that would not result in take of a listed species.	No measurable effects on listed species.
	Geographic Extent	Any geographic extent that could result in take of a listed species.	Changes in behavior at any geographic scale that are not expected to result in take of a listed species. Typically applies to one or very few locations.	
	Duration or Frequency	Any duration or frequency that could result in take of a listed species.	Infrequent, temporary, or short-term changes that are not expected to result in take of a listed species.	
Loss or Degradation of Designated Critical Habitat	Magnitude or Intensity	Effects to any of the essential features of designated critical habitat that would diminish the value of the habitat for the survival and recovery of the listed species for which the habitat was designated.	Effects to designated critical habitat that would not diminish the functions or values of the habitat for the species for which the habitat was designated.	No measurable effects on designated critical habitat.
	Geographic Extent	Effects to designated critical habitat at any geographic extent that would diminish the value of the habitat for listed species. Note that the likely to adversely affect threshold for geographic extent depends on the nature of the effect. Some effects could occur at a large scale but still not appreciably diminish the habitat function or value for a listed species. Other effects could occur at a very small geographic scale but have a large adverse effect on habitat value for a listed species.	Effects realized at any geographic extent that would not diminish the functions and values of the habitat for which the habitat was designated. Typically applies to one or few locations within a designated critical habitat.	
	Duration or Frequency	Any duration or frequency that could result in reduction in critical habitat function or value for a listed species.	Any duration or frequency that would not diminish the functions and values of the habitat for which the habitat was designated. Typically applies to Infrequent, temporary, or short-term changes.	

Birds

One federally listed bird, the piping plover, is known to occur within coastal areas of Pennsylvania. Depending on the project types and locations, direct mortality or injury to these birds could occur from collisions or electrocutions with manmade cables and wires, vehicle strikes, or by disturbance or destruction of nests during ground disturbing activities. 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. Additional BMPs and mitigation measures, as defined in Chapter 17, may be implemented as appropriate to further minimize potential impacts.

Fish

The shortnose sturgeon (*Acipenser brevirostrum*) is found in the Lehigh Valley region, in the Delaware River. Direct mortality or injury to the endangered shortnose sturgeon species could occur from vessel/boat strikes or entanglements resulting from the Proposed Action are unlikely as the majority of FirstNet deployment projects would not occur in the aquatic environment. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 17, may be implemented as appropriate to further minimize potential impacts.

Reptiles and Amphibians

There are no federally listed amphibians in Pennsylvania.

The federally listed threatened bog turtle (*Clemmys muhlenbergii*) occurs within wetland and floodplain areas. Direct mortality to the bog turtle could occur in construction zones either by excavation activities or by vehicle strikes. Impacts would likely be isolated, individual events. 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. Additional BMPs and mitigation measures, as defined in Chapter 17, may be implemented as appropriate to further minimize potential impacts.

Invertebrates

Seven federally listed aquatic invertebrates occur in Pennsylvania, the Clubshell Mussel (*Pleurobema clava*), Dwarf Wedgemussel (*Alasmidonta heterodon*), Northern Riffleshell (*Epioblasma torulosa rangiana*), Rabbitsfoot Mussel (*Quadrula cylindrica cylindrical*), Rayed Bean Mussel (*Villosa fabalis*), Sheepnose Mussel (*Plethobasus cyphyus*), and Snuffbox Mussel (*Epioblasma triquetra*). Direct or indirect mortality or injury could occur to these species if land clearing or excavation activities associated with the Proposed Action occur in an area inhabited by one of these species. Direct mortality could occur if any action, however unlikely, would require direct changes to waterbodies serving as habitat to these species. This is highly unlikely based on the Proposed Action; indirect impacts on invertebrate habitat caused by increased erosion and sedimentation is more likely, although still of low probability. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 17, may be implemented as appropriate to further minimize potential impacts.

Plants

Two federally listed plant species occur in Pennsylvania: the Northeastern Bulrush (*Scirpus ancistrochaetus*) and the Small Whorled Pogonia (*Isotria medeoloides*). 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. 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. Additional BMPs and mitigation measures, as defined in Chapter 17, may be implemented as appropriate to further minimize potential impacts.

Reproductive Effects

Reproductive effects are considered those that either directly or indirectly reduce the breeding success of a listed species either by altering its breeding timing or location, or reducing the rates of growth, maturation, and survival of offspring, which can affect the breeding success. Potential effects to federally listed terrestrial mammals, birds, terrestrial reptiles and marine reptiles, amphibians, fish, invertebrates, and plants with known occurrence in Pennsylvania are described below.

Terrestrial Mammals

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. Additional BMPs and mitigation measures, as defined in Chapter 17, may be implemented as appropriate to further minimize potential impacts.

Birds

The piping plover is the only federally listed bird species known to nest in Pennsylvania 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 piping plovers or roseate terns to abandon their nests, relocate to less desirable locations, or cause stress to individuals reducing survival and reproduction. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 17, may be implemented as appropriate to further minimize potential impacts.

Reptiles and Amphibians

There are no federally listed amphibians in Pennsylvania.

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. Additional BMPs and mitigation measures, as defined in Chapter 17, may be implemented as appropriate to further minimize potential impacts.

Fish

Deployment activities in the upstream portions of the Delaware River watershed resulting in increased disturbance (e.g., humans, noise), especially during spawning activity, and changes in water quality and quantity can cause stress resulting in lower productivity of the shortnose sturgeon (see Section 12.2.4, Water Resources, for a discussion of potential impacts to water resources). Impacts to reproduction for the endangered shortnose sturgeon species are unlikely as the majority of 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. Additional BMPs and mitigation measures, as defined in Chapter 17, may be implemented as appropriate to further minimize potential impacts.

Invertebrates

Changes in water from ground disturbing activities could cause stress resulting in lower productivity for the federally listed mollusks known to occur in Pennsylvania. In addition, introduction of invasive aquatic species can indirectly affect the rayed bean mussel (*Vilosa fabalis*) as result of fish populations that they rely on for their reproductive cycle being altered (USFWS, 2012d). Impacts associated with deployment activities are expected to result in less than significant changes to water quality. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 17, may be implemented as appropriate to further minimize potential impacts.

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 fish, invertebrates, and plants with known occurrence in Pennsylvania are described below.

Mammals

Activity and noise associated with the installation of new infrastructure in Pennsylvania could impact mammal breeding, feeding, or sheltering activities, though impacts are likely to be short-term provided the planned activities would occur on a small-scale, focused on site-specific activity. It is clear that behavioral responses are strongly affected by the context of exposure and by the animal's experience, motivation, and conditioning however, mammals have the capacity to divert from sound sources during activities. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 17, may be implemented as appropriate to further minimize potential impacts.

Birds

Because many birds have extremely long migrations, protection efforts for critical sites along migratory routes must be coordinated over vast distances often involving many different countries. For example, the piping plover migrates long distances from their breeding and wintering sites. They often return to the same stopover sites year and after year. 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 the piping plover. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 17, may be implemented as appropriate to further minimize potential impacts.

Reptiles and Amphibians

There are no federally listed amphibians in Pennsylvania.

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 or amphibians. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 17, may be implemented as appropriate to further minimize potential impacts.

Fish

Changes in water quality as a result of ground disturbing activities could impact food sources for the shortnose sturgeon. Further, increased human disturbance, noise, and vessel traffic could cause stress to shortnose sturgeon causing them to abandon spawning locations or alter migration patterns. Behavioral changes to the shortnose sturgeon are unlikely as the majority of 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. Additional BMPs and mitigation measures, as defined in Chapter 17, may be implemented as appropriate to further minimize potential impacts.

Invertebrates

Changes in water quality, habitat loss or alternation, and introduction of aquatic invasive species could impact food sources for federally listed mollusks resulting in lower productivity. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 17, may be implemented as appropriate to further minimize potential impacts.

Plants

No behavioral effects to federally listed plants are expected as a result of the Proposed Action.

Loss or Degradation of Designated Critical Habitat

Effects to designated critical habitat and any of its essential features that could diminish the value of the habitat for the listed species or its survival and recovery would be considered an adverse effect and could be potentially significant. Depending on the species or habitat, the adverse effect threshold would vary for geographic extent. 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. Only the rabbitsfoot mussel has designated critical habitat in the state.

Terrestrial Mammals

No designated critical habitat occurs for terrestrial mammals in Pennsylvania. 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 piping plover in Pennsylvania; 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 or amphibians in Pennsylvania. 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.

Fish

No designated critical habitat occurs for fish in Pennsylvania. 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

Critical habitat occurs for one aquatic invertebrate in Pennsylvania, the rabbitsfoot mussel (*Quadrula cylindrica cylindrical*), in the Lake Erie region, along portions of French Creek, Muddy Creek, and Allegheny River (Figure 12.1.6-3). Land clearing, excavation activities, and other ground disturbing activities in this region of Pennsylvania could lead to habitat loss or degradation, which could lead to adverse effects to the piping plover depending on the duration, location, and spatial scale of the associated activities. BMPs and mitigation measures to help mitigate or reduce these impacts are described in Chapter 17.

Plants

No designated critical habitat occurs for plants in Pennsylvania. 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 on protected species.

Activities with the Potential to Affect Listed Species

Potential deployment-related effects to threatened and endangered species and their habitats as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential effects to threatened and endangered species include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to threatened and endangered species. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct injury/mortalities of threatened and endangered species that are not mobile enough to avoid construction activities (e.g., 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 12.2.4, 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. Additional BMPs and mitigation measures, as defined in Chapter 17, may be implemented as appropriate to further 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 partners 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 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.

<u>Deployment Impacts</u>

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. Additional BMPs and mitigation measures, as defined in Chapter 17, may be implemented as appropriate to further minimize potential impacts.

Operational Impacts

As explained above, operational activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that activities may affect, but are not likely to adversely affect, threatened and endangered species and their habitats as a result of routine operations, management, and monitoring. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 17, may be implemented as appropriate to further minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the nationwide, interoperable, public safety broadband network would not be deployed; therefore there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no effects to 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 12.1.6.6, Threatened and Endangered Species and Species of Conservation Concern.

12.2.7. Land Use, Recreation, and Airspace

12.2.7.1. Introduction

This section describes potential impacts to land use, recreation, and airspace resources in Pennsylvania 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.

12.2.7.2. 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 12.2.7-1. As described in Section 12.2, 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 land use, recreation, and airspace resources addressed in this section are presented as a range of possible impacts.

Table 12.2.7-1: 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

12.2.7.3. 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 ROWs or easement. The deployment, operation, and maintenance of structures, towers, roads, and other permanent features could conflict with exiting development or land use. The installation of poles, towers, structures, or other aboveground facilities or assets could have short- or long-term effects to existing development or land use based on the characteristics of the structures or facilities, such as the location, type, or height. In addition, the acquisition of ROWs or easements and the construction of roads to access facilities and locations could influence changes in land use. The effects from these actions would depend on the geographic location; compatibility with existing land uses; and characteristics of the right-of-way, easement, or access road. These characteristics, such as the length, width, and location could change the existing land use to another category or result in the short- or long-term loss of the existing land use.

Based on the impact significance criteria presented in Table 12.2.7-1, 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 ROWs or easement. The deployment, operation, and maintenance of structures, towers, roads, and other permanent features could conflict with surrounding land use patterns and options for surrounding land uses. The installation of poles, towers, structures, or other aboveground facilities or assets could have short- or long-term effects to surrounding land use patterns or options for surrounding land uses based on the characteristics of the structures or facilities, such as the location, type, or height. In addition, the acquisition of ROWs or easements and the construction of roads to access facilities and locations could influence changes in surrounding land uses. The effects from these actions would depend on the geographic location; compatibility with surrounding land uses; and characteristics of the ROW, easement, or access road. These characteristics, such as the length, width, and location could conflict with surrounding land use patterns or restrict options for surrounding land uses.

Based on the impact significance criteria presented in Table 12.2.7-1, 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 ROW 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 aboveground facilities could alter the types and locations of recreation activities.

Based on the impact significance criteria presented in Table 12.2.7-1, less than significant impacts would be anticipated as restricted access or a loss of access to recreation areas would not occur; only short-term impacts or small-scale limitations during the construction phase would be expected.

