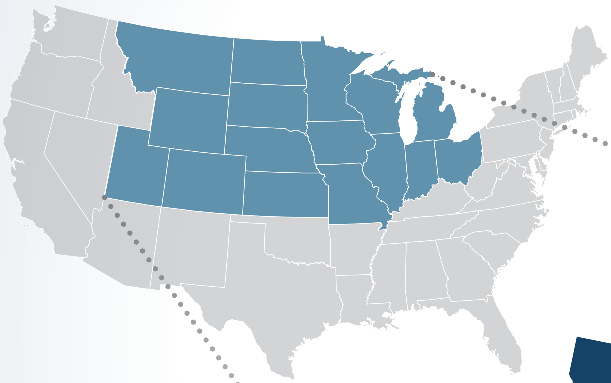
FirstNet®

Nationwide Public Safety Broadband Network

Draft Programmatic Environmental Impact Statement for the Central United States

VOLUME 3 - CHAPTER 5



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First Responder Network Authority

FirstNet®

Nationwide Public Safety Broadband Network
Draft Programmatic Environmental Impact Statement for the Central United States

VOLUME 3 - CHAPTER 5

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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

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5. INDIANA

Indiana was populated for centuries by American Indian tribes with a rich cultural history. In 1787, Congress passed the Northwest Ordinance, making Indiana and the surrounding lands a U.S. Territory. Indiana gained statehood in 1816 (Indiana Historical Bureau, 2015). Indiana is bordered by Wisconsin and Lake Michigan to the north, Ohio to the east, Kentucky to the south, and Illinois to the west. This chapter provides details about the existing environment of Indiana as it relates to the Proposed Action.

General facts about Indiana are provided below:

- **State Nickname**: The Hoosier State
- **Land Area:** 35,826 square miles; **U.S. Rank**: 38 (U.S. Census Bureau, 2015a)
- **Capital:** Indianapolis
- **Counties:** 92 (U.S. Census Bureau, 2015m)
- **2015 Estimated Population:** Over 6.5 million people; **U.S. Rank:** 16 (U.S. Census Bureau, 2015a; U.S. Census Bureau, 2015b)
- **Most Populated Cites:** Indianapolis, Fort Wayne, Evansville, and South Bend (U.S. Census Bureau, 2015m)
- **Main Rivers:** Kankakee, Mississinewa, Ohio, Wabash, White, Whitewater, East Fork White, Blue, and Tippecanoe
- **Bordering Waterbodies:** Ohio River, Wabash River, and Lake Michigan
- **Mountain Ranges**: None
- **Highest Point:** Hoosier Hill (1,257 feet) (USGS, 2015g)

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5.1. AFFECTED ENVIRONMENT

5.1.1. Infrastructure

5.1.1.1 Definition of the Resource

This section provides information on key Indiana 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 5.1.1.3 provides an overview of the traffic and transportation infrastructure in Indiana, including road and rail networks and airport facilities. Indiana public safety infrastructure could include any infrastructure utilized by a public safety entity[1] as defined in Title VI of the Middle Class Tax Relief and Job Creation Act of 2012 (Public Law [Pub. L.] No. 112-96, Title VI Stat. 156 (codified at 47 United States Code [U.S.C.] 1401 et seq.) (the Act), including infrastructure associated with police, fire, and emergency medical services (EMS). However, other organizations can qualify as public safety services as defined by the Act. Public safety services in Indiana are presented in more detail in Section 5.1.1.4. Section 5.1.5 describes specific public safety communications infrastructure and commercial telecommunications infrastructure in Indiana. An overview of utilities in Indiana, such as power, water, and sewer, are presented in Section 5.1.1.6.

5.1.1.2 Specific Regulatory Considerations

Multiple Indiana laws and regulations pertain to the state's public utility and transportation infrastructure and its public safety community. Table 5.1.1-1 identifies the relevant laws and regulations, the affected agencies, and their jurisdiction as derived from the state's applicable statutes and administrative rules referenced in column one. Appendix C, Environmental Laws and Regulations, identifies applicable federal laws and regulations.

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

Table 5.1.1-1: Relevant Indiana Infrastructure Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
IC: Title 10 Public Safety; Title 13 Environment: Indiana Administrative Code (IAC): Title 280 Division of Preparedness and Training; Title 290 Department of Homeland Security	Indiana Department of Homeland Security	Oversees the state's emergency management functions and plans and provides for rapid and efficient communications during a disaster.
IC: Title 8 Utilities and Transportation: IAC: Title 170 Indiana Utility Regulatory Commission	Indiana Utility Regulatory Commission	Regulates telecommunications, electric, power, common carrier, railroad, waste, and sewage companies.
IC: Title 8 Utilities and Transportation; Title 9 Motor Vehicles: IAC: Title 105 Indiana Department of Transportation; Title 110 Aeronautics Commission of Indiana; Title 120 Department of Highways	Indiana Department of Transportation (INDOT)	Identifies, develops, coordinates, and implements the state's transportation policies and assures the orderly development and maintenance of an efficient statewide system of transportation.

5.1.1.3 Transportation

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

The Indiana Department of Transportation (INDOT) has jurisdiction over freeways and major roads, airports, railroads, ports, and harbors in the state; local counties have jurisdiction for smaller streets and roads. The mission of the INDOT is to "plan, build, maintain, and operate a superior transportation system enhancing safety, mobility, and economic growth" (INDOT, 2015a).

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

- 97,553 miles of public roads (FHWA, 2014a) and 19,019 bridges (FHWA, 2015a);
- 3,884 miles of rail network that includes passenger rail and freight (INDOT, 2011);
- 569 aviation facilities, including airstrips and heliports (FAA, 2015f); and
- 3 major public ports (Ports of Indiana, 2015a)

Road Networks

As identified in Figure 5.1.1-1, the major urban centers of the state from north to south are Gary, South Bend, Fort Wayne, Lafayette, Indianapolis, Terre Haute, Bloomington, and Evansville. Indiana has eight major interstates connecting its major metropolitan areas to one another, as well as to other states. Travel outside the major metropolitan areas is conducted on interstates, state, and county roads. Table 5.1.1-2 lists the interstates and their start/end points in Indiana. Per the national standard, even numbered interstates run from west to east with the lowest numbers beginning in the south; odd numbered interstates run from north to south with the lowest numbers beginning in the west (FHWA, 2015b).

Table 5.1.1-2: Indiana Interstates

Interstate	Southern or Western Terminus in IN	Northern or Eastern Terminus in IN
I-64	IL line at Griffin	KY line at New Albany
I-65	KY line at Jeffersonville	I-90 in Gary
I-69	SE Riverside Dr. in Evansville	MI line near Jamestown
I-70	IL line at State Line	OH line at Richmond
I-74	IL line near Rileysburg	OH line near West Harrison
I-80	IL line at Munster	OH line at Angola
I-90	IL line at Hammond	OH line at Angola
I-94	IL line at Hammond	MI line near Michigan City

In addition to the Interstate System, Indiana has both National Scenic Byways and State Scenic Byways. National and State Scenic Byways are roads that are recognized for one or more archaeological, cultural, historic, natural, recreational, and scenic qualities (FHWA 2013). Figure 5.1.1-1 illustrates the major transportation networks, including roadways, in Indiana. Section 5.1.8, Visual Resources, describes the National and State Scenic Byways found in Indiana from an aesthetic perspective.

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

- Historic National Road: 824.2 miles through Illinois, Indiana, Maryland, Ohio, Pennsylvania, and West Virginia.
- Indiana’s Historic Pathways: 250 miles through southern Indiana.
- Ohio River Scenic Byway: 943 miles through Illinois, Indiana, and Ohio.

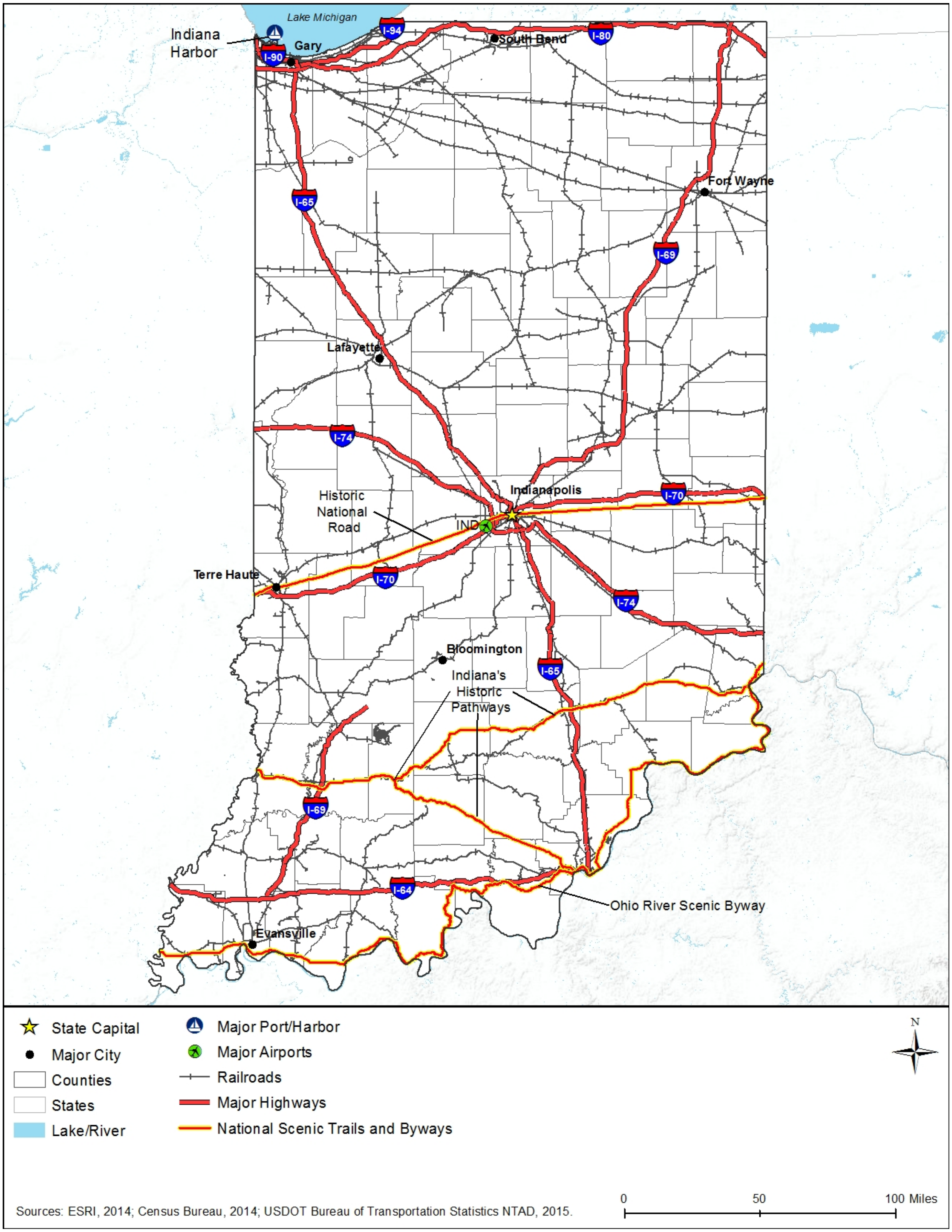

Figure 5.1.1-1: Indiana Transportation Networks

State Scenic Byways are roads with statewide interest; State Scenic Byways are designated and managed by INDOT. Some State Scenic Byways may be designated on portions of National Scenic Byways. Indiana has five State Scenic Byways that crisscross the entire state (INDOT, 2015b)[2]:

- Wabash River Scenic Byway (formally known as River Road Scenic Byway);
- Whitewater Canal Scenic Byway;
- Whitewater Canal Scenic Byway Loop Routes;
- Historic Michigan Road Byway; and
- Lincoln Highway Scenic Byway.

Airports

Air service to the state is primarily provided by four airports: Indianapolis International Airport (IA), South Bend IA, Fort Wayne IA, and Evansville Regional Airport. Indianapolis International Airport (IND) is located southwest of downtown Indianapolis. Operated by the Indianapolis Airport Authority, IND facilitates an average of 135 flights per day (IND, 2015). In 2013, IND served about 7.2 million passengers and handled around 2.2 billion pounds of cargo (IND, 2015). This high volume of cargo makes IND the eighth busiest airport in the nation in terms of cargo moved, attributed mainly to FedEx Express basing its second largest operation in the world at IND (IND, 2015). Figure 5.1.1-1 illustrates the major transportation networks, including airports, in the state. Section 5.1.7, Airspace, provides greater detail on airports and airspace in Indiana.

Rail Networks

Indiana is connected to a network of passenger rail (Amtrak), public transportation (commuter rail), and freight rail. Figure 5.1.1-1 illustrates the major transportation networks, including rail lines, in Indiana.

Amtrak runs five lines throughout Indiana. The Capitol Limited runs between Washington, DC and Chicago, IL once per day and serves three stations in Indiana. The Cardinal runs between New York City, NY and Chicago three times per week and serves six stations in Indiana. The Hoosier State runs between Indianapolis and Chicago four times per week and serves five stations in Indiana. The Lake Shore Limited runs between New York City or Boston, MA and Chicago once per day and serves three stations in Indiana. The Michigan Services runs between Chicago and Pontiac, MI several times per day and serves two stations in Indiana (Amtrak, 2015a). In fiscal year 2010, approximately 136,000 passengers used Amtrak in Indiana (INDOT, 2011).

Table 5.1.1-3 provides a complete list of Amtrak lines that run through Indiana.

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

Table 5.1.1-3: Amtrak Train Routes Serving Indiana

Route	Starting Point	Ending Point	Length of Trip	Cities Served in Indiana
Capitol Limited	Washington, DC	Chicago, IL	18 hours	Waterloo, Elkhart, South Bend
Cardinal	New York, NY	Chicago, IL	26 hours 30 minutes	Connersville, Indianapolis, Crawfordsville, Lafayette, Rensselaer, Dyer
Hoosier State	Indianapolis, IN	Chicago, IL	5 hours	Indianapolis, Crawfordsville, Lafayette, Rensselaer, Dyer
Lake Shore Limited	New York, NY or Boston, MA	Chicago, IL	19 hours	South Bend, Elkhart, Waterloo
Michigan Services	Chicago, IL	Pontiac, MI	6 hours 30 minutes	Hammond, Michigan City

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

The Northern Indiana Commuter Transportation District (NICTD) operates the South Shore Line (SSL), which runs from Chicago to South Bend, in northwest Indiana. The SSL makes 12 stops in Indiana (NICTD, 2015). In 2009, NICTD served 3.9 million passengers, with an average of 13,000 passengers per weekday and 5,200 per weekend day (INDOT, 2011).

Indiana has three Class I freight railroads operating in the state, as well as 39 regional, local, and switching/terminal railroads (INDOT, 2011). The Federal Railroad Administration (FRA) classifies railroads as Class I, Class II, or Class III based on corporate revenue thresholds (FRA, 2015a). Of the 3,884 miles of track in Indiana, "Class I carriers operate over 2,315 route miles, regional carriers operate over 269 route miles, local carriers operate over 1,107 route miles, and switching & terminal carriers operate over 194 miles of track" (INDOT, 2011). The three largest Class I railroads in the state own 2,595 miles of track: Canadian National Railway, CSX Transportation, and Norfolk Southern Corporation (INDOT, 2011). In 2009, Indiana was the ninth busiest state in the nation for the total tons of freight carried by rail: about 247 million tons of freight moved via freight rail in Indiana in that year (INDOT, 2011).

Harbors and Ports

Located in northwest Indiana on the south shore of Lake Michigan is the Indiana Harbor. This small portion of Indiana bordering Lake Michigan, and near the border with Illinois, is home to the states' steel industry and its associated steelmaking facilities. Over 100 years old and owned by ArcelorMittal, the "Indiana Harbor complex is the largest integrated steelmaking facility in North America" (ArcelorMittal, 2015a). The Indiana Harbor facility protrudes from the shore out into Lake Michigan. As depicted in Figure 5.1.1-1, the facility can be reached via I-94 or I-90, although several interstates crisscross the surrounding areas (ArcelorMittal, 2015b). Among other products, the Indiana Harbor steelmaking complex produces "hot-rolled, cold-rolled, hot-dip galvanized, and aluminized sheet" steel (ArcelorMittal, 2015a). Products from ArcelorMittal's Indiana Harbor are used in a multitude of industries, including automotive and construction, which highlights the importance of this industry to Indiana (ArcelorMittal, 2014).

The Indiana Harbor Canal runs through the steelmaking complex and into the state's interior. This canal allows cargo ships to move from Lake Michigan into the Grand Calumet River which eventually reaches Lake Calumet (NIRPC, 2015). Lake Calumet, located in Illinois is home to some facilities of the Port of Chicago (IIPD, 2015). The waters of the Harbor and the Canal are among the most polluted in the country. "With a history rich in steelmaking, meatpacking, and oil refining, a cocktail of heavy metals, PCBs, PAHs, NAPL, and oil and grease was discharged into the river before modern environmental controls were established" (NIRPC, 2015).

Also worth mentioning is the Port of Indiana – Burns Harbor. Operated by Ports of Indiana, the Burns Harbor facility is situated on Lake Michigan, east of the Indiana Harbor. While the Ports of Indiana operates three facilities (Burns Harbor, Mount Vernon and Jeffersonville), the Port of Indiana – Burns Harbor is the only one that borders an open body of water. The ports at Mount Vernon and Jeffersonville are both based along the Ohio River in inland Indiana (Ports of Indiana, 2015a). As depicted in Figure 5.1.1-1, the Port of Indiana – Burns Harbor can be reached over land via I-94. Rail service is provided by Norfolk Southern Railroad, with "direct interchange with 16 different railroads in nearby Chicago including all major Class Is" (Ports of Indiana, 2015b). From the Port of Indiana – Burns Harbor, ships can reach the Great Lakes, St. Lawrence Seaway, and the Gulf of Mexico via the Inland Waterways System. Among the facility's most common cargo is steel (coiled, scrap, finished, etc.), grain, salt, vehicles, coal and lumber (Ports of Indiana, 2015c).

5.1.1.4 Public Safety Services

Indiana public safety services generally consist of public safety infrastructure and first responder personnel aligned with the demographics of the state. Table 5.1.1-4 presents Indiana's key demographics including estimated population; land area; population density; and number of counties, cities/towns, and municipal governments. More information about these demographics is presented in Section 5.1.9, Socioeconomics; however, these demographics are key to understanding the breadth of public safety services throughout the state.

Table 5.1.1-4: Key Indiana Indicators

Indiana Indicators	
Estimated Population (2015)	6,619,680
Land Area (square miles) (2010)	35,826.11
Population Density (persons per sq. mile) (2010)	181.0
Municipal Governments (2013)	567

Sources: (U.S. Census Bureau, 2015) (U.S. Census Bureau, 2013)

Table 5.1.1-5 presents Indiana's public safety infrastructure, including fire and police stations. Table 5.1.1-6 identifies first responder personnel including dispatch, fire and rescue, law enforcement, and emergency medical personnel in the state.

Table 5.1.1-5: Public Safety Infrastructure in Indiana by Type

Infrastructure Type	Number
Fire and Rescue Stations [a]	1,186
Law Enforcement Agencies [b]	482
Fire Departments [c]	763

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

Sources: (U.S. Fire Administration, 2015) (U.S. Bureau of Justice Statistics, 2011)

Table 5.1.1-6: First Responder Personnel in Indiana by Type

First Responder Personnel	Number
Police, Fire and Ambulance Dispatchers [a]	2,060
Fire and Rescue Personnel [b]	24,867
Law Enforcement Personnel [c]	19,940
Emergency Medical Technicians and Paramedics [d e]	5,220

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

Sources: (U.S. Fire Administration, 2015) (U.S. Bureau of Justice Statistics, 2011) (BLS, 2015g)

5.1.1.5 Telecommunications Resources

There is no central repository of information for public safety communications infrastructure and commercial telecommunications infrastructure; therefore, the following information and data are combined from a variety of sources, as referenced. Communications throughout the state are based on a variety of publicly- and commercially-owned technologies. Figure 5.1.1-2 presents a typical wireless configuration including both a narrowband public safety land mobile radio (LRM) network (traditional radio network) and a commercial broadband access network (wireless technology); backhaul (long-distance wired or wireless connections), core, and commercial networks including a long term evolution (LTE) evolved packet core (modern broadband cellular networks); and network applications (software) delivering voice, data, and video communications. (FCC, 2016a)

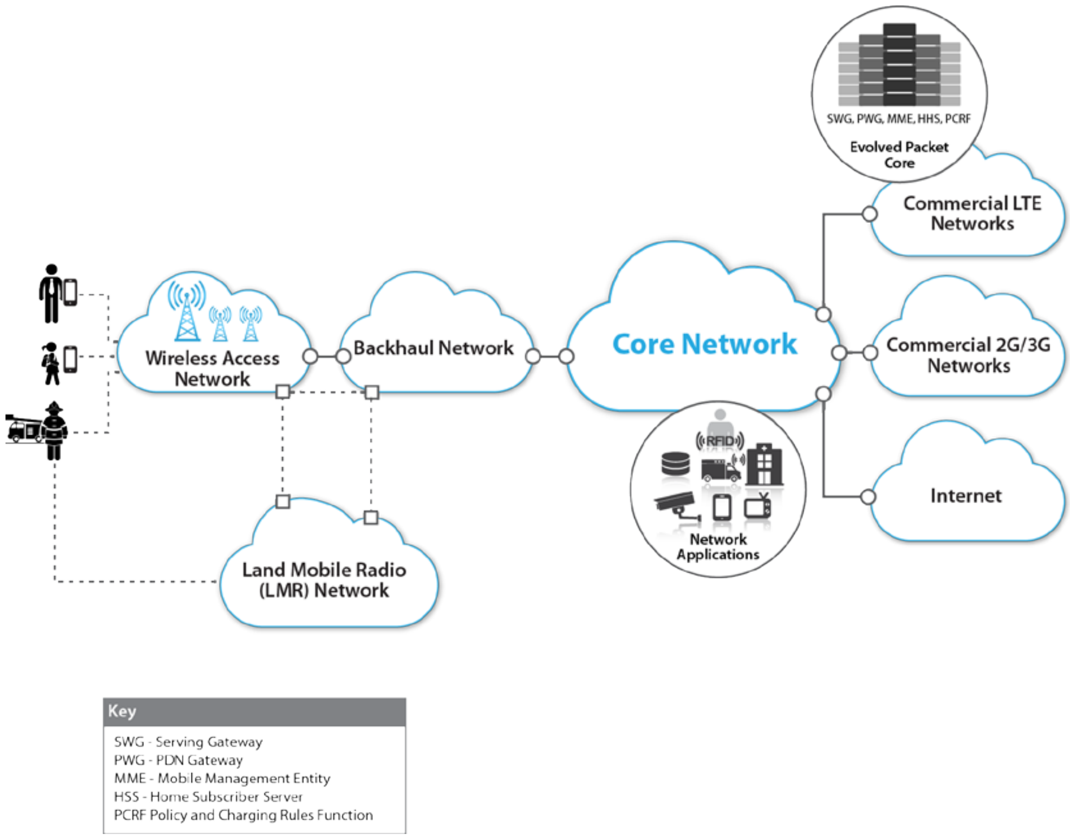

Figure 5.1.1-2: Wireless Network Configuration

Prepared by: Booz Allen Hamilton

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 5.1.1), 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 (NIST, 2015). Historically, there have been many challenges and impediments to timely and effective sharing of information. Communication interoperability has also been a persistent challenge, along with issues concerning spectrum availability, embedded infrastructure, and differing standards among stakeholders (NTFI, 2005). This has caused a fragmented approach to communications implementation across the U.S. and specifically in Indiana. There are five key reasons why public safety agencies often cannot connect through existing communications (NTFI, 2005):

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

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

To address the need for greater interoperability in Indiana across Public Safety LMR systems the state has committed to a broad-based adoption of the Phase 1 digital Project 25 (P25) technology of its legacy analogy land mobile radio system, Safety Acting for Everyone-Together (SAFE-T) network (IPSC, 2015a). The SAFE-T network provides statewide coverage in Indiana using an 800 MHz radio site network. The network uses both analog and digital radios as the Indiana Integrated Public Safety Commission (IPSC) explains; "SAFE-T a statewide, interoperable, wireless public safety communications system for Indiana local, state, and federal first responders/public safety officials. SAFE-T operates on a Motorola 4.1 Astro Smartzone OmniLink 800 MHz trunked voice and data system. It supports both analog and digital radios, providing 95 percent portable on the street coverage statewide, using 153 communications sites connected by T1 lines and microwave" (IPSC, 2015a). The Indiana P25 upgrade is being implemented in phases and is projected to be completed in 2016 (IPSC, 2014).

The lead organization driving public safety networks modernization and governance over the SAFE-T network is the IPSC with coordinated ownership over public safety narrowband as well as broadband upgrades and transition planning.

Statewide Public Safety Networks

The Indiana SAFE-T network provides statewide coverage with tower sites in all Indiana counties as depicted by Figure 5.1.1-3 (IPSC, 2012).

Indiana's statewide, county, and city/town public safety communication systems are in transition as the SAFE-T digital P25 systems are phased in, and as multiple county/municipal governments elect to adopt interim P25 systems. The most significant current upgrade however, is the six-phase statewide upgrade to the SAFE-T digital P25 rolling set of deployments. Indiana has embarked on a multi-year upgrade to the P25 digital network technology for its SAFE-T public safety legacy network with the southern counties of Indiana in a phased roll-out, as depicted by Figure 5.1.1-4 (IPSC, 2014). The SAFE-T digital upgrade project commenced in September 2015 and will continue through projected completion in July 2016, according to Indiana's IPSC (IPSC, 2015b).

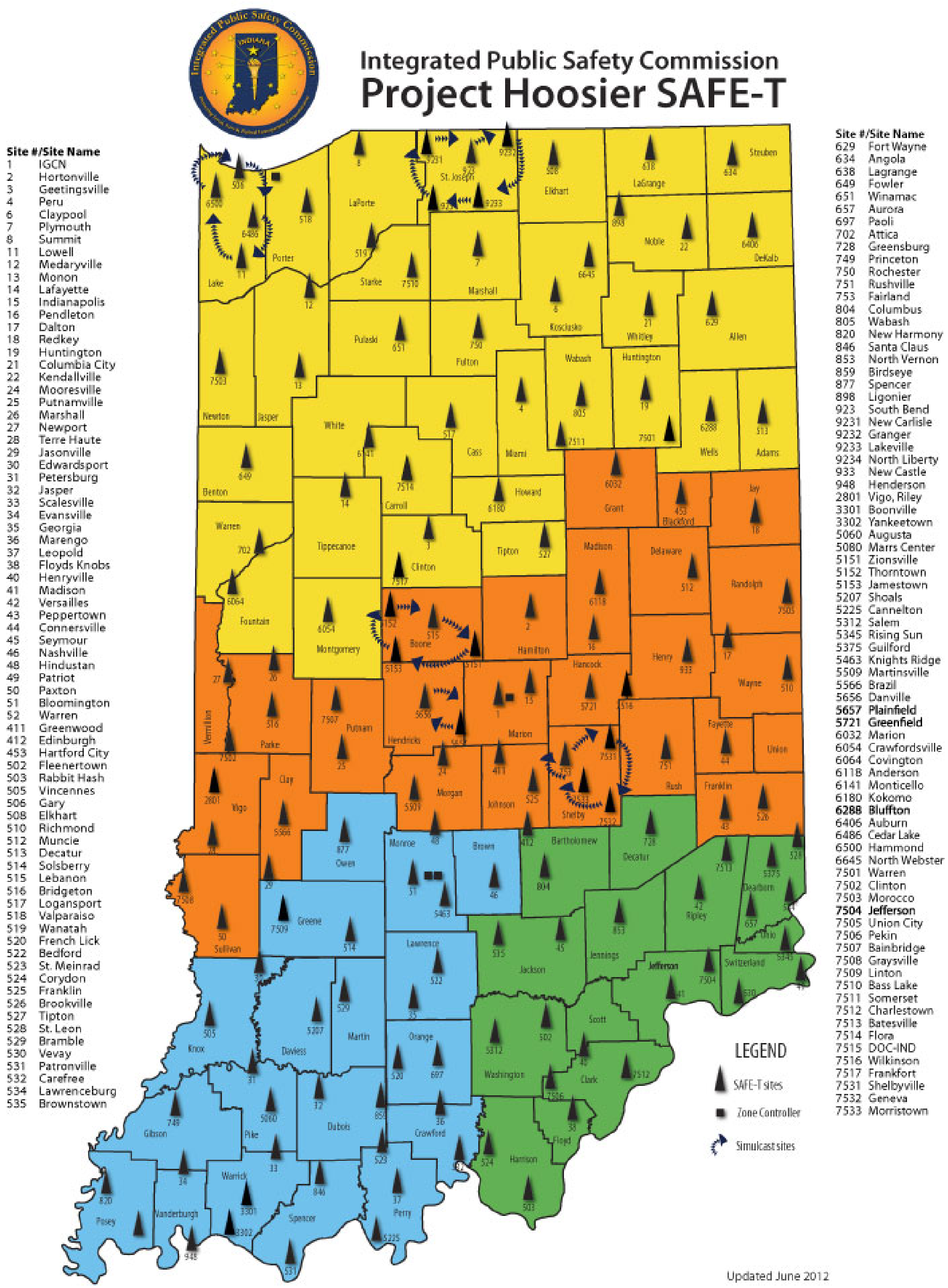

Figure 5.1.1-3: Indiana SAFE-T Tower Network Statewide Coverage

Source: (IPSC, 2012)