Loss of Enjoyment of Public or Private Recreation Land

The deployment of new towers, and the resulting built tower, could influence the enjoyment of public or private recreation land. Enjoyment of recreation land could be temporarily impacted by crews accessing the site during the deployment and maintenance of structures, towers, roads, and other permanent features. The deployment of poles, towers, structures, or other aboveground facilities could affect the enjoyment of recreational land based on the characteristics of the structures or facilities, including permanent impacts to scenery, short-term noise impacts, and the presence of deployment or maintenance crews.

Based on the impact significance criteria presented in Table 12.2.7-1, 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 12.2.7-1, 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 likely not impact airspace resources.

12.2.7.4. 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 Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure, and the specific deployment requirements, some activities would result in potential impacts to land use, recreation, and airspace resources and others would not. Impacts to airspace are not anticipated as these activities would comply with all FAA regulations. 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 ROW.
    - 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 Federal Aviation Regulations (FAR) 14 CFR, Part 77, *Safe, Efficient Use, and Preservation of the Navigable Airspace* (See Section 12.1.7.6, Obstructions to Airspace Considerations), Pennsylvania Consolidated Statutes (CS), Title 74, Chapter 57, § 5701 (a) & (b); and Commonwealth of Pennsylvania regulation Title 67, Article IV, Chapter 479 Obstruction to Aircraft, based on Title 74 Pennsylvania CS §§5101-6169.

  - 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 12.1.7.6 Obstructions to Airspace Considerations), Pennsylvania Consolidated Statutes (CS), Title 74, Chapter 57, § 5701 (a) & (b); and Commonwealth of Pennsylvania regulation Title 67, Article IV, Chapter 479 Obstruction to Aircraft, based on Title 74 Pennsylvania CS §§5101-6169.

- 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 nearshort 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 12.1.7.6, Obstructions to Airspace Considerations), Pennsylvania Consolidated Statutes (CS), Title 74, Chapter 57, § 5701 (a) & (b) (See Section 12.10.5.4); and Commonwealth of Pennsylvania regulation Title 67, Article IV, Chapter 479 Obstruction to Aircraft, based on Title 74 Pennsylvania CS §§5101-6169 (See Section 12.10.5.4).

- 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 12.1.7.6, Obstructions to Airspace Considerations), Pennsylvania Consolidated Statutes (CS), Title 74, Chapter 57, § 5701 (a) & (b); and Commonwealth of Pennsylvania regulation Title 67, Article IV, Chapter 479 Obstruction to Aircraft, based on Title 74 Pennsylvania CS §§5101-6169.

- 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
    - 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 AGL or do not trigger any of the other FAA obstruction to airspace criteria listed in Section 12.1.7.6, 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 on land use.

Activities with the Potential to Have Impacts

Potential construction/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 ROW.
    - Land Use: Construction activities could temporarily restrict existing and surrounding land uses at isolated locations.
    - Recreation: It is anticipated that plowing, trenching, or directional boring may cause temporary, localized restrictions to recreational land or activities, which may persist during the deployment phase. It is reasonable to anticipate that small reductions in visitation to localized areas may occur during the deployment phase.
    - Airspace: No impacts are anticipated – see previous section.

  - New Build – Aerial Fiber Optic Plant: Installing new poles and hanging cables on previously disturbed or new (undisturbed) ROWs or easements and the potential construction of access roads.

        - Land Use: These activities could result in term potential impacts to land uses. Construction activities could temporarily restrict existing and surrounding land uses at isolated locations. New structures, poles, or access roads on previously undisturbed ROWs or easements could have long-term impacts to existing and surrounding land uses. The magnitude of the impact would depend on the specific location and the compatibility of the new structures with existing and surrounding land uses.
        - Recreation: Deployment activities may cause temporary, localized restricted access to recreation land or activities, which may persist for the duration of the deployment phase. Small reductions to visitation during the deployment phase may be anticipated.
        - Airspace: No impacts are anticipated – see previous section.

    - New Build – Submarine Fiber Optic Plant: Installing cables in limited nearshore and inland bodies of water and the constructing landings and/or facilities on shore to accept submarine cable.
        - Land Use: Construction activities could temporarily restrict existing and surrounding land uses at isolated locations. New landings and/or facilities on shore could have long-term impacts to existing and surrounding land uses. The magnitude of the impact would depend on the specific location and the compatibility of the new facilities with existing and surrounding land uses.
        - Recreation: Deployment may temporarily restrict recreation on or within limited nearshore and inland bodies of water and the surrounding area during the deployment phase. Reductions in visitation may result during deployment.
        - Airspace: No impacts are anticipated – see previous section.

    - Installation of Optical Transmission or Centralized Transmission Equipment: Installation of equipment including construction of new boxes, huts, or access roads.
        - Land Use: Construction activities could temporarily restrict existing and surrounding land uses at isolated locations. New boxes, huts, or access roads could have long-term impacts to existing and surrounding land uses. The magnitude of the impact would depend on the specific location and the compatibility of the new facilities with existing and surrounding land uses.
        - Recreation: Deployment of installation equipment and the construction of boxes, huts, or access roads may restrict access to recreation land or activities. Reductions in visitation during deployment may occur.
        - Airspace: No impacts are anticipated – see previous section.

- Wireless Projects
    - New Wireless Communication Towers: Installing new wireless towers, associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads.

- Land Use: Construction activities could temporarily restrict existing and surrounding land uses at isolated locations. New wireless towers, associated structures, or access roads could have long-term impacts to existing and surrounding land uses. The magnitude of the impact would depend on the specific location and the compatibility of the new facilities with existing and surrounding land uses.
- Recreation: Deployment of new towers and associated structures could result in temporary, localized restricted access for recreation land or activities for the duration of the deployment phase. Reductions in visitation or duration of recreational activity may result from restricted access.
- Airspace: Installation of new wireless towers could result in impacts to airspace if towers exceed 200 feet AGL or meets the other criteria listed in Section 12.1.7.6 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 12.1.7.6, 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 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 partners 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 12.2.8, 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

12.2.7.5. 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 construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to land use, recreation, and airspace resources as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts to land use. While a single deployable technology may have imperceptible impact, multiple technologies operating in close proximity for longer periods could impact existing and surrounding land uses. There could be impacts to recreation activities during the deployment of technologies if such deployment were to occur within or near designated recreation areas. Enjoyment of activities dependent upon the visibility of wildlife or scenic vistas may be affected, however, impacts would be less than significant due to the temporary nature of likely deployment activities. If deployment triggers any obstruction criterion or result in changes to flight patterns and airspace restrictions, FirstNet (or its partners) would consult with the FAA to determine how to proceed. Chapter 17 discusses BMPs and mitigation measures that could be implemented, as appropriate, 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 Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections Operation of deployable technologies would result in land use, land ownership, airspace, and recreation (access and enjoyment) similar in type to those described for the Preferred Alternative. The frequency and extent of those potential impacts would be greater than for the Proposed Action because under this Alternative, deployable technologies would be the only options available. As a result, this alternative would require a larger number of terrestrial and airborne deployable vehicles and a larger number of deployment locations in—all of which would potentially affect a larger number of properties and/or areas of airspace. Overall, these potential impacts would be less than significant due to the temporary nature of deployment activities. 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 land use, recreation resources, or airspace. Environmental conditions would therefore be the same as those described in Section 12.1.7, Land Use, Recreation, and Airspace.

12.2.8. Visual Resources

12.2.8.1. Introduction

This section describes potential impacts to visual resources in the state 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

12.2.8.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on visual resources were evaluated using the significance criteria presented in Table 12.2.8-1. As described in Section 12.2, 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 visual resources addressed in this section are presented as a range of possible impacts.

12.2.8.3. *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 Pennsylvania, residents and visitors travel to many national and state parks and forests, such as the Allegheny National Forest, to view its mountains, valleys, and gorges. 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. Pennsylvania has a five-year Historic Preservation Plan that identifies a framework for action and collaboration to preserve landscapes and viewsheds, among other environmental and historical areas and buildings (Pennsylvania Historical and Museum Commission, 2015e). The Bureau of Historic Preservation reviews development plans for impact to “significant resources” and provides advice on addressing and resolving the issues in accordance with the Preservation Plan (Pennsylvania Historical and Museum Commission, 2015a). If new towers were constructed to a height that required lighting, nighttime vistas could be affected in areas where the night skies do not have light disruptions or are within unpopulated areas.

Based on the impact significance criteria presented in Table 12.2.8-1, impacts to the aesthetic character of scenic resources or viewsheds would be considered potentially significant if landscapes were permanently removed or fragmented, or if damage to historic or cultural resources occurred. Given the small-scale of likely FirstNet activities, impacts are expected to be less than significant.

Nighttime lighting

If new towers or facilities were constructed to a height that required lighting, nighttime vistas could be affected in areas where the night skies do not have light disruptions or are within unpopulated areas. If nighttime lighting were necessary for the operation or function of a facility that caused regional impacts or permanent changes to night sky conditions, those effects would be considered potentially significant.

Table 12.2.8-1: 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

NA = not applicable

Based on the impact significance criteria presented in Table 12.2.8-1, 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.

12.2.8.4. 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, 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 on visual resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to visual resources as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur as a result of ground disturbance, vegetation removal, or installation of permanent structures if development occurs in scenic areas. The types of deployment activities that could be part of the Preferred Alternative and result in potential impacts to visual resources include the following:

- Wired Projects
    - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to visual resources. The degree of impact would depend on the timing, location, and type of 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 ROWs 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 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.

Depending on specific design, Construction of New Wireless Communication Towers or Installation of Optical Transmission or Centralized Transmission Equipment options could introduce new artificial lighting, due to FAA regulations or other security concerns. New lighting associated with FirstNet structures could contribute incrementally to sky glow. As a result of the temporary nature of deployment, these effects would be less than significant. 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.

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. 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.

12.2.8.5. 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 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 partners 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. 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 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 12.1.8, Visual Resources.

12.2.9. Socioeconomics

12.2.9.1. Introduction

This section describes potential impacts to socioeconomics in Pennsylvania 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.

12.2.9.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on socioeconomics were evaluated using the significance criteria presented in Table 12.2.9-1. As described in Section 12.2, 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 socioeconomics addressed in this section are presented as a range of possible impacts.

Table 12.2.9-1: Impact Significance Rating Criteria for Socioeconomics

Type of Effect	Effect Characteristics	Impact Level: Potentially Significant	Impact Level: Less than Significant with BMPs and Mitigation Measures Incorporated	Impact Level: Less than Significant	Impact Level: No Impact
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**
Impacts to Employment	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

12.2.9.3. Description of Environmental Concerns

This section discusses at a high level the types of socioeconomic impacts that could result from deployment of the NPSBN. Socioeconomic impacts could be negative or positive. Subsections below address socioeconomic impacts in four general areas, following the breakdown of the significance rating criteria in the table above:

- Impacts to Real Estate;
- Economic Benefits or Adverse Impacts related to Changes in Spending, Income, Industries, and Public Revenues;
- Impacts to Employment; and
- Changes in Population Number or Composition.

In addition to the specific impacts noted below, the Proposed Action would likely have broad, beneficial impacts to all four areas in times of disaster, by improving the response of public safety personnel. Reduced damages and faster recovery would result. This would support property values; maintain corporate income, personal income, and government revenues; preserve jobs; and reduce disruptions to populations.

Impacts to Real Estate

Deployment of the NPSBN has the potential to improve property values in areas that have 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 Pennsylvania. Median values of owner-occupied housing units in the 2009–2013 period ranged from over $240,000 in the greater Philadelphia area, to approximately $107,000 in the Erie area. These figures are general indicators only. Property values are probably both higher and lower in specific localities. Any property value effects of deployment of the NPSBN would occur at a localized level.

Some telecommunications infrastructure, such as wireless communications towers, may adversely affect property values, depending on infrastructure location and other characteristics. Researchers believe these negative impacts relate to perceptions of the aesthetics of towers, or fears over electromagnetic radiation. Economists and appraisers have studied this issue and use a statistical analysis methodology known as hedonic pricing, or hedonic modelling, to assess how different attributes of properties such as distance from a tower affect property value (Bond, Sims, & Dent, 2013). Essentially, analysts compare the value of multiple properties while statistically controlling for differences in property attributes, in order to isolate the effect of a specific attribute such as proximity of a communications tower.