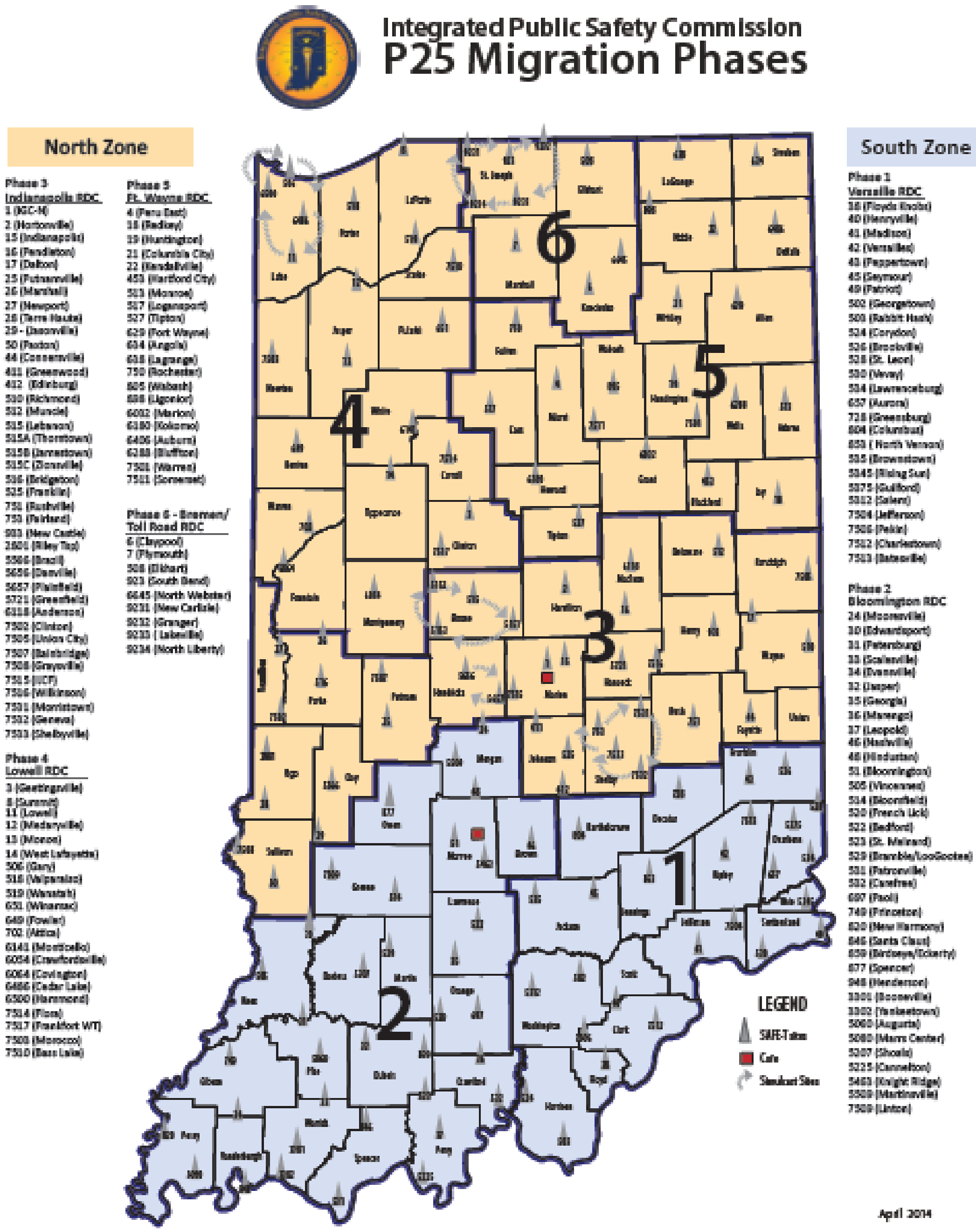

Figure 5.1.1-4: Indiana P-25 Migration Phases

Source: (IPSC, 2014)

The Indiana State Police (ISP) use the legacy SAFE-T network for point-to-point and statewide police emergency communications on Very High Frequency (VHF)[3] (RadioReference.com,

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

2015a). In addition, the ISP uses VHF frequencies in selective ISP Districts, which are regional patrol areas[4] (RadioReference.com, 2015a).

The Indiana Department of Homeland Security uses the SAFE-T network for communications for both intercounty and statewide emergency communications on VHF[5] (two channels), and loVHF[6] (two channels) for backup emergency communications (RadioReference.com, 2015b).

According to the ISPC, the Indiana SAFE-T network has broad-based adoption and is used by 17 state agencies, 92 sheriff offices, 524 local law enforcement agencies, 92 county emergency management agencies, as well as 11 federal agencies (IPSC, 2013).

In 2012, Indiana initiated interoperability discussions related to its SAFE-T network with neighboring states Ohio, Kentucky, Michigan, and Illinois. The discussions aimed at the objective of increasing cross-border coordinated planning, improving technology compatibility, and increasing cross-border capabilities. The objectives have been achieved and improved incident response has resulted from neighboring state joint cooperation (State of Indiana, 2012).

City and County Public Safety Networks

At the local and county public safety level, legacy analog VHF or Ultra High Frequency (UHF)[7] systems continue to provide dispatch, tactical communications, and voice communications capabilities for police/sheriff, fire, and EMS users (RadioReference.com, 2015c).

In addition to Indiana's 800 MHz Phase 1 P25 Network, there were five additional city/county digital P-25 systems operating as of mid-2015, summarized in Table 5.1.1-7 below (Project 25.org, 2015a) (Project 25.org, 2015b). Phase 1 P25 systems use the Frequency Division Multiple Access (FDMA) channel access schema and Phase 2 P25 systems use Time Division Multiple Access (TDMA).

Table 5.1.1-7: Indiana City/County P25 Systems

Indiana P25 Systems	Frequency Band	P25 Version	Access Type
Allen County Public Safety P25	800 MHz	Phase 1	Frequency Division
Indianapolis Department of Public Safety	800 MHz	Phase 1	Frequency Division
Mishawaka Public Safety	800 MHz	Phase 1	Frequency Division
New Albany Public Safety	800 MHz	Phase 1	Frequency Division
Floyd County (New Albany Public Safety System)	800 MHz	Phase 2	Time Division

Source: (FCC, 2014a) (FCC, 2014b)

Public Safety Answering Points (PSAP)

According to the Federal Communication Commission's (FCC) Master PSAP registry, there are 179 PSAPs serving Indiana's 92 counties (FCC, 2015b).

[4] Toll Road and Lafayette Troop Districts.
[5] VHF Channels: 155.025 MHz and 158.925 MHz.
[6] loVHF Channels: 37.10 MHz and 37.26 MHz.
[7] UHF band covers frequencies ranging from 300 MHz to 3000 MHz (NTIA, 2005).

Commercial Telecommunications Infrastructure

Indiana'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 Indiana'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

Indiana's commercial telecommunications industry provides the full spectrum of telecommunications technologies and networks, including coaxial cable (traditional copper cable), fiber optics, hybrid fiber optics / coaxial cable, microwave, wireless, and satellite systems. Table 5.1.1-8 presents the number of providers of switched access[8] lines, Internet access,[9] and mobile wireless services including coverage.

Table 5.1.1-8: Telecommunications Access Providers and Coverage in Indiana as of December 31, 2013

Commercial Telecommunications Access Providers	Number of Service Providers	Coverage by Households
Switched access lines [a]	170	97.4% of households
Internet access [b]	98	52% of households
Mobile wireless [c]	9	90% of population

[a] Switched access lines are a service connection between an end user and the local telephone company's switch (the basis of older telephone services); this number of service providers was reported by the FCC as of December 31, 2013 in Table 17 in "Local Telephone Competition: Status as of December 31, 2013" as the total of ILEC and non-ILEC providers (FCC, 2014b).
[b] Internet access providers are presented in Table 21 in "Internet Access Services: Status as of December 31, 2013" by technology provided; number of service providers is calculated by subtracting the reported Mobile Wireless number from the total reported number of providers (FCC, 2014a).
[c] Mobile wireless provider data is provided by the FCC in the sources identified. However, NTIA's National Broadband Map provides newer data, so FirstNet is using NTIA's GIS-based data from the National Broadband Map instead of the data reported by the FCC. The process for retrieving the National Broadband Map data is explained in detail in a subsequent footnote in Section 5.1.1.5, Last Mile Fiber Assets.
Sources: (FCC, 2014a) (FCC, 2014b)

Table 5.1.1-9 shows the wireless providers in Indiana along with their geographic coverage. The following five maps: Figure 5.1.1-5 to Figure 5.1.1-9 show the combined coverage for the top two providers; Sprint and T-Mobile's coverage; Hoosier Broadband and TransWorld Network Corp.'s coverage; Zig Wireless, WATCH Communications, and Fourway Computer Product Inc.'s; and the coverage of all other providers with less than 5 percent coverage area, respectively.

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[8] "A service connection between an end user and the local telephone company's switch; the basis of plain old telephone services" (FCC, 2013).
[9] Internet access includes Digital Subscriber Line (DSL), cable modem, fiber, satellite, and fixed wireless providers.

Table 5.1.1-9: Wireless Telecommunications Coverage by Providers in Indiana

Wireless Telecommunications Providers	Coverage
AT&T Mobility LLC	99.99%
Verizon Wireless	96.56%
Sprint	77.01%
T-Mobile	34.24%
Hoosier Broadband	15.05%
TransWorld Network, Corp.	14.75%
WATCH Communications	10.90%
Zig Wireless	10.38%
Fourway Computer Products, Inc.	6.11%
Other[a]	53.42%

Source: (NTIA, 2014)

[a] Other: Provider with less than 5 percent coverage area. Providers include: Cricket Wireless; FULLnet; Sitco, LLC; CSInet Internet; Access Corp.; Enhanced Telecommunications Corporation; MidwayNet, LLC; Ligtel Communications; Citizens Communications Broadband; Blueriver Networking Services; Internet Communications Inc.; RTC Communications Corp; Surf Air Wireless; Node1 Internet; MetaLINK Technologies, Inc.; PSC; Community Wireless Of Charlestown, LLC; NetsurfUSA, Inc.; Broadway Broadband; Performance PC; Monon Telephone Co. Inc.; PCS-WIN; Joink; NewWays Networking, LLC; KC Online LLC; East Allen High Speed Internet, LLC; Eastern Indiana Wifi Inc.; NineStar Communications; Swayzee Communications; PDS Wireless; State of the Art Communications; Northwestern Indiana Telephone Company; Portative Technologies, LLC; On-Ramp Indiana, Inc.; airHOP; New Lisbon Telephone Company; Good Connections; Kendallville Internet Inc.; Northern Indiana Technologies, Inc.; Geetel Communications; Parallax Systems; Wabash Mutual Telephone Company; Clear; Echo Wireless LLC; Michiana Wireless, Inc.; Foundation Telecommunications, Inc.; MetroFastNet, LLC; Microdome.net