A recent literature review examined such studies in the U.S., 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 Pennsylvania. The average unemployment rate in 2014 was 5.8 percent, lower than the national rate of 6.2 percent. Counties with unemployment rates below the national average (that is, better employment performance) were located throughout much of the state, especially in the northwestern, southwestern, and southeastern portions, plus some counties in the center of the state. Counties with unemployment rates above the national average were also located throughout the state, especially in the west-central and northeast areas.

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 12.2.9-1 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 in Table 12.2.9-1. 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.

12.2.9.4. 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 12.2.9-1.

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 on socioeconomic resources.

Activities with the Potential to Have Impacts

Potential impacts to socioeconomics for the Preferred Alternative would encompass a range of impacts that could result from deployment activities. The discussion below indicates which of the four types of socioeconomic impacts discussed above and listed again here apply to each type of deployment activity. For greater detail on the nature of these impacts, see the Description of Environmental Concerns section above.

- Impacts to Real Estate;
- Changes to Spending, Income, Industries, and Public Revenues;
- Impacts to Employment; and
- Changes in Population Number or Composition.

Positive impacts on property values would generally not result from one or a few particular activities, but instead would result from the totality of the new NPSBN infrastructure and operational systems that enable improved public safety services to currently underserved areas. Similarly, any change to population numbers in a few locations as discussed above would result from large contract awards and contractor decisions about employee locations, not from specific deployment activities. Therefore, these types of impacts are not included in the activity-focused discussions below.

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Installation of fiber optic cable in existing conduit would have the following types of socioeconomic impacts:
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
  - Collocation on Existing Aerial Fiber Optic Plant: Collocation of new aerial fiber optic plant on existing utility poles and other structures would have the following types of socioeconomic impacts:
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.

- Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.

- Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber would be conducted electronically through existing infrastructure, and would have the following types of socioeconomic impacts:
  - Changes to Spending, Income, Industries, and Public Revenues – Labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
  - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.

- New Build – Submarine Fiber Optic Plant: The installation of cables in 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 partners 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, as described above. 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. 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.

12.2.9.5. 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 construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to socioeconomics resulting from implementation of this alternative could be as described below.

Deployment Impacts

As explained above, all deployment activities represent economic activity and thus have socioeconomic impacts. These impacts would primarily be beneficial, such as generation of business income and employee wages, and creation or sustainment of jobs. The impacts would be small for each activity, and therefore less than significant.

Deployable technologies such as COWs, COLTs, and SOWs, along with aerial deployable technologies, would require storage, staging, and launch/landing areas. Development or enlargement of these facilities could have adverse impacts on nearby property values. The potential for such impacts is higher under this alternative than the Preferred Alternative because it is likely that these facilities would be implemented in greater numbers and over a larger geographic extent. These potential impacts are anticipated to be less than significant as described above. Chapter 17 discusses BMPs and mitigation measures that could be implemented, as appropriate, 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed. Therefore, there would be no associated deployment or installation 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 12.1.9, Socioeconomics.

12.2.10. Environmental Justice

12.2.10.1. Introduction

This section describes potential impacts to environmental justice in Pennsylvania 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

12.2.10.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on environmental justice were evaluated using the significance criteria presented in Table 12.2.10-1. As described in Section 12.2, 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 environmental justice addressed in this section are presented as a range of possible impacts.

Table 12.2.10-1: Impact Significance Rating Criteria for Environmental Justice

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Effects associated with other resource areas (e. g., human health and safety, cultural resources, socioeconomics) that have a disproportionately high and adverse impact on low-income populations and minority populations	Magnitude or Intensity	Direct and disproportionately high and adverse effects on environmental justice communities (as defined by EO 12898) that cannot be fully mitigated	Effect that is potentially significant, but with mitigation is less than significant	Direct effects on environmental justice communities (as defined by EO 12898) that are not disproportionately high and adverse, and therefore do not require mitigation	No direct effects on environmental justice communities, as defined by EO 12898
	Geographic Extent	Effects realized within counties at the Census Block Group level		Effects realized within counties at the Census Block Group level	Effects realized within counties at the Census Block Group level
	Duration or Frequency	Persists during the life of the project		Persists for as long as the entire construction phase or a portion of the operations phase	NA

NA = Not Applicable

12.2.10.3. 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, may 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.

Construction impacts are localized, and property value impacts of wireless telecommunications projects rarely extend beyond 300 meters (984 feet) of a communications tower (Bond, Sims, & Dent, 2013). In addition, impacts related to deployment are of short duration. The potential for significant environmental justice impacts from the FirstNet deployment activities would be limited. Most, but not all, of the FirstNet operational activities have very limited potential for impacts as these activities are limited in scale and short in their duration.

Before FirstNet deploys 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 Affected Environment (Section 12.1.10) as having moderate potential or high potential for environmental justice populations would particularly warrant further screening. As discussed in Section 12.1.10, Pennsylvania's population has lower percentages of minorities than the region or the nation, and a rate of poverty that is similar to the region's rate and lower than the nation's rate. Areas with high potential for environmental justice populations are distributed fairly even across the state, and occur both within and outside of the 10 largest population concentrations. This includes some of the state's sparsely populated areas in the center and west of the state. The distribution of areas with moderate potential for environmental justice populations is also fairly even across the state. Further analysis using the data developed for the screening analysis in Section 12.1.10 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, 2015l; USEPA, 2014c).

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.

12.2.10.4. 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, 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 on environmental justice.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to environmental justice for the Preferred Alternative would encompass a range of impacts that could occur as a result of disturbance to communities from construction activities, such as noise, dust, and traffic. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to environmental justice communities include the following:

- Wired Projects
    - New Build – Buried Fiber Optic Plant: New fiber optic cable installation usually requires construction activities such as trenching, plowing (including vibratory plowing), or directional boring, as well as construction of hand holes, pulling vaults, junction boxes, huts, and POP structures. These activities could temporarily generate noise and dust, or disrupt traffic. If such impacts occur disproportionately to environmental justice communities, they would be considered environmental justice impacts.

    - New Build – Aerial Fiber Optic Plant: Pole/structure installation could temporarily generate noise and dust, or disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.

    - New Build – Submarine Fiber Optic Plant: The installation of cables in 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 partners 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

12.2.10.5. 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 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 temporarily generated, 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 partners 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 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 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 12.1.10, Environmental Justice.

12.2.11. Cultural Resources

12.2.11.1. Introduction

This section describes potential impacts to cultural resources in Pennsylvania 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.

12.2.11.2. 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 12.2.11-1. As described in Section 12.2, 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.

12.2.11.3. 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 12.2.11-1, 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 in areas with archaeological deposits or within historic districts. However, given that archaeological sites and historic properties are present throughout Pennsylvania, some deployment activities may be in these same areas, in which case BMPs (see Chapter 17) would help avoid or minimize the potential impacts.

Indirect Effects to Historic Properties (i.e., visual, noise, vibration, atmospheric)

The potential for indirect effects to historic properties would be present during deployment of the proposed facilities/infrastructure and during trenching, grading, and/or foundation excavation activities. Indirect effects include the introduction of visual, noise, atmospheric, and/or vibration effects that diminish a property's historic integrity. The greatest likelihood of potentially significant impacts from indirect effects would be from the deployment of equipment in areas that would cause adverse visual effects to historic properties. To the extent practicable, FirstNet would attempt to minimize activities in areas within or adjacent to historic districts or properties.

Table 12.2.11-1: 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
Loss of character defining attributes of historic properties	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, tribal historic preservation office, 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.

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 Americans. 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.

12.2.11.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to cultural resources, while others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have no impacts to cultural resources under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be no impacts to cultural resources since the activities that would be conducted at these small entry and exit points are not likely to produce impacts.

- Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to cultural. If required, and if done in existing huts with no ground disturbance, installation of new associated equipment would also have no impacts to cultural resources because there would be no ground disturbance and no perceptible visual changes.

- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact cultural resources because those activities would not require ground disturbance or create perceptible visual effects.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact cultural resources, it is anticipated that this activity would have no impact on cultural resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to cultural resources as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur as a result of ground disturbance activities, including destruction of cultural or historic artifacts. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to cultural resources include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, 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 riverine areas of Pennsylvania 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 the port of Philadelphia. Impacts to cultural resources could also potentially occur as result of the construction of landings and/or facilities on shore to accept submarine cable, which could result in the disturbance of archaeological and historical sites, such as wharves and seawalls (archaeological deposits tend to be located in association with bodies of water, and Pennsylvania, for example, has numerous maritime and riverine archaeological sites associated with its 18th and 19th 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 Philadelphia and Pittsburgh 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 partners 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 effects 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. 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.

12.2.11.5. 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 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the deployment impacts, it is anticipated that there would be effects, but no adverse effects to historic properties associated with implementation/running of the deployable technology. No adverse effects would be expected to either site access or viewsheds due to the temporary nature of expected activities. As with the Preferred Alternative, it is anticipated that there would be no effects to cultural resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment as part of routine maintenance or inspections occurs off established access roads or corridors, impacts to archaeological sites could occur, however, in the event that this is required, FirstNet would engage in consultation as required under Section 106 of the NHPA. 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 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 12.1.11, Cultural Resources.

12.2.12. Air Quality

12.2.12.1. Introduction

This section describes potential impacts to Pennsylvania'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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

12.2.12.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on Pennsylvania's air quality were evaluated using the significance criteria presented in Table 12.2.12-1. As described in Section 12.2, 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 Pennsylvania's air quality addressed in this section are presented as a range of possible impacts.

12.2.12.3. 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 Pennsylvania that are in maintenance or nonattainment for one or more criteria pollutants, particularly, ozone and particulate matter are statewide issues (see Section 12.1.12, Air Quality and Figure 12.1.12-1). The counties of Allegheny and Philadelphia are in maintenance for CO. The counties of Beaver and Berks are in nonattainment for lead. The county of Allegheny is in maintenance for PM_{10}.

Table 12.2.12-1: Impact Significance Rating Criteria for Pennsylvania

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

The counties of Allegheny, Armstrong, Beaver, Berks, Bucks, Butler, Cambria, Chester, Delaware, Greene, Indiana, Lancaster, Lawrence, Lehigh, Montgomery, Northampton, Philadelphia, Washington, and Westmoreland are in nonattainment for $PM_{2.5}$. The counties of Cumberland, Dauphin, Lebanon, and York are in maintenance for $PM_{2.5}$. The counties of Allegheny, Armstrong, Beaver, Berks, Bucks, Butler, Carbon, Chester, Delaware, Fayette, Lancaster, Lehigh, Montgomery, Northampton, Philadelphia, Washington, and Westmoreland are in nonattainment for O_3. The counties of Adams, Blair, Cambria, Centre, Clearfield, Cumberland, Dauphin, Erie, Franklin, Greene, Indiana, Lackawanna, Lebanon, Luzerne, Mercer, Monroe, Perry, Tioga, Wyoming, and York are in maintenance for O_3. The counties of Allegheny, Armstrong, Beaver, Indiana, and Warren are in nonattainment for SO_x.

Based on the significance criteria presented in Table 12.2.12-1, impacts to air quality 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 Pennsylvania; however, NAAQS exceedances are not anticipated. Given that nonattainment areas are present throughout Pennsylvania (Figure 12.1.12-1), 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.

12.2.12.4. 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 on 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 development 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 vehicles used to lay the cable. In addition, the construction of landings and/or facilities on shore to accept submarine cable could result in products of combustion and fugitive dust from heavy equipment used for grading, foundation excavation, or other ground disturbing activities.

- Installation of Optical Transmission or Centralized Transmission Equipment: Emissions associated with the installation of optical transmission or centralized transmission equipment would be limited to the short-term, temporary use of vehicle and construction equipment. Long-term impacts are unlikely, as the power requirements for optical networks are relatively low.

- Wireless Projects
  - New Wireless Communication Towers: Activities associated with installing new wireless towers and associated structures (e.g., generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in products of combustion. Operating vehicles and other heavy equipment, running generators while conducing excavation activities, and landscape grading to install new wireless towers and associated structures or access roads could result in products of combustion and fugitive dust.