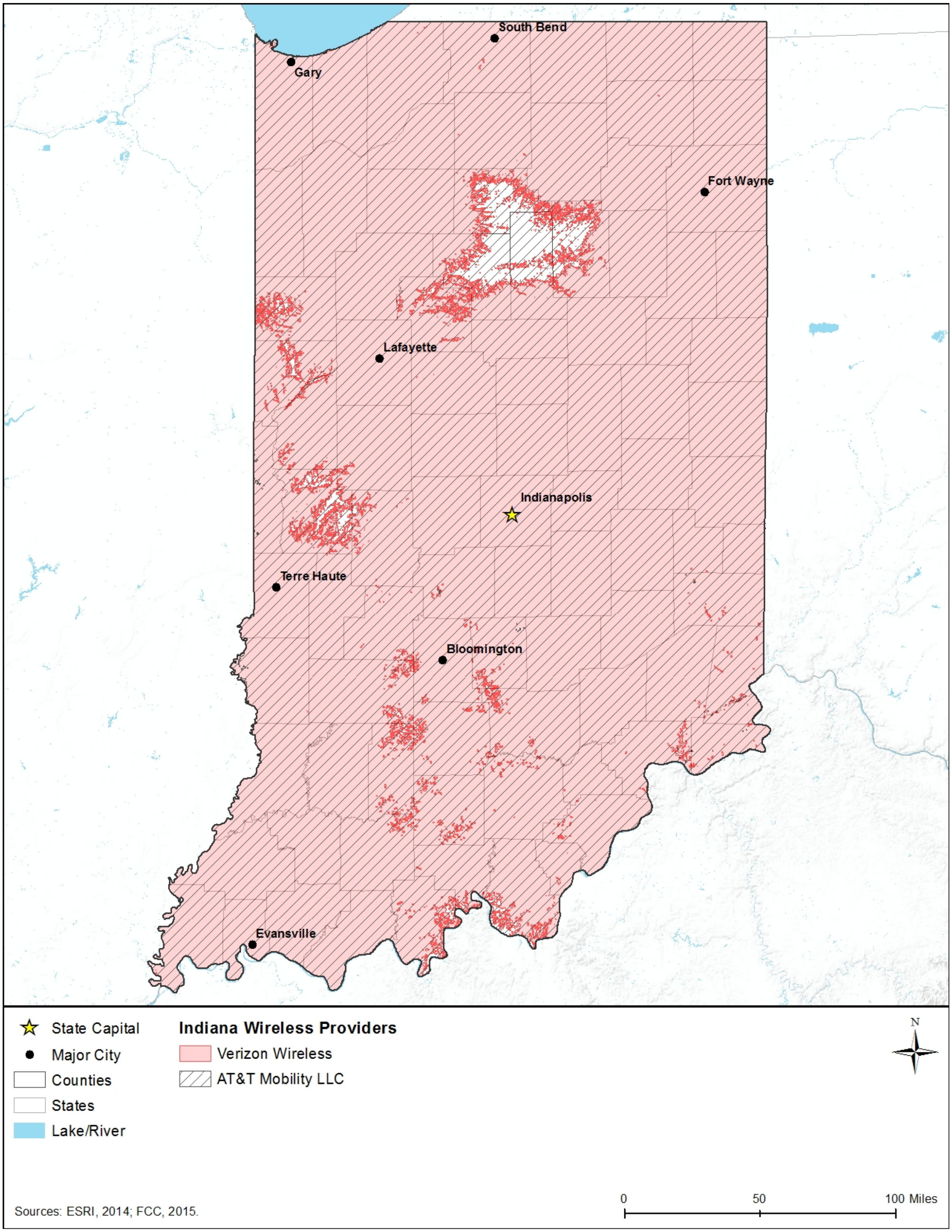

Figure 5.1.1-5: AT&T Mobility LLC and Verizon Wireless Availability in Indiana

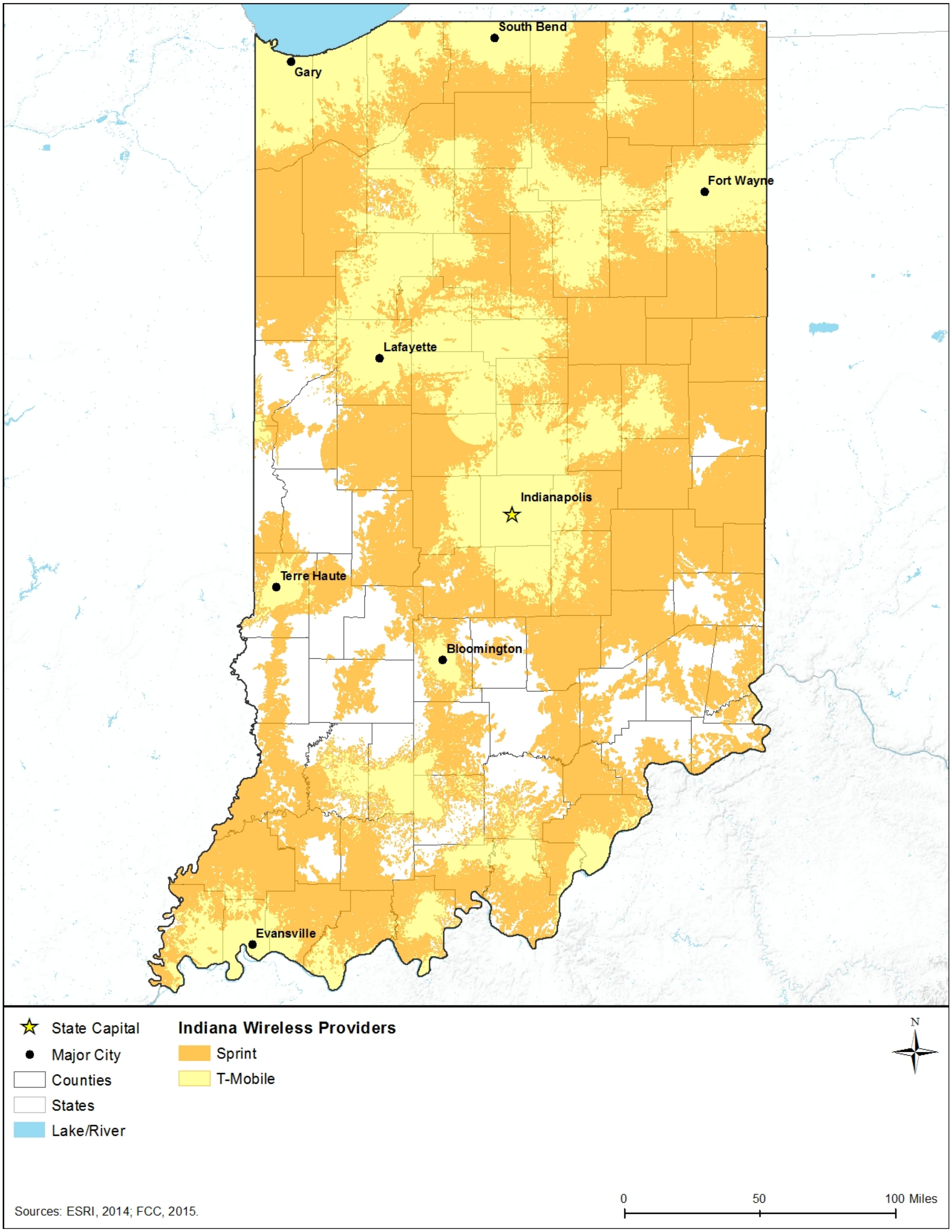

Figure 5.1.1-6: Sprint and T-Mobile Wireless Availability in Indiana

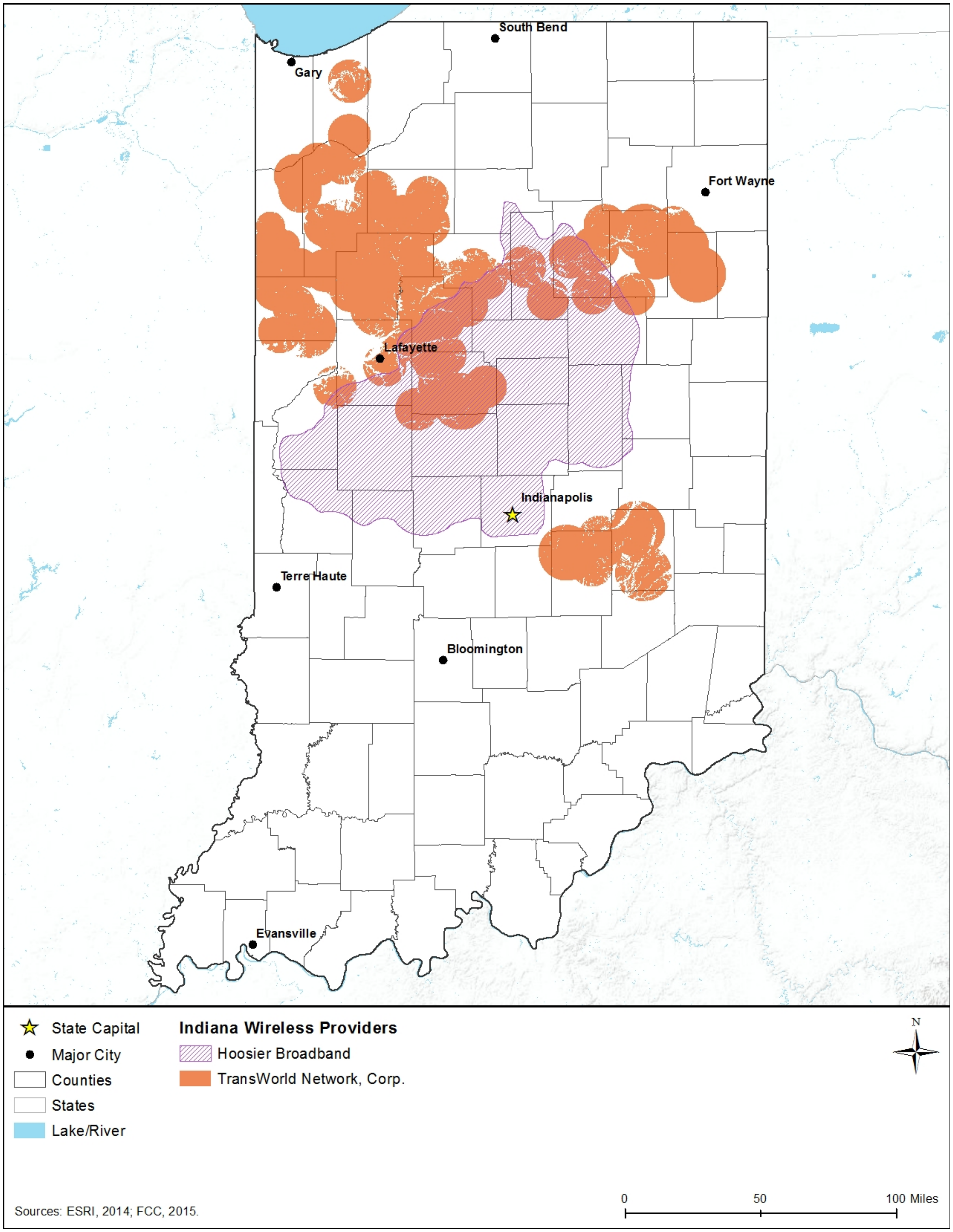

Figure 5.1.1-7: Hoosier Broadband and TransWorld Network, Corp. Wireless Availability in Indiana

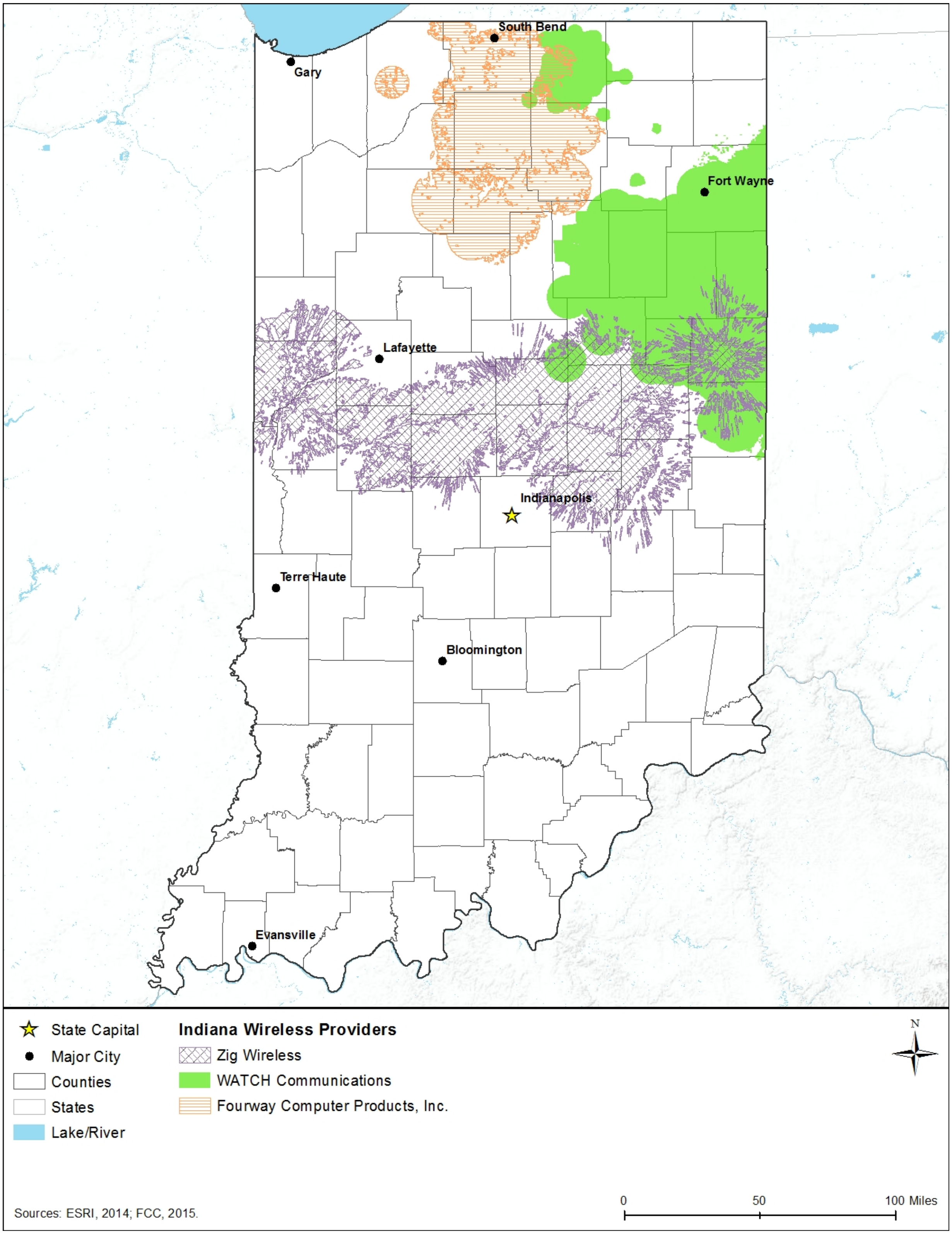

Figure 5.1.1-8: Zig Wireless, WATCH Communications, and Fourway Computer Products, Inc. Wireless Availability in Indiana

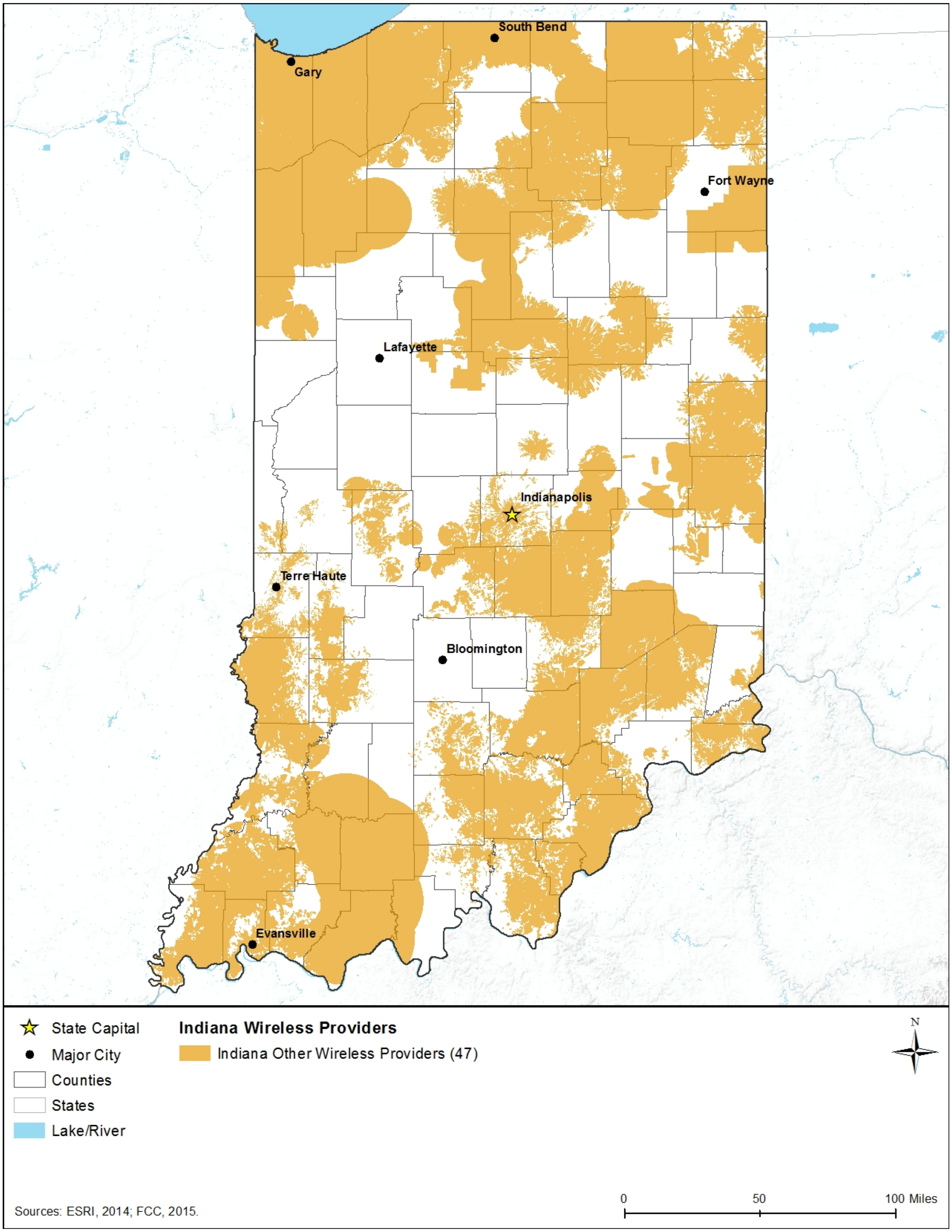

Figure 5.1.1-9: Other Providers Wireless Availability in Indiana

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 (RF) 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 5.1.1-10 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 5.1.1-10: Types of Towers

Telecommunications tower infrastructure can be found throughout Indiana, although tower infrastructure is concentrated in the higher and more densely populated areas of Indiana: Gary, Fort Wayne, Lafayette, Indianapolis, Terre Haute, Bloomington, South Bend, and Evansville. Owners of towers and some types of antennas are required to register those infrastructure assets with the FCC.[10] Table 5.1.1-10 presents the number of towers (including broadcast towers) registered with the FCC in Indiana by tower type, and Figure 5.1.1-11 presents the location of those structures, as of July 2016.

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

Table 5.1.1-10: Number of Commercial Towers in Indiana by Type

Constructed[a] Towers[b]		Constructed Monopole Towers	
100ft and over	355	100ft and over	0
75ft – 100ft	940	75ft – 100ft	0
50ft – 75ft	547	50ft – 75ft	66
25ft – 50ft	281	25ft – 50ft	50
25ft and below	22	25ft and below	18
Subtotal	**2,145**	**Subtotal**	**134**
Constructed Guyed Towers		**Buildings with Constructed Towers**	
100ft and over	55	100ft and over	3
75ft – 100ft	93	75ft – 100ft	5
50ft – 75ft	24	50ft – 75ft	10
25ft – 50ft	3	25ft – 50ft	3
25ft and below	0	25ft and below	1
Subtotal	**175**	**Subtotal**	**22**
Constructed Lattice Towers		**Multiple Constructed Structures[c]**	
100ft and over	6	100ft and over	7
75ft – 100ft	118	75ft – 100ft	0
50ft – 75ft	82	50ft – 75ft	0
25ft – 50ft	29	25ft – 50ft	0
25ft and below	6	25ft and below	0
Subtotal	**241**	**Subtotal**	**7**
Constructed Tanks[d]			
Tanks	9		
Subtotal	**9**		
Total All Tower Structures		**2,733**	

[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, 2016).
[b] Self standing or guyed (anchored) structure used for communication purposes (FCC, 2012).
[c] Multiple constructed structures per antenna registration (FCC, 2016c).
[d] Any type of tank – water, gas, etc. with a constructed antenna (FCC, 2016c).

Source: (FCC, 2016)

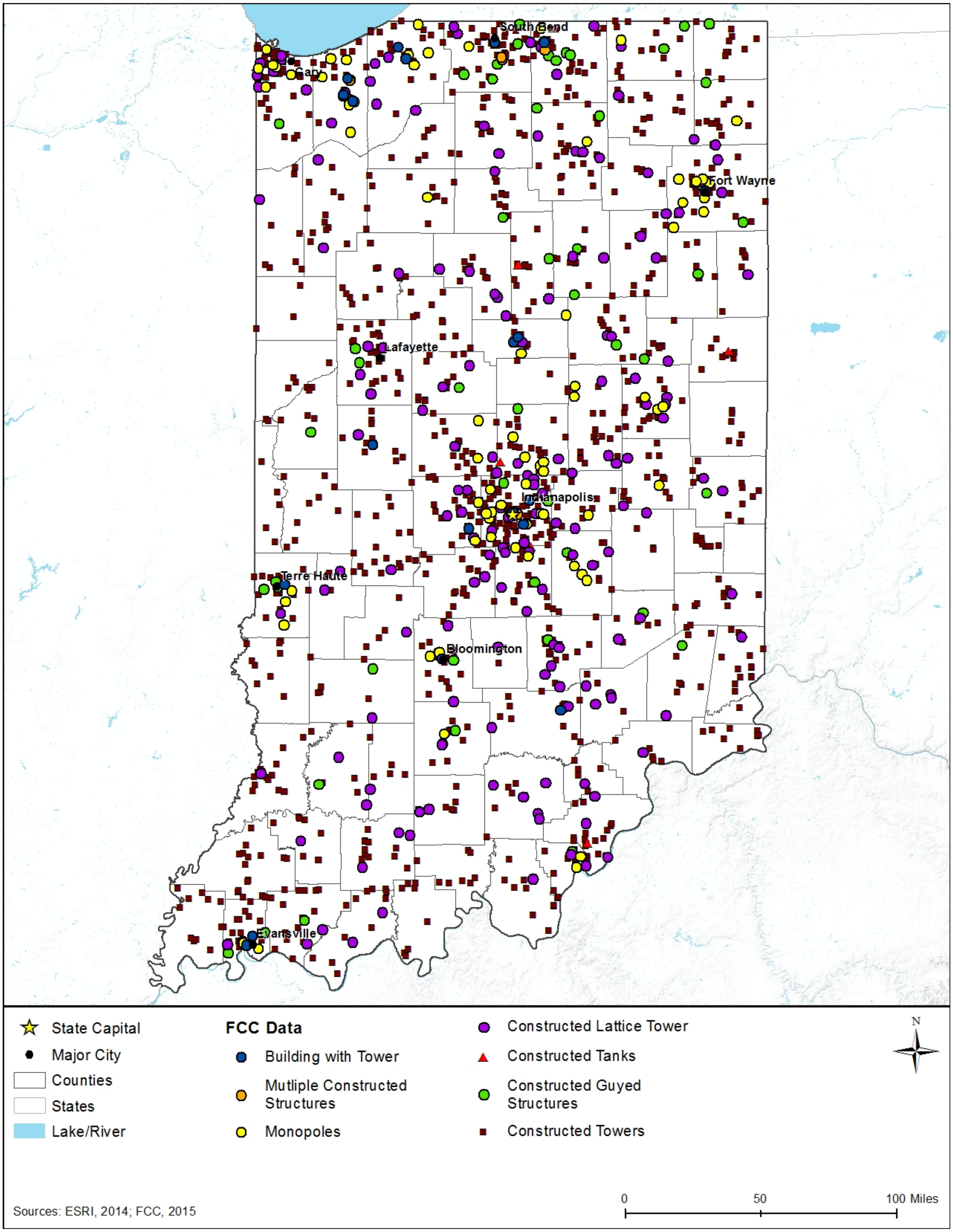

Figure 5.1.1-11: FCC Tower Structure Locations in Indiana

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 (ROWs). 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 5.1.1-12. 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)

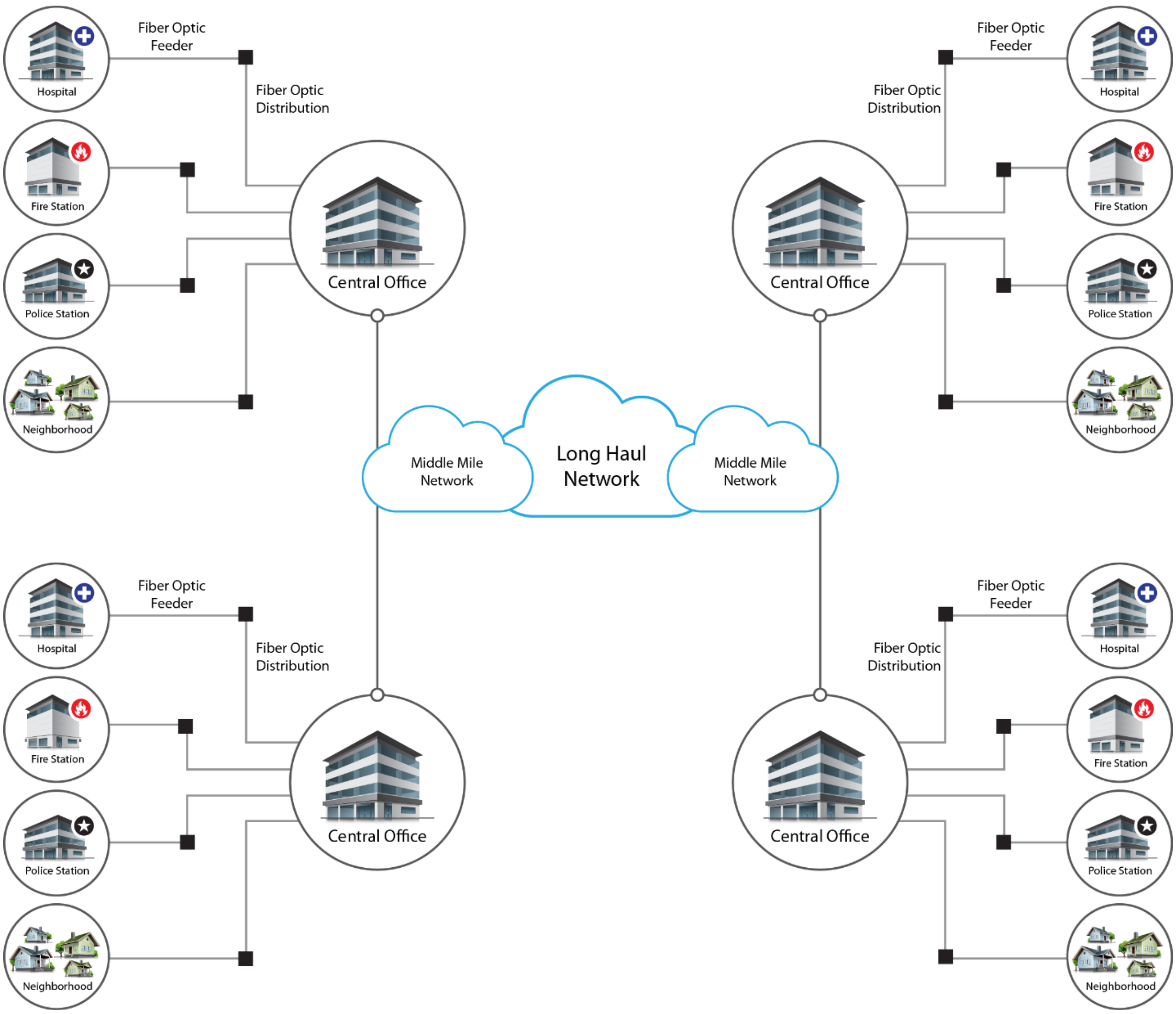

Figure 5.1.1-12: Typical Fiber Optic Network in Indiana

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

Last Mile Fiber Assets

In Indiana, fiber access networks are concentrated in the highest population centers as shown in the figures below. In Indiana, there are 54 fiber providers that offer service in the state, as listed in Table 5.1.1-11. Figure 5.1.1-13 shows coverage for Frontier Communications and Comcast, Figure 5.1.1-14 shows coverage for AT&T Indiana and Indiana Fiber Network LLC, Figure 5.1.1-15 shows coverage for CenturyLink and Mediacom Indiana LLC, Figure 5.1.1-16 shows coverage for Verizon, Zayo Enterprise Networks, and Fairnet LLC, and Figure 5.1.1-17 shows coverage for all other providers with less than 5 percent coverage area, respectively.[11]

Table 5.1.1-11: Fiber Provider Coverage

Fiber Provider	Coverage
Frontier Communications	28.66%
Comcast	14.57%
AT&T Indiana	13.57%
Indiana Fiber Network, LLC	13.17%
Mediacom Indiana LLC	12.04%
CenturyLink	11.91%
Verizon	9.05%
Zayo Enterprise Networks	8.59%
Fairnet LLC	6.93%
Other[a]	38.26%

Source: (NTIA, 2014)
[a]Other: Provider with less than 5 percent coverage area. Providers include: On-Ramp Indiana, Inc.; TDS TELECOM; TIME WARNER CABLE; MegaPath Corporation; Comteck of Indiana, Inc.; Supernova Systems Inc.; Hancock Communications, Inc.; Pulaski White Rural Telephone Coop., Inc.; Lightbound, LLC; Smithville Communications; Endeavor Communications; NineStar Connect; RTC Communications; Brighthouse Networks; PSC; Joink; New Paris Telephone Co., Inc.; Southeastern IN Rural Telephone; NewWave Communications; Windstream; Parallax Systems; Sunman Telecommunications Corporation; OnlyInternet.net; Citizens Telephone Corporation; Community Fiber Solutions; NITCO; WOW!; Tele-Media Solutions; Mulberry Cooperative Telephone CO., Inc.; Metronet; AdamsWells Telecom; Monon Telephone Co. Inc.; One Communications; New LisbonTelephone Company; Ligonier Telephone Company; Geetel Communications; TV Cable; Bloomingdale Home Telephone Company; Yeoman Telephone Company Inc.; Swayzee Communications; Accelplus; Level 3 Communications, LLC; Wintek Corporation; Covad Communications Company; Cogent Communications

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

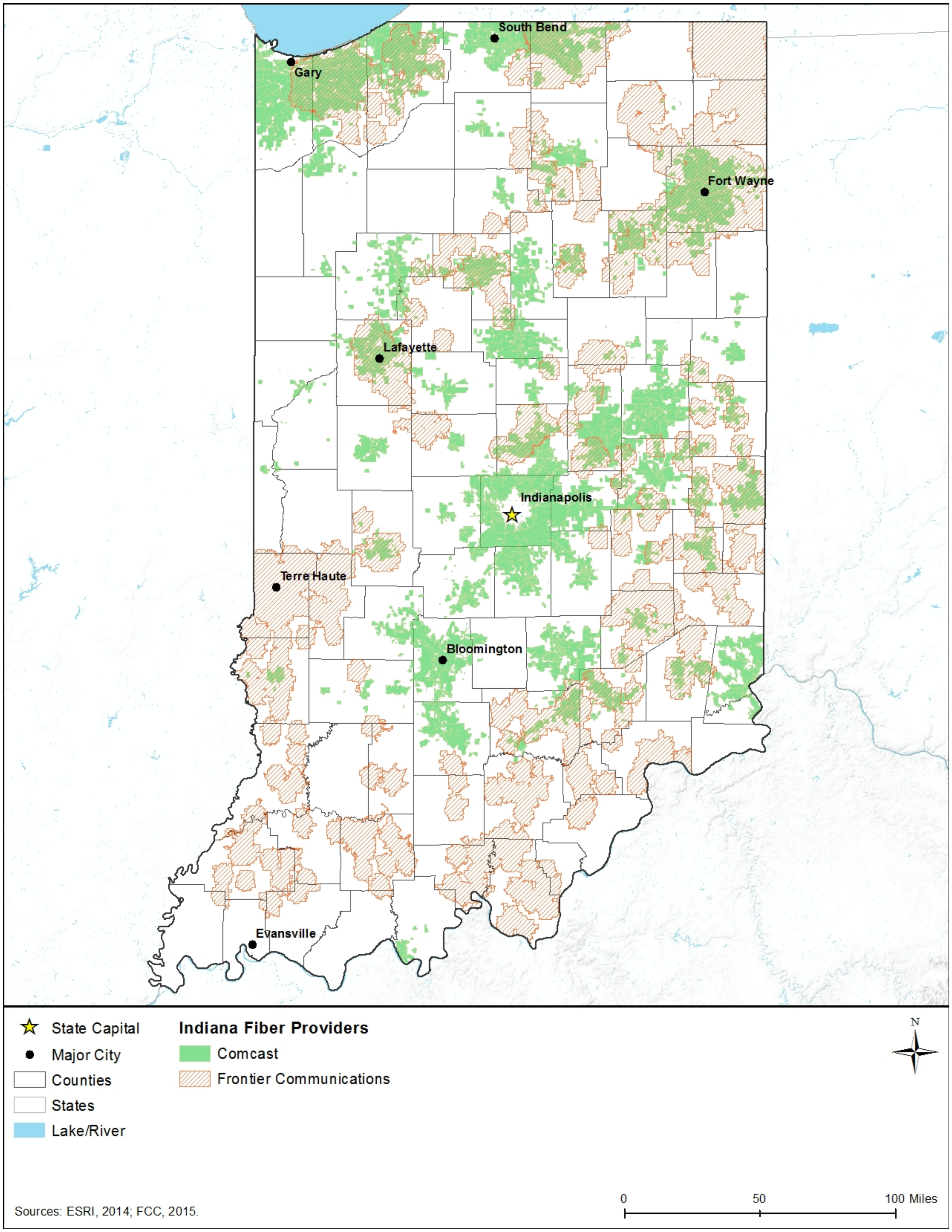

Figure 5.1.1-13: Fiber Availability in Indiana for Comcast and Frontier Communications