  - Collocation on Existing Wireless Tower, Structure, or Building: Vehicles and equipment used to mount or install equipment, such as antennas or microwave dishes, on an existing tower could impact air quality. If additional power units, structural hardening, and physical security measures required grading or excavation, then exhaust and fugitive dust from heavy equipment used for these activities could also result in increased air emissions.

  - Deployable Technologies: The type of deployable technology used would dictate the types of air pollutants generated. For example, mobile equipment deployed via heavy trucks could generate products of combustion from the internal combustion engines associated with the vehicles and onboard generators. These units may also generate fugitive dust depending on the type of road traveled during deployment (i.e., paved versus unpaved roads). Aerial platforms (e.g., UASs or other aircraft) would generate pollutants during all phases of flight.

In general, the pollutants of concern from the abovementioned activities would be products of combustion from burning fossil fuels in internal combustion engines and fugitive dust from site preparation activities and vehicles traveling on unpaved road surfaces. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the construction impacts. These impacts are anticipated to be less than significant due to the limited nature of the deployment. 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.

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. 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.

12.2.12.5. 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 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 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.

12.2.13. Noise

12.2.13.1. Introduction

This section describes potential noise impacts from construction, deployment, and operation of the Proposed Action and alternatives in Pennsylvania. 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.

12.2.13.2. Impact Assessment Methodology and Significance Criteria

The noise impacts of the Proposed Action were evaluated using the significance criteria presented in Table 12.2.13-1. As described in Section 12.2, 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 noise impacts to Pennsylvania addressed in this section are presented as a range of possible impacts.

Table 12.2.13-1: 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

12.2.13.3. 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 12.2.13-1, 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.

12.2.13.4. 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.

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:

- Wireless Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. Noise generated by equipment required to install fiber would be infrequent and of short duration, and is not expected to create perceptible impacts.

  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up dark fiber would require no construction or installation activities, and therefore would have no noise impacts.

- Satellites and Other Technologies
  - Satellite Enabled Devices and Equipment: The duration of construction activities associated with installing permanent equipment on existing structures would most likely be short-term. It is anticipated that insignificant levels of noise would be emitted during installment of this equipment. Noise caused by these construction and installation activities would be similar to other construction activities in the area, such as the installation of cell phone towers or other communication equipment. Deployment and operation of satellite-enabled devices and equipment are expected to have minimal to no impact on the noise environment.

  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact noise resources, it is anticipated that this activity would have no impact on those resources.

Activities with the Potential for Noise Impacts

Construction, deployment, and operation activities related to the Preferred Alternative could create noise impacts from either the construction or operation of the infrastructure. The types of infrastructure deployment 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 partners 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. 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.

12.2.13.5. 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 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 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 partners 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. 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 partners 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.

12.2.14. Climate Change

12.2.14.1. Introduction

This section describes potential impacts to climate and climate change-vulnerable resources in Pennsylvania 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.

12.2.14.2. 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 12.2.14-1. As described in Section 12.2, 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 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, 2015s), 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.

Table 12.2.14-1: 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 GHG 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

12.2.14.3. 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).

Air Temperature

Figures 3.14.6-1 and 3.14.6-2 illustrate the anticipated temperature changes for low and high GHG emission scenarios for Pennsylvania from a 1969 to 1971 baseline.

Cfa – Figure 12.2.14-1 shows that by mid-century (2040 to 2059), temperatures in the entire state of Pennsylvania under a low emissions scenario will increase by approximately 4 °F (USGCRP, 2009).

By the end of the century (2080 to 2099) under a low emissions scenario temperatures for the majority of the region will increase by approximately 6 °F, however temperatures in the southeastern most portion of the Cfa region for the same time period are only expected to increase by approximately 5 °F (USGCRP, 2009).

Figure 12.2.14-2 shows that under a high emissions scenario for the period (2040 to 2059), temperatures will increase by approximately 5 °F. Under a high emissions scenario for the period (2080 to 2099) in the Cfa region of Pennsylvania, temperatures will increase by approximately 9 °F (USGCRP, 2009).

Cfb – By mid-century (2040 to 2059), temperatures under a low emissions scenario will increase at the same rate as the Cfa region. By the end of the century in the Cfb region, temperatures will increase by approximately 6 °F (USGCRP, 2009).

Temperatures under high emissions scenarios will increase at the same rate as the Cfa region by the mid-and-end of the century (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 Cfb region under both low and high emissions scenarios (USGCRP, 2009).

Dfb – 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 Cfb and Dfa regions under both low and high emissions scenarios (USGCRP, 2009).

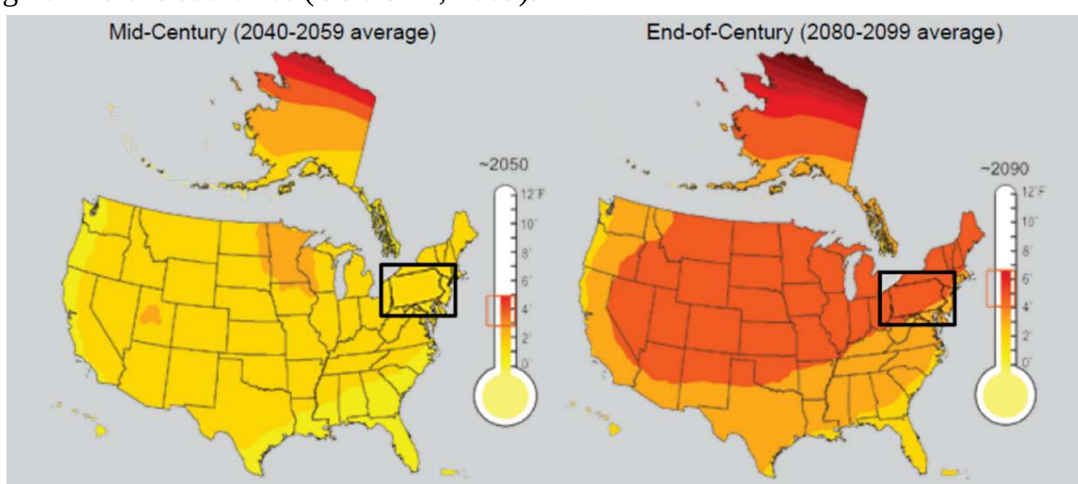


Figure 12.2.14-1: Pennsylvania Low Emission Scenario Projected Temperature Change

Source: (USGCRP, 2009)

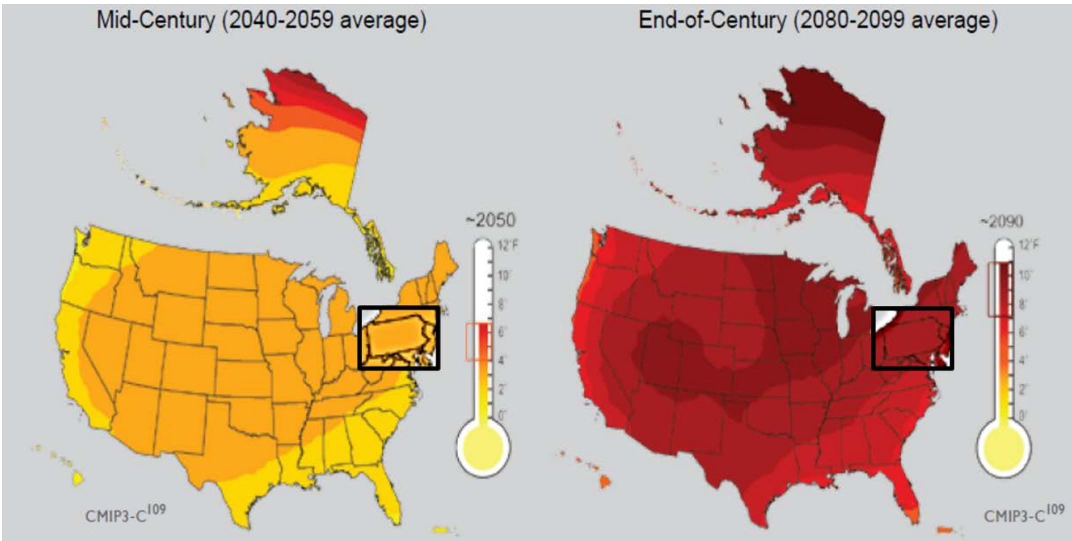


Figure 12.2.14-2: Pennsylvania High Emission Scenario Projected Temperature Change

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 12.2.14-3 and Figure 12.2.14-4 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 12.2.14-3 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 12.2.14-4 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 12.2.14-3 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 and spring for the entire state of Pennsylvania. In summer, precipitation is expected to increase by 10 percent for the majority of the Cfa region, with no expected increase in precipitation in the eastern portion of the Cfa region. However, there are no expected increases in precipitation in fall other than fluctuations due to natural variability (USGCRP, 2014b).

Figure 12.2.14-4 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 is expected to increase by 10 percent for the majority of the Cfa region, with no expected increase in precipitation on the eastern border of the state. No significant change to fall precipitation is anticipated over the same period (USGCRP, 2014b).

Cfb – Under a rapid emissions reduction scenario in the period 2071 to 2099, precipitation will increase by 10 percent in winter, spring and summer in the Cfb region of Pennsylvania. No significant change to fall precipitation is expected.

If emissions continue to increase, precipitation is expected to increase 20 percent in winter and spring while summer precipitation will increase 10 percent. No significant change to fall precipitation 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 Pennsylvania in a low GHG emissions scenario.

While, precipitation changes for the Dfa region are consistent with projected changes for the Cfb region of Pennsylvania in a high GHG emissions scenario (USGCRP, 2014b).

Dfb – Precipitation changes for the Dfb region are consistent with projected changes for the Cfa and Dfa regions of Pennsylvania in a low GHG emissions scenario.

Under a high emissions scenario, winter precipitation is expected to increase 30 percent in the Dfb region of Pennsylvania. In spring, precipitation is expected to increase 20 percent. While in summer, precipitation in the majority of the Dfb region is expected to increase 10 percent while the western most border will not have any significant change to summer precipitation. No significant change to summer precipitation is expected (USGCRP, 2014b).