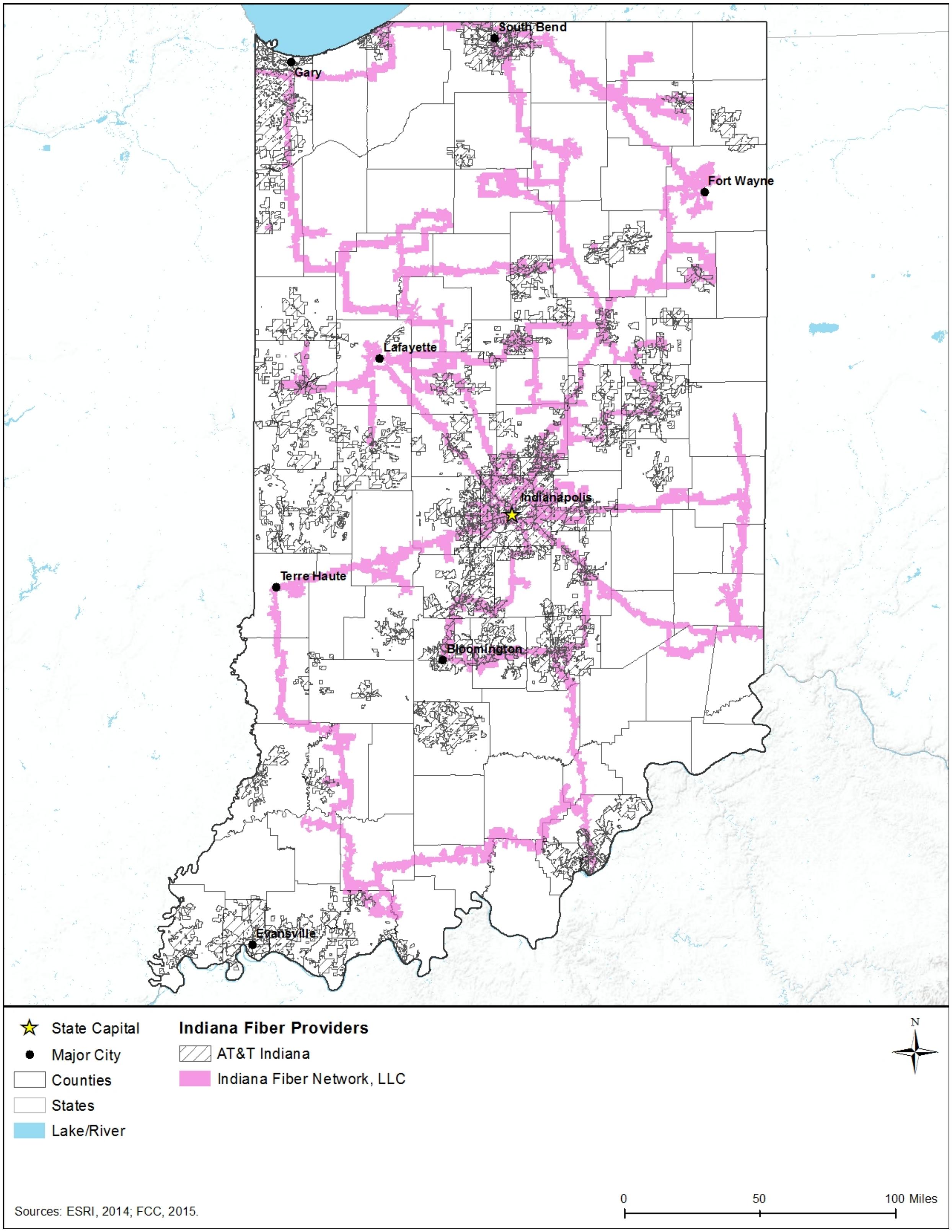

Figure 5.1.1-14: AT&T and Indiana Fiber Network, LLC's Fiber Availability in Indiana

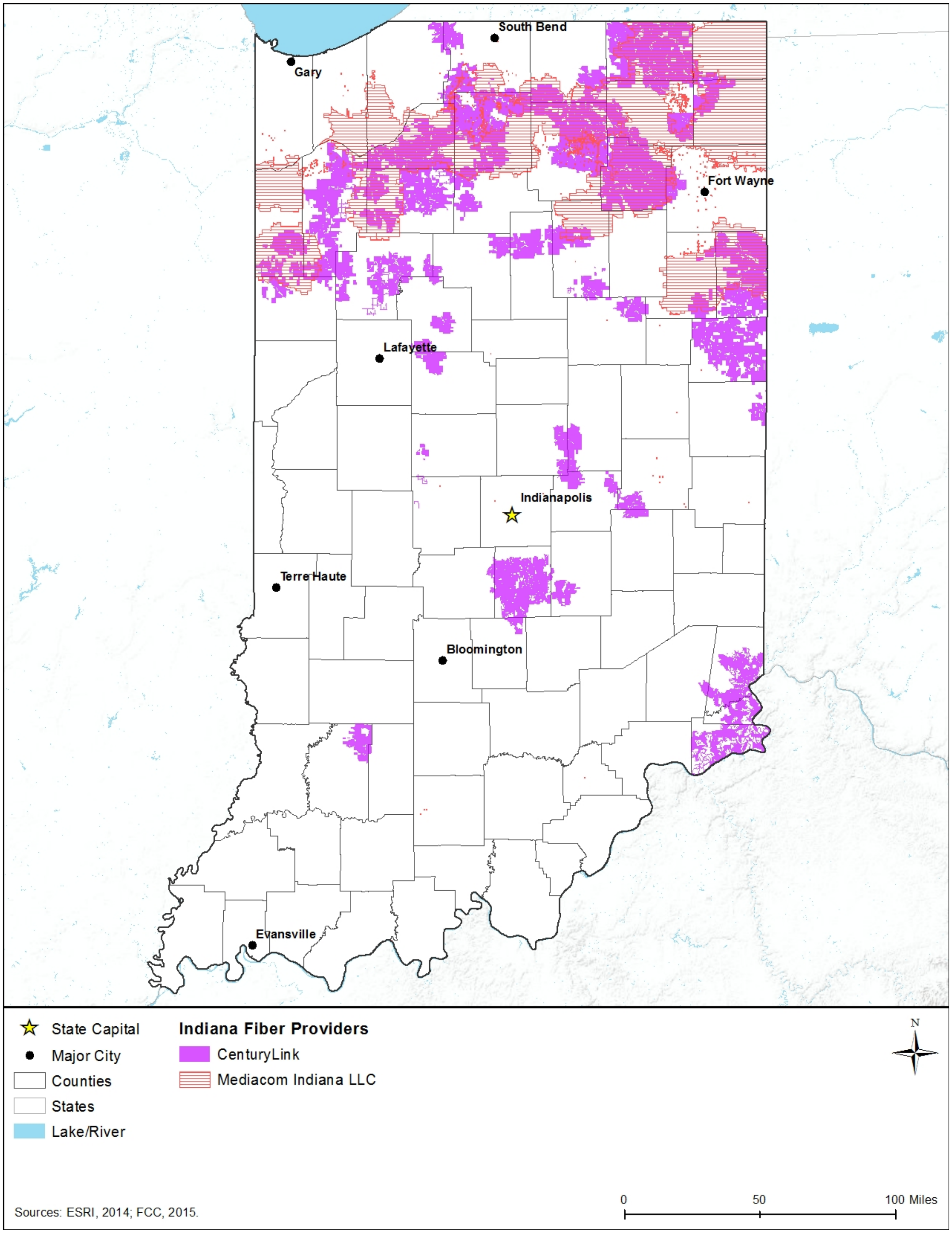

Figure 5.1.1-15: CenturyLink and Mediacom Indiana LLC's Fiber Availability in Indiana

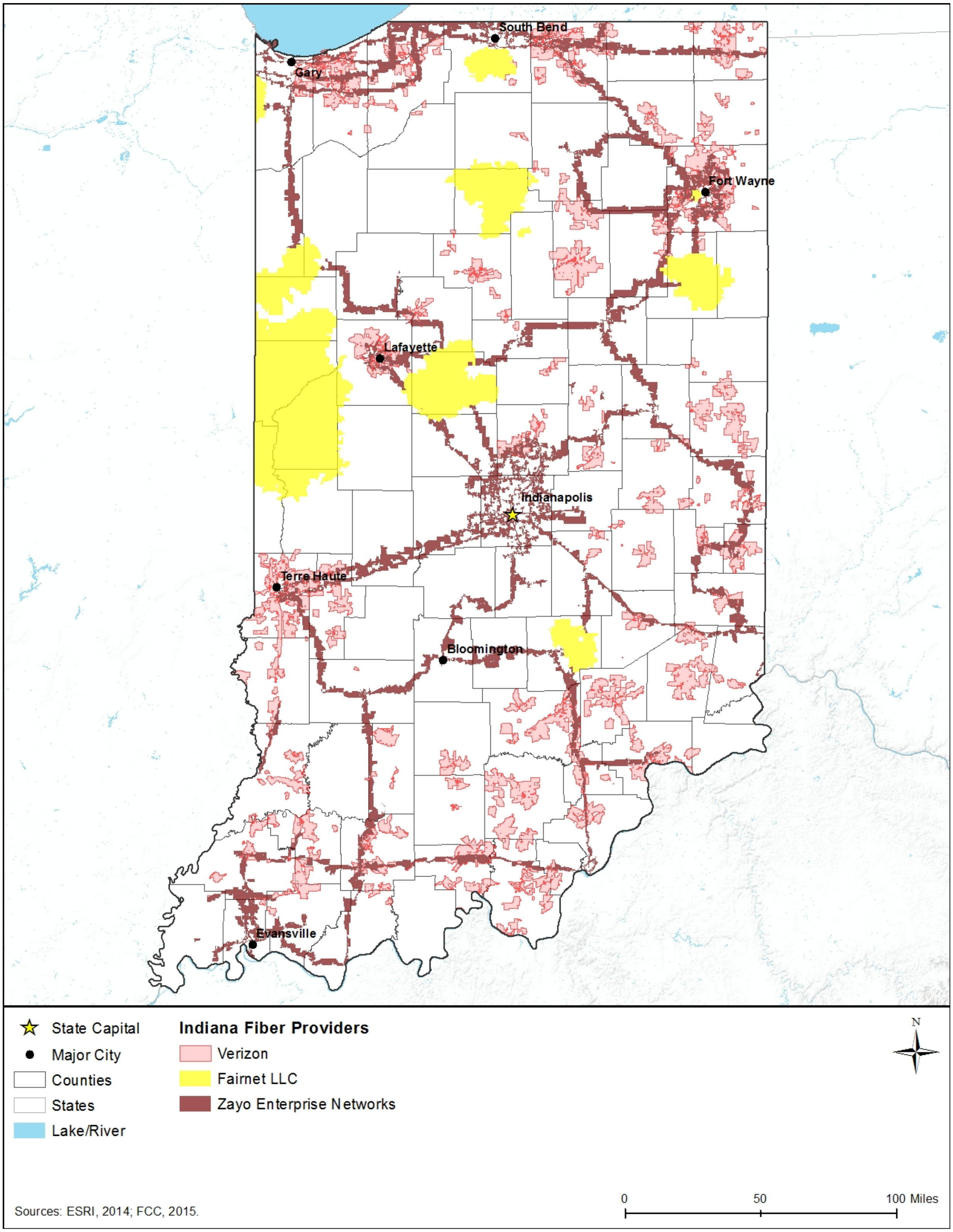

Figure 5.1.1-16: Verizon, Fairnet LLC, and Zayo Enterprise Networks' Fiber Availability in Indiana

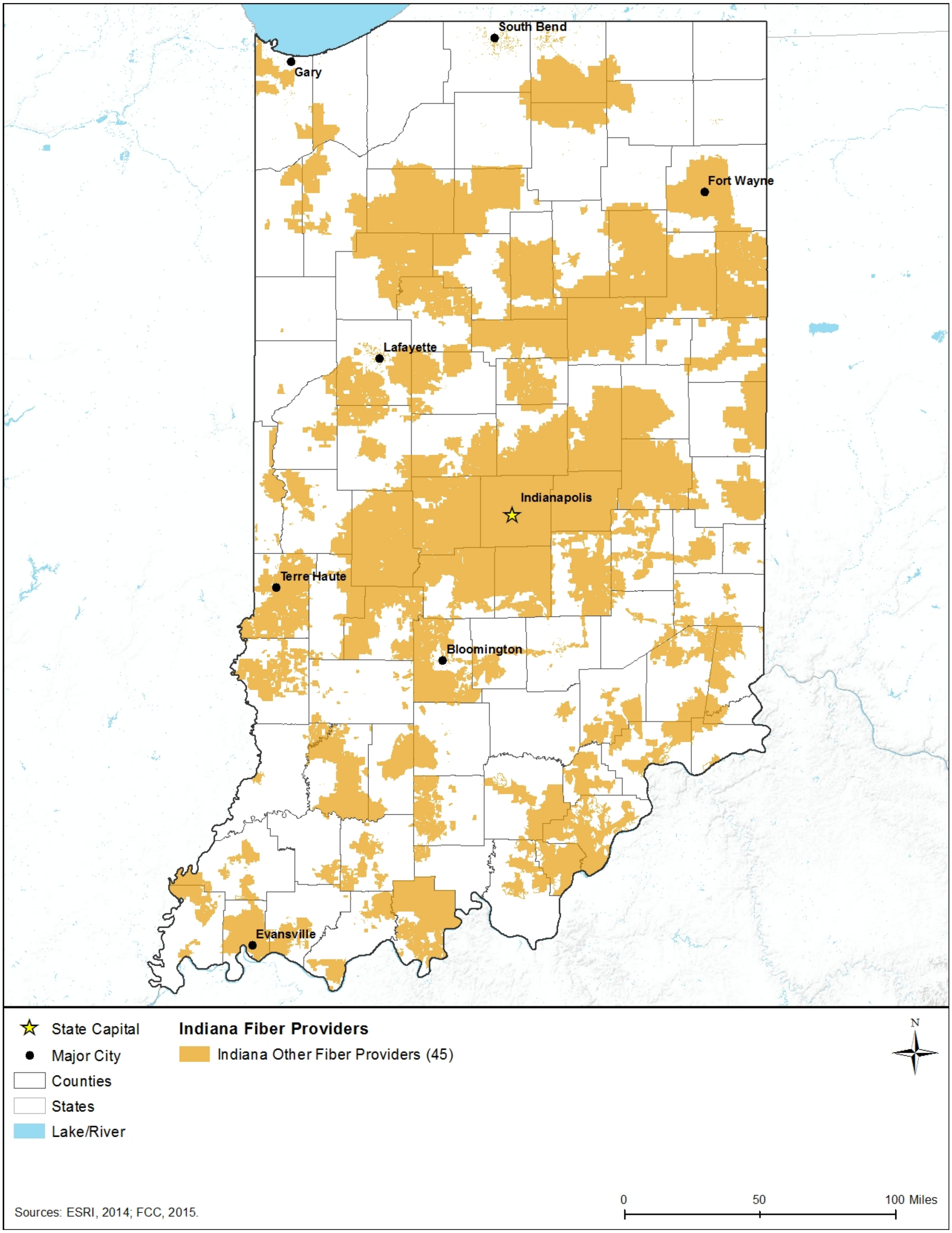

Figure 5.1.1-17: Other Providers' Fiber Availability in Indiana

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). Ownership of data centers may be public or private; comprehensive information regarding data centers may not be publicly available as some are related to secure facilities.