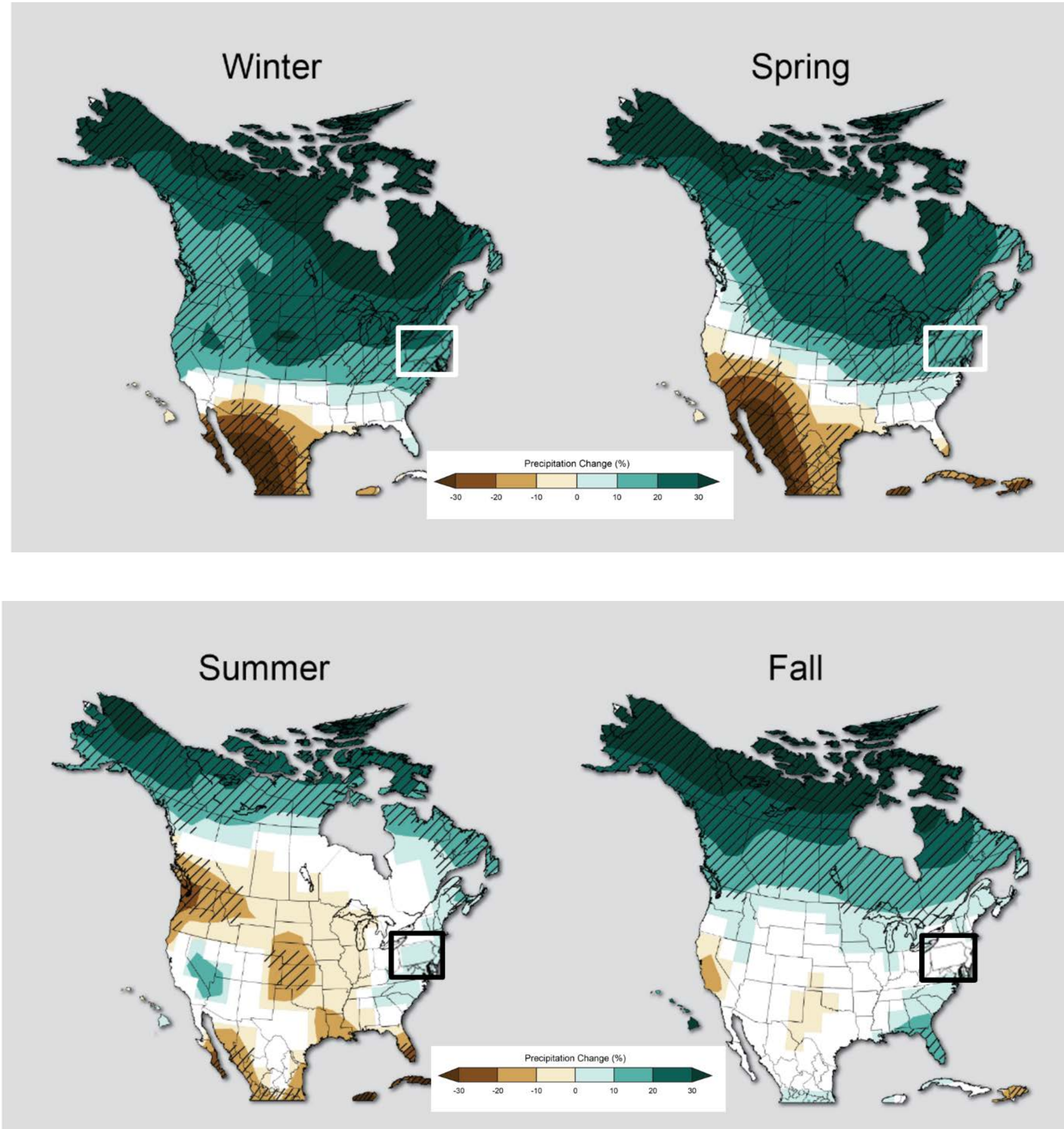


Figure 12.2.14-3: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a Low Emissions Scenario

Source: (USGCRP, 2014b)

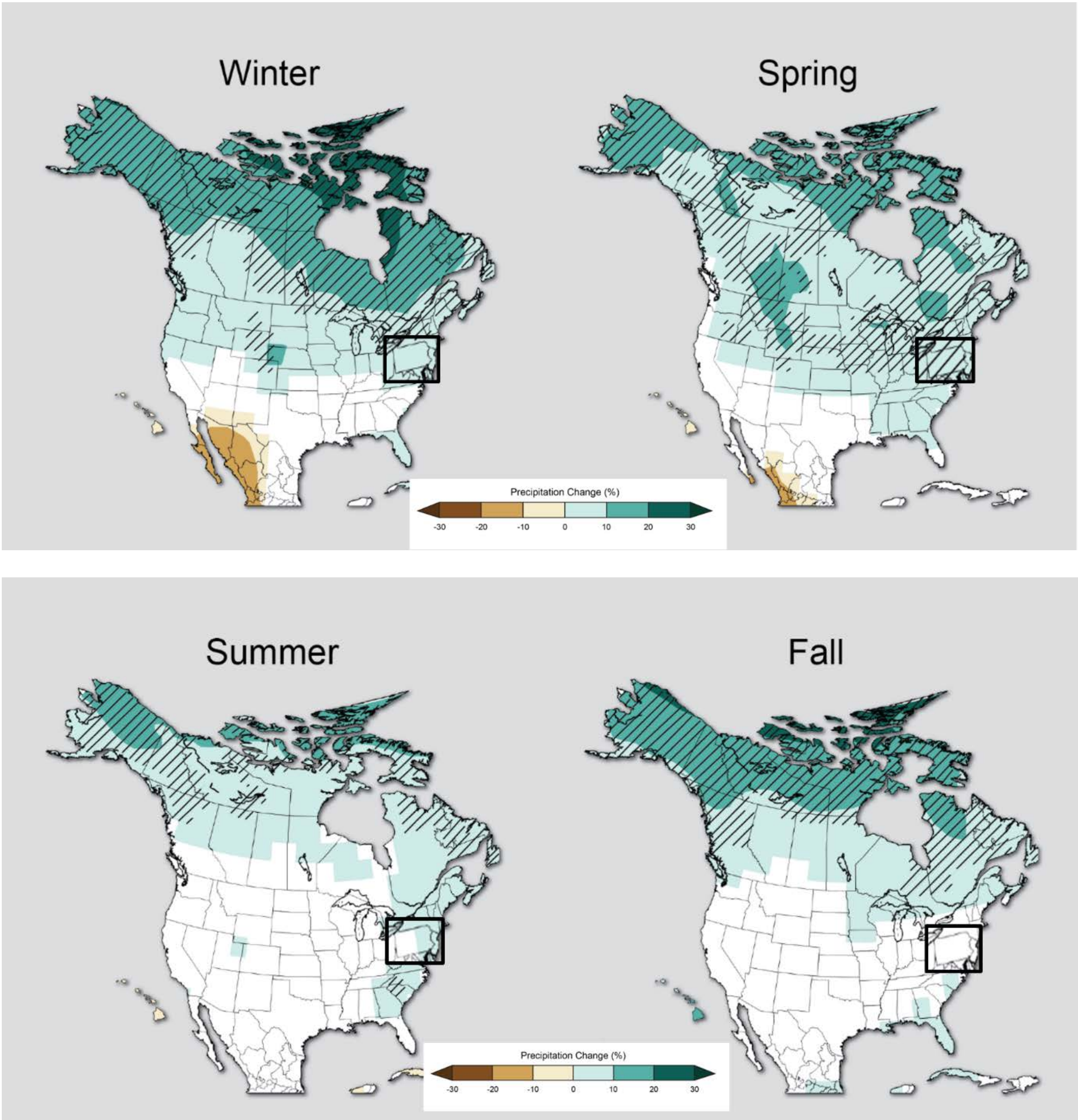


Figure 12.2.14-4: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a High Emissions Scenario

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, 2012a). 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, 2012a). "Ocean heat content also influences sea level and currents" (USEPA, 2012a).

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 lever rise scenarios. Variation in sea level rise along different stretches of coast is mostly due to varying rates of land subsidence (also known as relative sea level rise). In the National Climate Assessment (NCA) potential sea level rise scenarios were reported. These scenarios were developed based on varying degrees of ocean warming and ice sheet loss as estimated by organizations like IPCC (NOAA, USGS, SERPD, and USACE, 2012). Figure 12.2.14-5 and Figure 12.2.14-6 show feet of sea level above 1992 levels at different tide gauge stations. Figure 12.2.14-5 shows an 8 inch global sea level rise above 1992 levels by 2050 and Figure 12.2.14-6 shows a 1.24 foot global sea level rise above 1992 levels by 2050 (USGCRP, 2014c).

Cfa – Figure 12.2.14-5 presents an 8 inch global average sea level rise above 1992 levels, resulting in a 1.0 to 1.3 foot sea level rise in 2050, which will only affect the Philadelphia area of Pennsylvania. Figure 12.2.14-6 indicates that a 1.24 foot sea level rise above 1992 level would result in a 1.7 to 2.0 foot sea level rise in 2050 along the Philadelphia area of Pennsylvania (USGCRP, 2014c).

Cfb, Dfa and Dfb – These Pennsylvania regions are not affected by sea level rise.

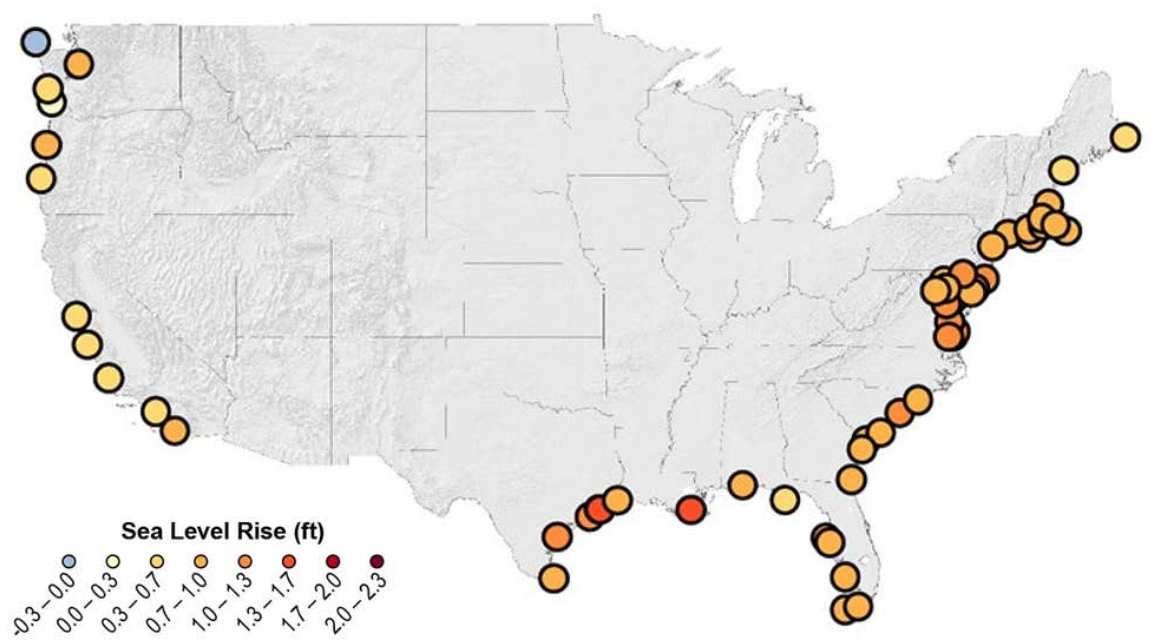


Figure 12.2.14-5: 8-inch Sea Level Rise Above 1992 Levels by 2050

Source: (USGCRP, 2014c)

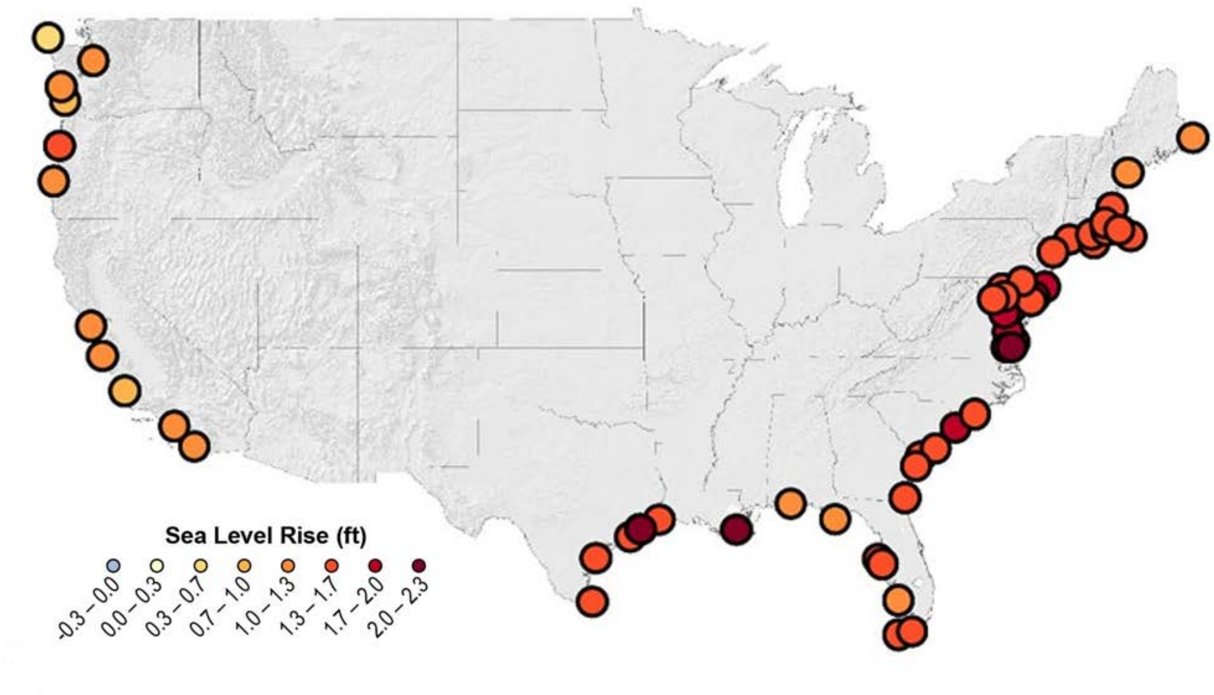


Figure 12.2.14-6: 1.24-foot Sea Level Rise Above 1992 Levels by 2050

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).

U.S. coastal waters are expected to experience more intense hurricanes with related increases in wind, rain, and storm surges (but not necessarily an increase in the number of storms that make landfall) (USGCRP, 2014d). Changes in hurricane intensity are difficult to project because there are contradictory effects at work. Warmer oceans increase storm strength with higher winds and increased precipitation. However, changes in wind speed and direction with height are also projected to increase in some regions; this tends inhibit storm formation and growth. Current research suggests stronger, more rain-producing tropical storms and hurricanes are generally more likely, though such storms may form less frequently; ultimately, more research would provide greater certainty (USGCRP, 2014d).

12.2.14.4. 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 12.2.14-1, climate change impacts as a result of GHG emissions could be significant and require a quantitative analysis if FirstNet's deployment of technology was responsible for increased emissions of 25,000 MT/year or more. The GHG emissions resulting from FirstNet activities fall into two categories: short-term and long-term. Short-term emissions could be associated with deployment activities (vehicles and other motorized construction equipment) and would have no long-term or permanent impact on GHG emissions or climate change. Long-term (both temporary and permanent) emission increases could result from operations, including the use of grid-provided electricity by FirstNet equipment such as transmitters and optical fiber, and from the temporary use of portable or onsite electric generators (a less efficient, more carbon-intensive source of electricity), during emergency situations when the electric grid was down, for example after a hurricane.

A single large cell tower would typically require 20-60kW of power to operate (Balshe, 2011). The CO_2 emissions associated with the operation of the tower would depend on whether it was supplied by a stand-alone power source, such as a generator, or from the grid, and whether it was operating at full power on a continuous basis. A standard 60kW 3-phase diesel generator consumes approximately 5.0 gallons of diesel per hour (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, 2014b). 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 (Vereecken, et al., 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 availability, and recreation. These effects would vary from state to state depending on the resources in question and their relationship to climate change. No BMPs will be described in this chapter for this aspect of the resource.

According to the Pennsylvania Climate Impacts Assessment Update (prepared by Pennsylvania State University but commissioned by the Pennsylvania DEP) climate change is expected to have mixed impacts on agriculture, forestry, and natural ecosystems (Shortle, J. et al, 2013), with positive impacts for certain agricultural sectors (seasonal crops), negative impacts on dairy farming. There will also be negative impacts on bodies of water such as lakes and streams that may experience increased runoff and algal blooms as rainfall becomes more extreme and temperatures rise (USGCRP, 2014p). Increasing frequency of summer heatwaves will have negative consequences for human health, both from the direct effects of heat and also increased air pollution (Shortle, J. et al, 2013).

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. Severe weather may impact FirstNet infrastructure and installations. Climate change is projected to increase the intensity of hurricanes on the east coast. Although Pennsylvania is not exposed to the direct effects of the landfall of a full-strength hurricane, it is at risk for severe rain events and flooding from hurricanes as the travel up the east coast of the U.S. In addition, climate change is expected to increase the intensity of rainfalls, increasing the potential for increased severe flooding in already flood-prone areas of the state. (USGCRP, 2014j). The increased incidence of heat waves may also negatively impact the operation of the electricity grid in Pennsylvania, both from the direct effect of heat on the infrastructure, and also the increased use of air conditioning increasing demand for electricity (Shortle, J. et al, 2013) (DOE, 2015).

12.2.14.5. 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 Pennsylvania, 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Climate Change Impacts on FirstNet Infrastructure or Operations

Climate change effects on the Preferred Alternative could be potentially significant to less than significant with BMPs and mitigation measures incorporated because climate change may potentially impact FirstNet installations or infrastructure during periods of extreme heat, severe storms, and other weather events. Mitigation measures could minimize or reduce the severity or magnitude of a potential impact resulting to the project, including adaptation, which refers to anticipating adverse effects of climate change and taking appropriate action to prevent and minimize the damage climate change effects could cause.

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.

12.2.14.6. 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 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. 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. These activities are expected to be less than significant due the limited duration of deployment activities.

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. 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. Climate change effects such as temperature, precipitation changes, and extreme weather during operations would be expected but could have little to no impact on the deployed technology due to the temporary nature of deployment. However, if these technologies are deployed continuously (at the required location) for an extended period, climate change effects on deployables could be similar to the Proposed Action, as explained above.

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 12.1.14, Climate Change.

12.2.15. Human Health and Safety

12.2.15.1. Introduction

This section describes potential impacts to human health and safety in Pennsylvania 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

12.2.15.2. 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 12.2.15-1. As described in Section 12.2, 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 human health and safety addressed in this section are presented as a range of possible impacts.

12.2.15.3. 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 12.2.15-1, 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 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.

Table 12.2.15-1: Impact Significance Rating Criteria for Human Health and Safety

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs 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, Toxic Substances Control Act (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 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 Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Exposure to Hazardous Materials, Hazardous Waste, and Occupational Hazards as a Result of Natural and Manmade 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

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, 2015b).

- Engineering controls,
- Work practice controls,
- Administrative controls, and then
- 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 (OSHA, 2015b). 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 (OSHA, 2015b). 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 Pennsylvania Department of Labor and Industry (PADLI) is not authorized by OSHA to administer a state program for public or private sector employers. Therefore, PADLI would defer 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 and mine lands at FirstNet deployment sites has the potential to negatively impact health and safety of workers and the general public. Past or present contaminated media, such as soil and groundwater, may be present and become disturbed as a result of site activities. Pennsylvania has a healthy historic and current mining industry, as presented in Section 12.1.15. In 2015, the Pennsylvania mining industry ranked 16th for non-fuel minerals (primarily crushed stone, cement, lime, sand and gravel), generating a value of $1.70B (USGS, 2016b). In 2013, the most recent data available, coal production in Pennsylvania ranked 3rd in the U.S., behind West Virginia and Kentucky, with 315 coalmining operations (82 underground and 233 surface) (EIA, 2013).

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 12.2.15-1, human health impacts could be significant if FirstNet deployment sites are near contaminated properties or abandoned or active mine lands. 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 Pennsylvania DEP, or through an equivalent commercial resource, such as Environmental Data Resources, Incorporated.

By screening sites for environmental contamination, mining activities, and reported environmental liabilities, the presence of historic contamination and unsafe ground conditions could be evaluated and may influence the site selection process. In general, the lower the density of environmental contamination or mining activities, the more favorable the site will be for FirstNet deployment projects. If sites containing known environmental contamination (or mine lands) are selected for proposed FirstNet deployment activities it may be necessary to implement additional controls (e.g., engineering, work practice, administrative, and/or PPE) to ensure workers, and the general public, are not unnecessarily exposed to the associated hazards. Additionally, for any proposed FirstNet deployment site, it is possible undocumented environmental contamination is present.

During FirstNet deployment activities, if any soil or groundwater is observed to be stained or emitting an unnatural odor, it may be an indication of environmental contamination. When such instances are encountered, it may be necessary to stop work until the anomaly is further assessed through record reviews or environmental sampling. Proposed FirstNet deployment will avoid known contaminate 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 Pennsylvania 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 Pennsylvania DEP 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 12.2.15-1, 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.

12.2.15.4. 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 on those resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to human health and safety as a result of implementation of the Preferred Alternative would encompass a range of impacts that occur as a result of ground disturbance activities, construction activities, equipment upgrade activities, management of hazardous materials and/or hazardous waste, and site selection. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to human health and safety include the following:

- Wired Projects
   - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber 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 in 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 and release of hazardous chemicals and hazardous waste. 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.

12.2.15.5. 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 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 hazardous materials (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 12.1.15, Human Health and Safety.

PA APPENDIX A – WATER RESOURCES

Table A-1: Characteristics of Pennsylvania's Watersheds, as Defined by Pennsylvania DEP

Watershed/Size Land Area within PA (square miles)	Major Surface Waterbodies	Major Water Quality Concerns
Delaware River (6,422)	Lackawaxen River Pennypack Creek Lehigh River Schuylkill River Tohickon Creek Crum Creek Neshaminy Creek Brandywine Creek	• Mine drainage • Urban runoff • Municipal wastewater • Erosion and sediments
Susquehanna River (20,960)	Chemung Creek Bowman Creek Sugar Creek Lackawanna River Towanda Creek Fishing Creek Wysox Creek Sinnemahoning Creek Wyalusing Creek Pine Creek Mehoopany Creek Bald Eagle Creek Tunkhannock Creek Moshannon Creek West Branch Susquehanna River Codorus Creek Conodoguinet Creek Juniata River Conestoga River Penns Creek Swatara Creek Conewago Creek Pequea Creek Yellow Breeches Creek	• Erosion and sediments • Agricultural nonpoint source pollution • Construction-related and urban runoff • Industrial and municipal wastewater • Mine drainage
Genesee River (99)	Genesee River Mundy Brook Turner Creek Ludlington Run	• Agricultural nonpoint source pollution • Erosion and sediments
Potomac (1,584)	Wills Creek Conococheague Creek Evitts Creek Antietam Creek Town Creek Toms Creek Sideling Hill Creek Marsh Creek Tonoloway Creek Rock Creek Licking Creek	• Mine drainage • Agricultural nonpoint source pollution • Municipal wastewater • Construction and development-related runoff and sediments

Watershed/Size Land Area within PA (square miles)	Major Surface Waterbodies	Major Water Quality Concerns
Ohio (15,614)	Allegheny River Beaver River Clarion River Conemaugh River French Creek Monongahela River Youghiogheny River	• Legacy wastewater discharges from industrial sources • Mine drainage, specifically aluminum, iron, and manganese • Gas/oil production-related brine
Lake Erie (511)	Lake Erie Walnut Creek Elk Creek Conneaut Creek	• Aquatic nuisance species • Erosion and sediments • Legacy wastewater discharges from industrial, commercial, and municipal sources

Source: (Pennsylvania DEP, 2012a)

Table A-2: Pennsylvania State Wild, Scenic, Pastoral, Recreational, and Modified Recreational Rivers

River Name	River Segment Description
Rivers or Segments Designated as Wild	
Lehigh River	(a) Sandy Run from the old railroad crossing to confluence with the Lehigh River
	(b) Stony Creek from Yellow Run to confluence with the Lehigh River
	(c) Bear Creek from unnamed tributary, below Bear Creek Dam to confluence with the Lehigh River
	(d) Little Bear Creek from headwaters to confluence with the Lehigh River
	(e) Glenn Onoko Falls from headwaters to confluence with the Lehigh River
	(f) Jeans Run from headwaters to confluence with Nesquehoning Creek
Lick Run	(a) From headwaters to PA Game Lands 89 gate at Farrandsville, PA
	(b) Branch Lick Run from headwaters to confluence with Lick Run
	(c) Campbell Run from PA Game Lands 89 boundary to confluence with Lick Run
	(d) Staver Run from Hazard Road crossing to confluence with Lick Run
	(e) Craig Fork from Hazard Road crossing to confluence with Lick Run
Pine Creek	(a) From Fourmile Run to confluence with Jerry Run
	(b) Fourmile Run from Painter/Leetonia Road crossing to confluence with Pine Creek
	(c) Right Branch Fourmile Run from the Gaines/Shippen township line to confluence with Fourmile Run
	(d) Campbell's Run from the Pine Creek Gorge Natural Area Boundary to confluence with Pine Creek
	(e) Pine Island Run from the Pine Creek Gorge Natural Area Boundary to confluence with Pine Creek
Stony Creek	Three tributary streams: Rattling Run, Yellow Springs and Rausch Creek from headwaters in Lebanon County to the PA Game Lands 211 gate at Ellendale Forge
Tucquan Creek	Tucquan Glen (Seven Streams) from River Road (State Road (SR) 3017) to confluence with the Susquehanna River
Rivers or Segments Designated as Scenic	
Bear Run	(a) From where the stream becomes perennial to the eastern edge of the tunnel under the B & O Railroad grade
	(b) Beaver Run from the Tree/Teaberry Trail to confluence with Bear Run
Lehigh River	(a) From Francis E. Walter Dam to Benchmark 548 at Bear Mountain, Jim Thorpe, PA