5.1.1.6 Utilities

Utilities are the essential systems that support daily operations in a community and cover a broad array of public services, such as electricity, water, wastewater, and solid waste. Section 5.1.4, Water Resources, describes the potable water sources in the state.

Electricity

The Indiana Utility Regulatory Commission (IURC) regulates some aspects of the operation of electric utilities in the state including; “the rates, financing, bonding, environmental compliance plans and service territories” (IURC, 2015a). The state gives municipal utilities, cooperative electric utilities, and not-for-profit corporations the ability to “remove themselves from the Commission's jurisdiction;” a process that requires the agreement of the local government or a majority vote of the municipality’s population (IURC, 2015a). There are currently nine municipal utilities, six investor-owned utilities, and five wholesale utilities under IURC regulation (IURC, 2013a). To contrast this, there are 67 municipal electric utilities that have successfully withdrawn themselves from IURC jurisdiction (IURC, 2013b). Additionally, there are 43 Rural Electric Membership Corporation (REMC) Utilities that have left IURC jurisdiction (IURC, 2012).

Nearly all of Indiana’s electricity comes from coal-burning facilities (EIA 2015a). In 201, approximately 85 percent of the state’s electricity came from these types of plants (EIA, 2015a). In that year, coal-fired plants generated 97,548,739 megawatthours[12] of power, out of the total 115,395,392 megawatthours produced (EIA, 2015b). Natural gas and wind power facilities produced 9,572,346 megawatthours (approximately 8 percent) and 3,496,042 megawatthours (approximately 3 percent) of power, respectively. Petroleum coke, other gasses, hydroelectric, solar, and biomass all produced small amounts of electricity, though petroleum coke and other gasses accounted for the largest portions of this remaining production. Coal has provided the largest portion of Indiana’s electricity for years, while renewable sources like wind or biomass have grown alongside petroleum coke. Generation from natural gas has increased dramatically

[12] One megawatthour is defined as one thousand kilowatt-hours or 1million watt-hours’; where one watthour is “the electrical energy unit of measure equal to one watt of power supplied to, or taken from, an electric circuit steadily for one hour” (EIA, 2016).

over the last five years (EIA, 2015b). Most of this electricity is used by Indiana's industrial sector, eclipsing the usage of the commercial sector. In 2013, industrial sources used 45.7 percent of the electricity generated, while the transportation sector used 21.4 percent, the residential sector 19.6 percent, and the commercial sector used just 13.3 percent (EIA, 2015g).

Water

The IURC also regulates water utilities, including "investor-owned, municipal, not-for-profit or cooperative utilities or they might operate as water conservancy districts" (IURC, 2015a). Their authority extends to rates, some aspects of environmental compliance, service territories, financing and bonding. "Indiana statutes allow municipal utilities, not-for-profit corporations, co-operative telephone and electric companies to remove themselves from the Commission's jurisdiction by ordinance of the local governing body or a majority vote of the people in the municipality" (IURC, 2015a). The IURC's jurisdiction extends to 72 water utilities in the state, which are a mixture of municipal, not-for-profit, or investor-owned utilities (IURC, 2015b). An additional 15 utilities (mostly investor-owned) that provide both water and wastewater services are also regulated by the IURC (IURC, 2015c). There are also 363 municipal water utilities that have withdrawn from IURC jurisdiction and oversight (IURC, 2015d). Likewise, there are 91 not-for-profit or investor-owned utilities that no longer report to the IURC (IURC, 2015e).

The quality of the drinking water supplied to Indiana citizens is within the purview of the Drinking Water Branch of the Indiana Department of Environmental Management (IDEM). Regulations regarding drinking water are required by the federal Safe Drinking Water Act (SDWA). The Drinking Water Branch ensures "that Public Water Supplies (PWS) deliver water to Hoosier homes and businesses that is adequate in quantity and is safe to drink" (IDEM, 2015n). Among their responsibilities are the inspection of PWSs, oversight of construction by issuing permits, ensuring water quality compliance, and responding to complaints from citizens (IDEM, 2015n). The Drinking Water Branch also runs the Source Water Protection Program, which helps to identify bodies of water that are sources of drinking water, as well as identifying possible sources of contamination. These results of these assessments are made available to the public (IDEM, 2015c).

Wastewater

Some aspects of wastewater treatment utilities in Indiana are regulated by the IURC. This includes the regulation of rates, environmental compliance, and service areas (IURC, 2015a). Twenty-nine utilities dedicated to the treatment of wastewater fall under IURC jurisdiction with the majority of these being investor owned; though some not-for-profit companies are also overseen by the IURC (IURC, 2015f). An additional 15 utilities (mostly investor-owned) that provide both water and wastewater services are also regulated by the IURC (IURC, 2015c). While the IURC regulates some aspects of business, the IDEM's Office of Water Quality issues National Pollutant Discharge Elimination System (NPDES) permits. Required by the Clean Water Act (CWA), these permits allow for the discharge of wastewater into state waters and set limits on the amounts of pollutants that may be discharged (IDEM, 2015g). The vast majority of the state's NPDES permits were issued prior to 1974. Most of the Office of Water Quality's permitting workload is related to the renewal of these 5-year permits. The IDEM offers a variety of permit types, including municipal, industrial, and wet weather (which includes stormwater permits and sewer overflow permits related to stormwater) (IDEM, 2015g). In addition to this, the state also requires that wastewater facility operators be certified through the IDEM. Multiple classes of these certifications are offered, dependent on the operators experience and the kind of plant they wish to operate (IDEM, 2015h).

Solid Waste Management

Indiana's solid waste is managed on a more local basis than many other states. A 1990 Indiana law "required each county in Indiana to form a SWMD" or Solid Waste Management Districts. These operate as local authorities on solid waste management issues (IDEM, 2015i). The state is divided into 72 districts, of which 66 represent just one county (IDEM, 2015j). Reporting requirements set forth in Indiana law require the Solid Waste Group of the IDEM to collect data from these districts on solid waste management. They also handle the issuing of permits for the operation of facilities, and conduct facility inspections (IDEM, 2015k). Currently, the state is home to a total of 220 permitted solid waste facilities, a mixture of landfills, transfer station, collection sites, and construction waste sites (IDEM, 2015l). Among these are 32 municipal landfills, which receive a large portion of the state's solid waste. In 2013, these facilities accepted 10,142,918 tons of waste. An approximate 52 years of functional life remains across all of them (IDEM, 2013). Recently, the IDEM has been requiring some recyclers to electronically "submit reports to IDEM on the amount and type of recyclables they process from Indiana's waste stream." Recyclers required to make these reports include recyclable materials brokers, solid waste facilities that recycle waste, owners of material recovery facilities (MRFs), and solid waste management districts (IDEM, 2015m).

5.1.2. Soils

5.1.2.1 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.

5.1.2.2 Specific Regulatory Considerations

The Proposed Action must meet the requirements of the National Environmental Policy Act (NEPA) and other applicable laws and regulations. A list of applicable state laws and regulations is included in Table 5.1.2-1 below.

Table 5.1.2-1: Relevant Indiana Soil Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Rule 5 (327 IAC 15-5)	Indiana Department of Environmental Management (IDEM)	An erosion control plan that contains the required elements in 327 IAC 15-5-7 is required as part of any construction activity that disturbs one acre or more of total land area.

5.1.2.3 Environmental Setting

Indiana is composed of three Land Resource Region (LRR),[13] as defined by the National Resources Conservation Service (NRCS) (NRCS, 2006):

- Central Feed Grains and Livestock Region,
- East and Central Farming and Forest Region, and
- Lake State Fruit, Truck Crop, and Dairy Region.

Within and among Indiana's three LRRs are sixteen Major Land Resource Areas (MLRA),[14] which are characterized by patterns of soils, climate, water resources, land uses, and type of farming (NRCS, 2006). The locations and characteristics of Indiana's MLRAs are presented in Figure 5.1.2-1 and Table 5.1.2-2.

[13] Land Resource Region: "A geographical area made up of an aggregation of Major Land Resource Areas (MLRA) with similar characteristics" (NRCS, 2006).
[14] 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).

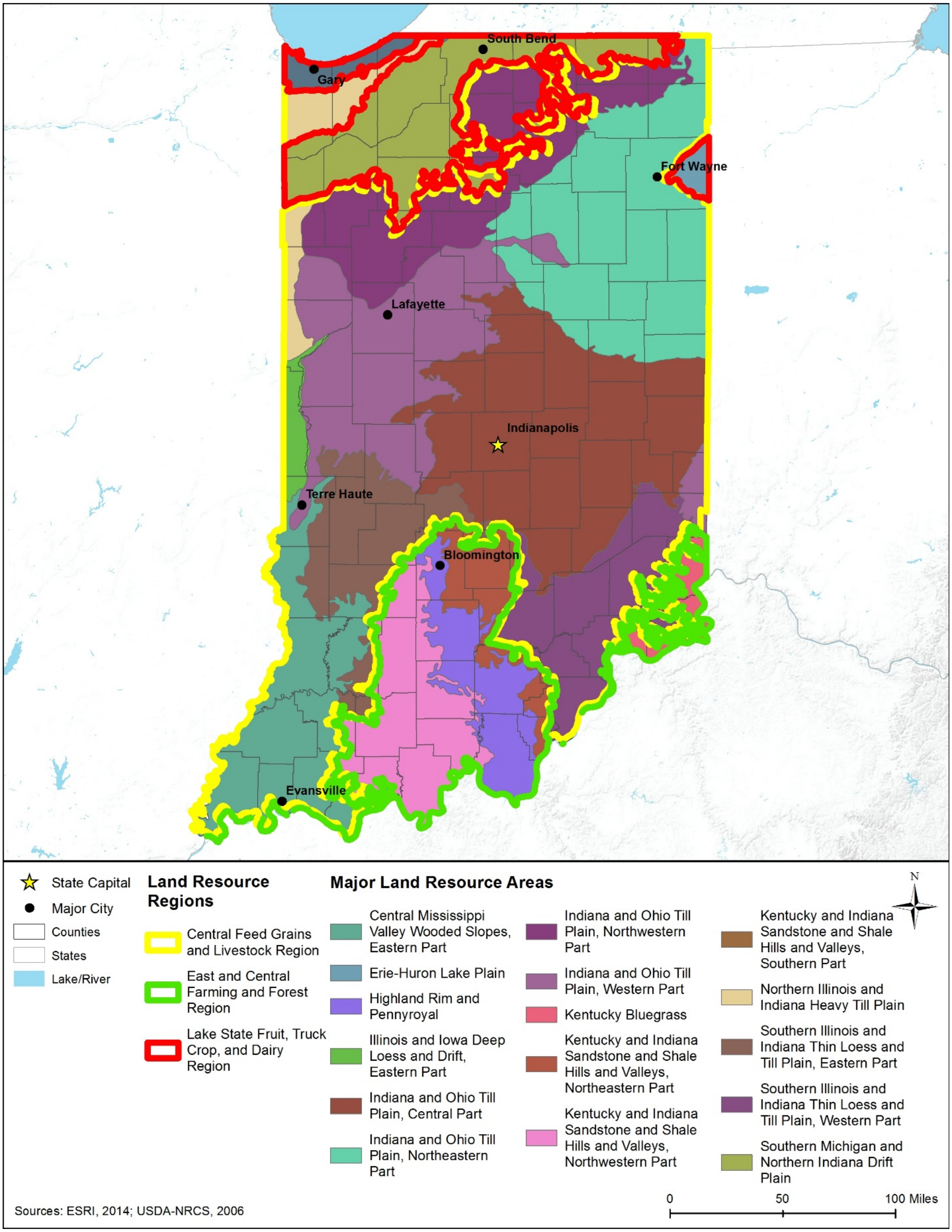

Figure 5.1.2-1: Locations of Major Land Resource Areas in Indiana

Table 5.1.2-2: Characteristics of Major Land Resource Areas in Indiana

MLRA Name	Region of State	Soil Characteristics
Central Mississippi Valley Wooded Slopes, Eastern Part	Southwestern Indiana	Alfisols,[a] Entisols,[b] Inceptisols,[c] and Mollisols[d] are the dominant soil orders. These very deep soils are loamy, silty, and clayey, and range from excessively drained to poorly drained.
Erie-Huron Lake Plain	Northeastern Indiana	Alfisols, Inceptisols, Mollisols, and Spodosols[e] are the dominant soil orders. These clayey or loamy soils[f] are typically poorly drained to somewhat poorly drained, and are very deep.
Highland Rim and Pennyroyal	Southern Indiana	Alfisols, Inceptisols, and Ultisols[g] are the dominant soil orders. These clayey or loamy soils are typically moderately well drained or well drained, and are moderately deep to very deep.
Illinois and Iowa Deep Loess and Drift, Eastern Part	Western Indiana	Alfisols and Mollisols are the dominant soil orders. These soils range from poorly drained to moderately well drained, and are typically moderately deep to very deep. They are silty or clayey.
Indiana and Ohio Till Plain, Central Part	Central Indiana	Alfisols, Inceptisols, and Mollisols are the dominant soil orders. These clayey or loamy soils typically range from somewhat poorly drained to very poorly drained, and are very deep.
Indiana and Ohio Till Plain, Northeastern Part	Northeastern Indiana	Alfisols, Inceptisols, and Mollisols are the dominant soil orders. These clayey or loamy soils typically range from somewhat poorly drained to very poorly drained, and are very deep.
Indiana and Ohio Till Plain, Northwestern Part	Northwestern Indiana	Alfisols, Entisols, Histosols,[h] Inceptisols, and Mollisols are the dominant soil orders. These typically deep and clayey or loamy soils range from very poorly drained to well drained.
Indiana and Ohio Till Plain, Western Part	Western and Southeastern Indiana	Alfisols, Inceptisols, and Mollisols are the dominant soil orders. These silty or loamy soils range from very poorly drained to well drained, and are very deep.
Kentucky Bluegrass	Southeastern Indiana	Alfisols, Inceptisols, and Mollisols are the dominant soil orders. These clayey or loamy well drained soils range from shallow to very deep.
Kentucky and Indiana Sandstone and Shale Hills and Valleys, Northeastern Part	Southern Indiana	Alfisols, Inceptisols, and Ultisols are the dominant soil orders. These soils are silty, loamy, or clayey, and range from somewhat poorly drained to well drained. They are moderately deep to very deep.
Kentucky and Indiana Sandstone and Shale Hills and Valleys, Northwestern Part	Southern Indiana	Alfisols, Inceptisols, and Ultisols are the dominant soil orders. These soils are silty, loamy, or clayey, and range from poorly drained to somewhat excessively drained. They are moderately deep to very deep.
Kentucky and Indiana Sandstone and Shale Hills and Valleys, Southern Part	Southern Indiana	These soils are generally Alfisols, and specifically Udalfs. They are loamy or clayey.
Northern Illinois and Indiana Heavy Till Plain	Northwestern and Western Indiana	Alfisols, Histosols, Inceptisols, and Mollisols are the dominant soil orders. These soils typically range from moderately well drained to poorly drained, and are moderately deep to very deep. They are "silty or clayey in the subsoil."