River Name	River Segment Description
	(b) Black (Hayes) Creek from Fourth Run to confluence with the Lehigh River
	(c) Hickory Run from Hickory Run Lake to confluence with the Lehigh River
	(d) Leslie Run from Poor Man's Pond to confluence with the Lehigh River
	(e) Mud Run from Panther Creek to confluence with the Lehigh River
	(f) Drakes Creek from junction with unnamed tributary below Christmans, PA to confluence with the Lehigh River
	(g) Black Creek from Quakake Creek to confluence with the Lehigh River
	(h) Nesquehoning Creek from confluence with Jeans Run to confluence with the Lehigh River
Lick Run	Robbins Run from headwaters to confluence with Lick Run
Octoraro Creek	(a) East Branch Octoraro Creek from Township Routes 414 (Chester Co.) and 455 (Lancaster Co.) and the bridge to Local Road 15058 (Steelville Road)
	(b) West Branch Octorara Creek from Meetinghouse Creek to confluence with Bowery Run
	(c) West Branch Octorara Creek from the Octoraro Water Company Dam to LR 36010 (Puseyville Road)
	(d) Stewart Run from 2 miles upstream to confluence with West Branch Octoraro Creek
Pine Creek	(a) From Marsh Creek to confluence with Fourmile Run
	(b) From Jerry Run to the Tioga/Lycoming county line
Tucquan Creek	(a) From headwaters near Rawlinsville, PA to confluence of Clark Run
	(b) Clark Run from headwaters at Mount Nebo, PA to confluence with Tucquan Creek
West (Northwest) French Creek	(a) From Hopewell Lake to 1 mile downstream of Snowdens Bridge
	(b) South Branch French Creek from headwaters to confluence with French Creek
	(c) Pine Creek from headwaters to confluence with French Creek
	(d) Rock Run from Harmonyville Road to confluence with French Creek
	(e) Beaver Run from Fairview Road & Route 100 to confluence with French Creek
	(f) West Branch Birch Run from Shady Lane Road to confluence with Birch Run
	(g) Birch Run from headwaters to confluence with French Creek
Yellow Breeches Creek	Hairy Springs Hollow from its headwaters to the backwater of Big Pond

River Name	River Segment Description
Rivers or Segments Designated as Pastoral	
LeTort Spring Run	(a) From Route 34 bridge to abandoned Reading Railroad bridge adjacent to LeTort Park, including Left Branch LeTort Spring Run from its source to confluence with the main stem
	(b) From Post Road to confluence with Conodoguinet Creek
Lower Brandywine	(a) From the confluence of the East and West Branches Brandywine Creek to the PA/DE Stateline, including the 1.1 mile horseshoe bend, Chester County, PA
	(b) Pocopson Creek from SR 842 to confluence with Brandywine Creek
	(c) East Branch Brandywine Creek from the Norfolk-Southern (formerly Penn Central) Railroad overpass to confluence with Brandywine Creek
	(d) Valley Creek from the Norfolk-Southern (formerly Penn Central) Railroad overpass to confluence with East Branch Brandywine Creek
	(e) West Branch Brandywine Creek from the Wawaset Bridge to confluence with Brandywine Creek
	(f) West Branch Brandywine Creek from a point 1600 feet downstream of Modena Borough Boundary to Wawaset Bridge, including 1.8 miles of Green Valley Stream and 2.2 miles of an unnamed tributary in Newlin Township, from Glenhall to Cannery Road
	(g) Broad Run from Beacon Hill Road to confluence with West Branch Brandywine Creek
	(h) Buck Run from 1.4 miles upstream of Log Cabin Road to confluence with West Branch Brandywine Creek
	(i) Doe Run from Fernwood Road to confluence with Buck Run
Octoraro Creek	(a) From Pine Grove Covered Bridge to PA/MD state line, including the 0.4 mile horseshoe bend in Chester County, at the state line
	(b) East Branch Octoraro Creek from LR 15058 (Steelville Road) to LR 15025 (Eden Road)
	(c) West Branch Octorara Creek from LR 36010 (Puseyville Road) to Octoraro Lake
Schuylkill River	Little Schuylkill River from Port Clinton (Forks) to New Ringgold Route 895 (Bridge)
Tulpehocken Creek	(a) From its headwaters near Kimmerlings Church, North Lebanon Township to Ramona Road (Township Road 560), Jackson Township
	(b) From western boundary of property now or formerly owned by Carl Sensenig to SR 4010 bridge, at the entrance to Heidelberg Country Club
Yellow Breeches Creek	From the backwater of Big Pond on Hairy Springs Hollow to SR 2004 at Bowmansdale, PA
Rivers or Segments Designated as Recreational	
Schuylkill River	From Port Clinton (Forks) to Cross Keys (Bridge)

River Name	River Segment Description
Tulpehocken Creek	(a) From the base of Blue Marsh Dam to confluence with the Schuylkill River
	(b) Cacoosing Creek from State Hill Road bridge (SR 3023) to confluence with Tulpehocken Creek
Yellow Breeches Creek	From SR 2004 bridge at Bowmansdale, PA to confluence with the Susquehanna River
Rivers or Segments Designated as Modified Recreational	
LeTort Spring Run	From abandoned Reading Railroad bridge adjacent to LeTort Park to Post Road, including mill race from Henderson Avenue to confluence with the main stem
Schuylkill River	(a) From Cross Keys (Bridge) to Reading (Route 422 above Fritz Island)
	(b) From Reading (Route 422 Bridge over Fritz Island) to Douglassville (Bridge)
	(c) From Douglassville (Bridge) to Fairmount Dam
	(d) Wet Branch Schuylkill River from Route 209 (Highway) to Cressona Route 183 (Bridge)
	(e) From Cressona Route 183 (Bridge) to Auburn Basin (Spillway)
	(f) From Auburn Basin (Spillway) to Port Clinton (Forks)

Source: (Pennsylvania DCNR, 2015i)

PA APPENDIX B – COMMUNITIES OF CONCERN

Table B-1: Pennsylvania Natural Heritage Program S1 Ranked Natural Community Types

Vegetative Community Type	USEPA Ecoregion(s)	Geographic Region(s)	Description	Distribution
Buckthorn-sedge-golden ragwort fen	Erie Drift Plain	Lake Erie	Wetlands occurring in calcareous soils[175], often with evidence of visible surface flow (seeps). Dominated by mixture of shrubs, sedges, other and herbaceous plants.	Western Pennsylvania, in areas that, due to soil conditions, have been extensively cleared of natural vegetation for agriculture and settlement.
Calcareous glacial lake	Erie Drift Plain	Lake Erie	Glacial lakes and surrounding areas with calcareous soils.	Northwestern Pennsylvania
Central Appalachian shale barren (Red cedar-mixed hardwood rich shale woodland)	Ridge and Valley	Susquehanna Valleys; Laurel Highlands/Southern Alleghenies	Occurs on steep, south-facing slopes of often calcareous, weathering shales, which are actively eroding. Red-cedar, white ash, oaks, hickories dominate, with mixed shrub layer. Characterized by a relatively dense, diverse herbaceous layer.	South-west central Pennsylvania
Elm-Ash-Maple Lakeplain forest	Eastern Great Lakes Lowlands	Lake Erie	Forested wetland with open canopy, occurring on flat terrain with small vernal ponds scattered throughout. Pumpkin ash trees are characteristic.	Restricted to the Lake Erie plain

[175] Soils containing an abundance of calcium carbonate from underlying chalk or limestone rock.

Vegetative Community Type	USEPA Ecoregion(s)	Geographic Region(s)	Description	Distribution
Ephemeral/fluctuating limestone sinkhole	Ridge and Valley; Northern Piedmont	Susquehanna Valleys; Hershey/Dutch Country; Laurel Highlands/Southern Alleghenies	A vernal pond community associated with limestone sinkholes with fluctuating water levels. Vegetation includes three-way sedge, sphagnum moss, cinnamon fern present.	Southeast-central Pennsylvania
Freshwater tidal mixed high marsh	Middle Atlantic Coastal Plain	Lehigh Valley	This intertidal marsh community occurs in low-lying, flat areas adjacent to the upper edges of sloping river banks which experience flooding only at the highest tides. Densely vegetated by robust wetland species.	Bucks County along the Neshaminy Creek at Neshaminy State Park and at Biles Island.
Great Lakes bluff seep	Eastern Great Lakes Lowlands	Great Lakes	Steep slopes of lacustrine sediment, glacial till, or shale bedrock adjacent to streams or Lake Erie. Perennial seepage factors into the continuous cycle of slump and regrowth typical of this community.	Lake Erie and area streams in northwestern Pennsylvania.
Great Lakes region bayberry-cottonwood community	Eastern Great Lakes Lowlands	Lake Erie	A complex mixture of shrubs and trees of a variety of ages due to the constant flux of dunes and sandplains along the lakeshore.	Occurs only on Presque Isle peninsula at Lake Erie
Great Lakes region bayberry-mixed shrub palustrine shrubland	Eastern Great Lakes Lowlands	Lake Erie	Shrubby vegetation on sandy soils located along Lake Erie shoreline, protected from open water by dune or sand ridges, and often surrounding swale ponds.	Occurs only on Presque Isle peninsula at Lake Erie

Vegetative Community Type	USEPA Ecoregion(s)	Geographic Region(s)	Description	Distribution
Great Lakes region dry sandplain	Eastern Great Lakes Lowlands	Lake Erie	A dry grassland community growing on sand deposits of the Lake Erie shoreline. Dominant species include Indian grass, switch grass, and little bluestem.	Occurs only on Presque Isle peninsula at in Lake Erie.
Great Lakes region palustrine sandplain	Eastern Great Lakes Lowlands	Lake Erie	A sparsely vegetated herbaceous community growing on moist sand flats. Dominated by rushes, sedges, and umbrella-nut sedges.	Occurs only on Presque Isle peninsula at Lake Erie.
Great Lakes region scarp seep	Eastern Great Lakes Lowlands	Lake Erie	Restricted to extremely steep, actively eroding, lakeshore bluff and creek wall slopes along Lake Erie. Open vegetation with a mix of stages due to cyclical slumping of hillslopes.	Lake Erie
Great Lakes region sparsely vegetated beach/shore	Eastern Great Lakes Lowlands	Lake Erie	Sparsely vegetated herbaceous community that occurs between the normal water line and upper limit of winter storms, in cobble, sand, and gravel substrates.	Along the Lake Erie coastline
Low heath shrubland	Erie Drift Plain, North Central Appalachians, Northern Allegheny Plateau, Ridge and Valley	Lake Erie, Allegheny Forest, Poconos	Most commonly occurs on ridgetops or other areas exposed to the elements, limiting tree and tall shrub growth. Thin or sandy soils and periodic fire are contributing elements. Blueberries dominant, pitch pine, quaking aspen, and gray birch are limited.	Glaciated northern portions of the state, including the Poconos and Alleghany mountains and forests.

Vegetative Community Type	USEPA Ecoregion(s)	Geographic Region(s)	Description	Distribution
Open sedge fen	Erie Drift Plain, Western Allegheny Plateau	Lake Erie, Laurel Highlands/Southern Alleghenies	Open, sedge-dominated wetlands occurring on sedge-peat substrate that are saturated most of the year. They are groundwater-fed wetlands, often with calcareous indicator plant species.	Eastern Pennsylvania
Pitch pine-rhodora-scrub oak woodland	Northern Allegheny Plateau	Poconos	A community on moist soils that may be influenced by fire. Dominant species include pitch pine, red maple, rhodora, and scrub oak trees, with blueberry and sheep laurel shrubs.	Restricted to the southern Pocono Plateau
Poison sumac-red cedar-bayberry fen	Northern Allegheny Plateau	Poconos	Wetlands with substantial organic layer, occurring over calcareous soils. Dominated by eastern red-cedar, bayberry, poison sumac, and shrubby cinquefoil.	Northeastern Pennsylvania
Red maple-magnolia coastal plain palustrine forest	Northern Piedmont, Middle Atlantic Coastal Plain	Lehigh Valley, Hershey/Dutch Country	Nutrient-poor, acidic swamp forest with deep muck layers over mineral soils with standing water. Red maple, sweet-bay magnolia, sweetgum, and blackgum dominant.	Southeastern Pennsylvania
Red spruce rocky summit	Northern Allegheny Plateau	Poconos	Trees that are short and diminished due to exposure to wind and ice. Plants limited to areas where soil has accumulated in cracks in the bedrock. Spruces, pines, red maple, with shrubs such as blueberry, huckleberry, and chokecherry, and extensive lichen.	Only known from one example in Wyoming County in northeastern Pennsylvania.

Vegetative Community Type	USEPA Ecoregion(s)	Geographic Region(s)	Description	Distribution
Red cedar-pine serpentine shrubland	Northern Piedmont	Hershey/Dutch Country; Lehigh Valley	Shrubland barren-like community with dense prairie-like ground cover and between 25 percent and 60 percent tree cover. Dominant species include sumac, huckleberry, oak, grasses, red cedar, and pitch pine. Occurs in areas of serpentine bedrock.	Southeastern Pennsylvania
Rhodora-mixed heath-scrub oak shrubland	North Central Appalachians	Poconos	Barren-like vegetation on deep, mesic, fine-loamy till. Shrubs dominate, primarily scrub oak, rhodora, sheep laurel, with scattered pitch pine or red maple.	Only from southern Pocono Plateau
River bluff seep	North Central Appalachians; Ridge and Valley; Central Appalachians; Western Allegheny Plateau	Allegheny Forest; Susquehana Valleys; Laurel Highlands/Southern Alleghenies	Grass and grass-like plants dominate, with scattered low shrubs. High amount of peat cover that is saturated most of the year. Occurs in high-elevation headwater basins of non-glaciated regions.	East-central portions of the state, at high elevations in the ridge and valley and mountain plateau regions.
Riverbank freshwater tidal marsh	Middle Atlantic Coastal Plain	Lehigh Valley	Herbaceous vegetation on tidal riverbanks with wild-rice, spatterdock, arrowhead, and spatterdock dominant. Exposed vegetation at low tide is usually mud-covered.	Shoreline areas along Delaware River in southeastern Pennsylvania.
Serpentine grassland	Northern Piedmont	Hershey/Dutch Country; Lehigh Valley	Restricted to areas over serpentine bedrock. Dense, prairie-like grasses dominate, shrubs less than 25 percent cover.	Southeastern Pennsylvania

Vegetative Community Type	USEPA Ecoregion(s)	Geographic Region(s)	Description	Distribution
Serpentine gravel forb community	Northern Piedmont	Hershey/Dutch Country; Lehigh Valley	Restricted to gravel areas over serpentine bedrock. Open, sunny areas result in dry, warm soil surface conditions. Herbaceous non-grasses dominate.	Southeastern Pennsylvania
Serpentine pitch pine-oak forest	Northern Piedmont	Hershey/Dutch Country; Lehigh Valley	Restricted to areas over serpentine bedrock, pat of barrens complex. Oaks, pitch pine, sassafras, red-cedar dominate, with thick shrub layer of greenbrier, catbrier, oaks, blueberry and huckleberry.	Southeastern Pennsylvania
Serpentine seepage wetland	Northern Piedmont	Hershey/Dutch Country; Lehigh Valley	Restricted to areas over serpentine bedrock. Groundwater seep areas with low slopes and dominated by grasses and grass-like plants.	Southeastern Pennsylvania
Side-oats gramma calcareous grassland	Ridge and Valley; Northern Piedmont	Susquehanna Valleys; Hershey/Dutch Country; Lehigh Valley	Small, prairie-like openings in woodland located on thin soils over calcareous bedrock. Grasses dominate, with some scattered forbs and woody species, trees usually only along margins or scattered.	Southeastern Pennsylvania
Sweetgum-oak coastal plain forest	Northern Piedmont; Middle Atlantic Coastal Plain	Lehigh Valley	Restricted to level, sandy soils. Sweetgum, willow oak, stagger-bush dominate, with greenbrier, fetter-bush, mountain laurel, and sweet pepperbush also present.	Southeastern Pennsylvania in the plains between Delaware River and the Piedmont.
Sweetgum-willow oak coastal plain palustrine forest	Middle Atlantic Coastal Plain	Lehigh Valley	Sweetgum-dominated forest occupying nearly level, seasonally flooded areas. Shrub growth may be dense, including swamp dog-hobble, sweet pepperbush, blueberry, and arrow-wood.	Southeastern strip of Bucks County parallel to the Delaware River.

Sources: (PNHP, 2015b; Fike, 1999)

Acronym List

Acronym	Definition
AARC	Average Annual Rate of Change
ACHP	Advisory Council On Historic Preservation
ACS	American Community Survey
AGL	Above Ground Level
AIM	Aeronautical Information Manual
AIRFA	American Indian Religious Freedom Act
AML	Abandoned Mine Lands
APE	Area of Potential Effect
AQCR	Air Quality Control Region
ARPA	Archaeological Resources Protection Act of 1979
ASL	Above Sea Level
ATC	Air Traffic Control
ATO	Air Traffic Organization
ATV	All-Terrain Vehicle
AVP	Wilkes-Barre/Scranton International
BGEPA	Bald and Golden Eagle Protection Act
BLM	Bureau of Land Management
BLS	Bureau of Labor Statistics
BMP	Best Management Practice
BTOP	Broadband Technology Opportunities Program
C2	Control and Communication
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CEQ	Council On Environmental Quality
CFA	Controlled Firing Area
CFR	Code of Federal Regulations
CGP	Construction General Permit
CH4	Methane
CIMC	Cleanups In My Community
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COLT	Cell on Light Truck

Acronym	Definition
COW	Cell on Wheels
CRS	Community Rating System
CS	Consolidated Statutes
CWA	Clean Water Act
DCNR	Department of Conservation and Natural Resources
DEP	Department of Environmental Protection
DOC	Department of Commerce
DOE	Department of Energy
DOT	Department of Transportation
DQE	Duquesne Light Company
EFH	Essential Fish Habitat
EIA	Energy Information Agency
EJ	Environmental Justice
EJWG	Environmental Justice Work Group
EMS	Emergency Medical Services
EO	Executive Order
EPCRA	Community Right To Know Act of 1986
ERI	Erie International/Tom Ridge Field
ESA	Endangered Species Act
EV	Exceptional Value
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulations
FCC	Federal Communications Commission
FEMA	Federal Emergency Management Agency
FGDC	Federal Geographic Data Committee
FLM	Federal Land Manager
FR	Federal Register
FSDO	Flight Standards District Offices
FSS	Flight Service Station
GAO	Government Accounting Office
GHG	Greenhouse Gas
HAP	Hazardous Air Pollutant
HASP	Health and Safety Plans
HFC	Hydrofluorocarbons

Acronym	Definition
HHRA	Human Health Risk Assessment
HQ	High Quality
HSCA	Hazardous Sites Cleanup Act
IBA	Important Bird Area
IFR	Instrument Flight Rules
IP	Internet Protocol
IPCC	Intergovernmental Panel On Climate Change
IPT	Williamsport Regional
LAMP	Lakewide Action and Management Plans
LBE	Arnold Palmer Regional
LBS	Locations-Based Services
LMR	Land Mobile Radio
LRR	Land Resource Region
LTE	Long-Term Evolution
LTR	Logic Trunked Radio
MBTA	Migratory Bird Treaty Act
MDT	Harrisburg International
MHI	Median Household Income
MLRA	Major Land Resource Areas
MMPA	Marine Mammal Protection Act
MMT	Million Metric Ton
MOA	Military Operation Area
MPLS	Multi-Protocol Label Switching
MSFCMA	Magnuson Stevens Fishery Conservation and Management Act
MSHA	Mine Safety and Health Administration
MSL	Mean Sea Level
MYA	Million Years Ago
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NAICS	North American Industry Classification System
NAS	National Airspace System
NCA	National Climate Assessment
NEP	National Estuary Program
NEPA	National Environmental Policy Act

Acronym	Definition
NFIP	National Flood Insurance Program
NHA	National Heritage Area
NHPA	National Historic Preservation Act of 1966, As Amended
NIH	National Institute of Health
NIST	National Institute of Standards and Technology
NJ	New Jersey
NM	Nautical Miles
NNL	National Natural Landmark
NOAA	National Oceanic and Atmospheric Administration
NOTAM	Notices To Airmen
NOX	Oxides of Nitrogen
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NPS	National Park Service
NPSBN	Nationwide Public Safety Broadband Network
NRC	National Response Center
NRCS	National Resources Conservation Service
NRHP	National Register of Historic Places
NSA	National Security Areas
NST	National Scenic Trail
NTFI	National Task Force On Interoperability
NWI	National Wetlands Inventory
OE/AAA	Obstruction Evaluation and Airport Airspace Analysis
OEJ	Office of Environmental Justice
OSHA	Occupational Safety and Health Administration
OTR	Ozone Transport Region
PA	Pennsylvania
PAAAQS	Pennsylvania Ambient Air Quality Standards
PAB	Palustrine Unconsolidated Bottom
PADLI	Pennsylvania Department of Labor and Industry
PADOH	Pennsylvania Department of Health
PA-STARNET	Pennsylvania Statewide Radio Network
PCB	Polychlorinated Biphenyls
PEIS	Programmatic Environmental Impact Statement

Acronym	Definition
PEM	Palustrine Emergent Wetlands
PEMA	Pennsylvania Emergency Management Agency
PFBC	Pennsylvania Fish & Boat Commission
PFO	Palustrine Forested Wetland
PGA	Peak Ground Acceleration
PGC	Pennsylvania Game Commission
PHL	Philadelphia International Airport
PIT	Pittsburgh International Airport
PM	Particulate Matter
PNHP	Pennsylvania Natural Heritage Program
POP	Point of Presence
PPE	Personal Protective Equipment
PREA	Pennsylvania Rural Electric Association
PRPA	Philadelphia Regional Port Authority
PSAP	Public Service Answering Points
PSCR	Public Safety Communications Research Program
PSD	Prevention of Significant Deterioration
PSP	Pennsylvania State Police
PSS	Palustrine Scrub-shrub Wetland
PTE	Potential To Emit
PUB	Palustrine Unconsolidated Bottom
PUC	Public Utility Commission
R&D	Research and Development
RCRA	Resource Conservation and Recovery Act
RF	Radio Frequency
ROW	Right of Way
SAA	Sense and Avoid
SASP	State Aviation System Plan
SDS	Safety Data Sheets
SEPTA	Southeastern Pennsylvania Transportation Authority
SF6	Sulfur Hexafluoride
SGCN	Species of Greatest Conservation Need
SHA	State Heritage Areas
SHPO	State Historic Preservation Office

Acronym	Definition
SIP	State Implementation Plan
SOC	Standard Occupational Classification
SOP	Standard Operating Procedures
SOW	System on Wheels
SOX	Oxides of Sulfur
SPL	Sound Pressure Level
SR	State Road
SSA	Sole Source Aquifer
SUA	Special Use Airspace
SWPPP	Stormwater Pollution Prevention Plan
TDMA	Time Division Multiple Access
TFR	Temporary Flight Restrictions
TMDL	Total Maximum Daily Load
TRI	Toxics Release Inventory
TSCA	Toxic Substances Control Act
TWA	Time Weighted Average
U.S.C.	U.S. Code
UA	Unmanned Aircraft
UAS	Unmanned Aircraft Systems
UAV	Unmanned Aerial Vehicle
UHF	Ultra High Frequency
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNV	University Park
U.S.	United States
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USDOT	U.S. Department of Transportation
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGCRP	U.S. Global Change Research Program
USGS	U.S. Geological Survey
UVA	University of Virginia
VFR	Visual Flight Rules

Acronym	Definition
VHF	Very High Frequency
VMT	Vehicle Miles Traveled
VOC	Volatile Organic Compound
V-TAC	Vehicular Tactical Networking
WCS	Wetlands Classification Standard
WWI	World War I
WWII	World War II

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