MLRA Name	Region of State	Soil Characteristics
Southern Illinois and Indiana Thin Loess and Till Plain, Eastern Part	Southwestern Indiana	Alfisols and Inceptisols are the dominant soil orders, with Entisols less so. These silty, loamy, or clayey soils range from poorly drained to well drained, and are deep or very deep.
Southern Illinois and Indiana Thin Loess and Till Plain, Western Part	Southeastern Indiana	Alfisols and Inceptisols are the dominant soil orders, with Entisols, Mollisols, and Ultisols less so. These soils typically range from somewhat poorly drained to well drained.
Southern Michigan and Northern Indiana Drift Plain	Northern Indiana	Alfisols, Histosols, and Mollisols are the dominant soil orders. These sandy or loamy soils range from very poorly drained to well drained, and are very deep.

[a] 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 percent of the world's ice-free land surface." (NRCS, 2015d)

[b] 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 percent of the world's ice-free land surface." (NRCS, 2015d)

[c] 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 percent of the world's ice-free land surface." (NRCS, 2015d)

[d] Mollisols: "Soils that have a dark colored surface horizon relatively high in content of organic matter. They are base rich throughout and quite fertile. Mollisols form under grass in climates that have a moderate to pronounced seasonal moisture deficit." (NRCS, 2015d)

[e] Spodosols: "Spodosols formed from weathering processes that strip organic matter combined with aluminum from the surface layer and deposit them in the subsoil. They commonly occur in areas of course-textured deposits under coniferous forests of humid regions, tend to be acid and infertile, and make up about 4 percent of the world's ice-free land surface." (NRCS, 2015d)

[f] Loamy Soil: "[A soil] that combines [sand, silt, and clay] in relatively equal amounts." (Purdue University Consumer Horticulture, 2006)

[g] 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 percent of the world's ice-free land surface." (NRCS, 2015d)

[h] Histosols: "Histosols have a high content of organic matter and no permafrost. Most are saturated year round, but a few are freely drained. They form in decomposed plan remains that accumulate in water, forest litter, or moss faster than they decay. Histosols make up about 1 percent of the world's ice-free land surface." (NRCS, 2015d)

Source: (NRCS, 2006)

Soil characteristics are an important consideration for FirstNet insomuch as soil properties could influence the suitability of sites for network deployment. Soil characteristics can differ over relatively short distances, reflecting differences in parent material, elevation, and position on the landscape, biota[15] such as bacteria, fungi, biological crusts, vegetation, animals, and climatic variables such as precipitation and temperature. For example, expansive soils[16] with wet and dry seasons alternately swell and shrink, which presents integrity risks to structural foundations (Rogers, Olshansky, & Rogers, 2004). Soils can also be affected by a variety of surface uses that loosen topsoil and damage or remove vegetation or other groundcover, which may result in accelerated erosion, compaction, and rutting[17] (discussed further in the subsections below).

[15] The flora and fauna of a region.

[16] Expansive soils are characterized by "the presence of swelling clay minerals" that absorb water molecules when wet and expand in size or shrink when dry leaving "voids in the soil" (Rogers, Olshansky, & Rogers, 2004).

[17] Rutting is indentations in soil from operating equipment in moist conditions or soils with lower bearing strength (USFS, 2009b).

5.1.2.4 Soil Suborders

Soil suborders are part of the soil taxonomy (a system of classification used to make and interpret soil surveys). Soil orders are the highest level in the taxonomy; there are 12 soil orders in the world characterized by both observed and inferred 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[18] soil database identifies 11 different soil suborders in Indiana (NRCS, 2015a). Figure 5.1.2-2 depicts the distribution of the soil suborders; Table 5.1.2-3 provides a summary of the major physical-chemical characteristics of the various soil suborders found.

5.1.2.5 Runoff Potential

The NRCS uses four Hydrologic Soil Groups (A, B, C, and D) that are based on a soil's runoff potential.[19] Group A generally has the smaller runoff potential, whereas Group D generally has the greatest (Purdue University, 2015). Table 5.1.2-3 provides a summary of the runoff potential for each soil suborder in Indiana.

Group A. **Sand, loamy sand or sandy loam soils.** This group of soils has "low runoff potential and high infiltration rates[20] 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). Aquolls, Psamments, Saprists, Udalfs, and Udolls fall into this category in Indiana.

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. Aquolls, Fluvents, Psamments, Udalfs, Udepts, Udolls, and Udults fall into this category in Indiana.

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[18] STATSGO2 is the Digital General Soil Map of the United States that shows general soil association units across the landscape of the nation. Developed by the National Cooperative Soil Survey, STATSGO2 supersedes the State Soil Geographic (STATSGO) dataset.

[19] 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.

[20] 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).

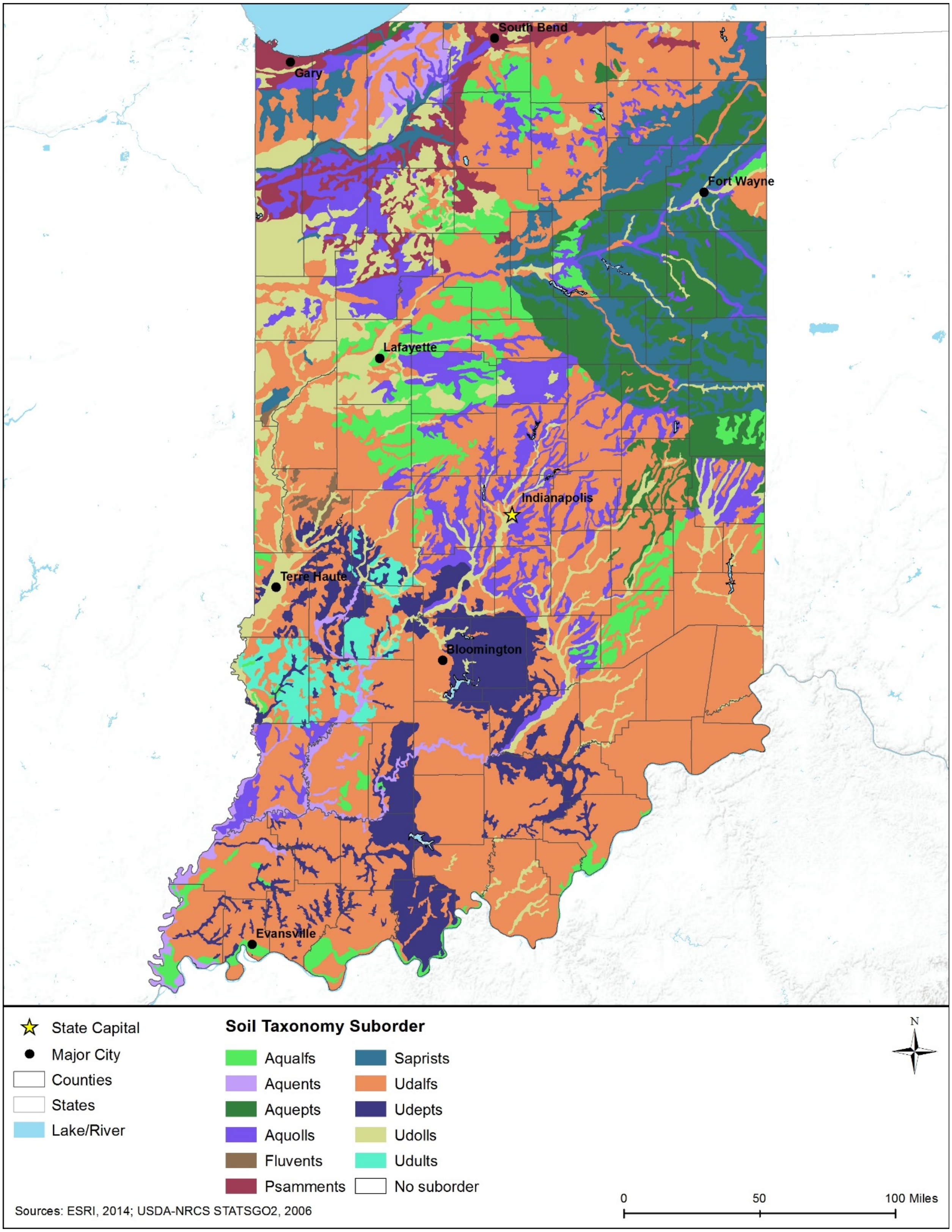

Figure 5.1.2-2: Indiana Soil Taxonomy Suborders

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Table 5.1.2-3: Major Characteristics of Soil Suborders[a] Found in Indiana, as depicted in Figure 5.1.2-2

Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (%)	Drainage Class	Hydric Soil[b]	Hydrologic Group	Runoff Potential	Permeability[c]	Erosion Potential	Compaction and Rutting Potential	Limitation for Construction
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.	Loam, Silt loam, Silty clay loam, Stratified silty clay loam to clay	0-3	Somewhat poorly drained	No	C, D	Medium, High	Low, Very Low	Medium to High, depending on slope	Low	Erosion
Entisols	Aquents	Widely distributed, with some forming in sandy deposits, and most forming in recent sediments. Aquents support vegetation that tolerates either permanent or periodic wetness, and are mostly used for pasture, cropland, forest, or wildlife habitat.	Loam, Stratified silt loam to loam to sandy loam to fine sandy loam	0-2	Very poorly drained to somewhat poorly drained	No, Yes	C, D	Medium, High	Low, Very Low	Medium to High, depending on slope	High, due to hydric soil and poor drainage conditions	Erosion and Compaction
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.	Silt loam	0-2	Somewhat poorly drained	No, Yes	C	Medium	Low	Medium	High, due to hydric soil and poor drainage conditions	Erosion and Compaction
Mollisols	Aquolls	Aquolls support grass, sedge, and forb vegetation, as well as some forest vegetation. However, most have been artificially drained and utilized as cropland.	Fine sandy loam, Loam, Loamy sand, Sand, Silt loam, Silty clay, Silty clay loam, Stratified sandy loam to clay, Stratified silt loam to clay	0-2	Very poorly drained to poorly drained	Yes	A, B, D	Low, Medium, High	High, Moderate, Very Low	Low to High, depending on slope	High, due to hydric soil and poor drainage conditions	Erosion and Compaction
Entisols	Fluvents	Fluvents are mostly freely drained soils that form in recently-deposited sediments on flood plains, fans, and deltas located along rivers and small streams. Unless protected by dams or levees, these soils frequently flood. Fluvents are normally utilized as rangeland, forest, pasture, or wildlife habitat, with some also used for cropland.	Stratified loamy sand to loam	0-2	Well drained	No	B	Medium	Moderate	Medium	Low	Erosion
Entisols	Psamments	Psamments are sandy in all layers. In some arid and semi-arid climates, they are among the most productive rangeland soils, and are primarily used as rangeland, pasture, or wildlife habitat. Those Psamments that are nearly bare are subject to wind erosion and drifting, and do provide good support for wheeled vehicles.	Loamy fine sand, Loamy sand, Sand	0-18	Somewhat poorly drained to excessively drained	No	A, B	Low, Medium	High, Moderate	Low to Medium, depending on slope	Low	Erosion
Histosols	Saprists	Saprists have organic materials are well decomposed, and many support natural vegetation and are used as woodland, rangeland, or wildlife habitat. Some Saprists, particularly those with a mesic or warmer temperature regime, have been cleared, drained, and used as cropland.	Muck	0-1	Very poorly drained	Yes	A	Low	High	Low	High, due to hydric soil and poor drainage conditions	Compaction

Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (%)	Drainage Class	Hydric Soil[b]	Hydrologic Group	Runoff Potential	Permeability[c]	Erosion Potential	Compaction and Rutting Potential	Limitation for Construction
Alfisols	Udalfs	Udalfs have an udic (humid or subhumid climate) moisture regime, and are believed to have supported forest vegetation at some time during development.	Clay, Clay loam, Fine sandy loam, Gravelly sandy clay loam, Loam, Sand, Sandy clay loam, Sandy loam, Silt loam, Silty clay, Silty clay loam, Stratified fine sand to silt, Stratified very gravelly coarse sand to sand, Very channery loam, Very gravelly sandy loam	0-35	Somewhat poorly drained to somewhat excessively drained	No	A, B, C, D	Low, Medium, High	High, Moderate, Low, Very Low	Low to High, depending on slope	Low	Erosion
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 silt loam, Silt loam, Weathered bedrock	0-80	Moderately well drained to well drained	No	B, C	Medium	Moderate, Low	Medium	Low	Erosion
Mollisols	Udolls	Udolls are found in humid climates. They are more or less freely drained, and have historically supported tall grass prairie. They are used as pasture or rangeland, and as cropland in areas with little slope.	Clay loam, Fine sandy loam, Loam, Loamy fine sand, Sandy loam, Silt loam, Silty clay loam	0-7	Somewhat poorly drained to well drained	No	A, B, C	Low, Medium	High, Moderate, Low	Low to Medium, depending on slope	Low	Erosion
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).	Loamy sand	25-50	Well drained	No	B	Medium	Moderate	Medium	Low	Erosion

[a] Soil suborders constitute a broad range of soil types. Within each suborder, the range of soil types may have a range of properties across the state, which result in multiple values being displayed in the table for that suborder.
[b] Hydric Soil: "A soil that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part" (NRCS, 2015c). Soil suborders constitute a broad range of soil types. Within each soil suborder, some specific soil types are hydric while others are not.
[c] Based on Runoff Potential, described in Section 5.1.2.5.
Source: (NRCS, 2015a) (NRCS, 1999)

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, Aquents, Aquepts, Udalfs, Udepts, and Udolls fall into this category in Indiana.

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, Aquents, Aquolls, and Udalfs fall into this category in Indiana.

5.1.2.6 Soil Erosion

“Soil erosion involves the breakdown, detachment, transport, and redistribution of soil particles by forces of water, wind, or gravity” (NRCS, 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 5.1.2-3 provides a summary of the erosion potential for each soil suborder in Indiana. Soils with medium to high erosion potential in Indiana include those in the Aqualfs, Aquents, Aquepts, Aquolls, Fluvents, Psamments, Udalfs, Udepts, Udolls, and Udults suborders, which are found throughout most of the state (Figure 5.1.2-2).

5.1.2.7 Soil Compaction and Rutting

Soil compaction and rutting occurs when soil layers are compressed by machinery or animals, which decreases both open spaces in the soil, as well as water infiltration rates (NRCS, 1996b). Moist soils with high soil water content are most susceptible to compaction and rutting, as they lack the strength to resist deformation caused by pressure. When rutting occurs, channels form and result in downslope erosion (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 10 tons can cause soil compaction of greater than 12 inches depth (NRCS, 1996b), (NRCS, 2003).

Loam, sandy loam, and sandy clay loam soils are most susceptible to compaction and rutting; silt, silty clay, silt loam, silty clay loam, and clay soils are more resistant to compaction and rutting (NRCS, 1996b). Table 5.1.2-3 provides a summary of the compaction and rutting potential for each soil suborder in Indiana. Soils with the highest potential for compaction and rutting in Indiana include those in the Aquents, Aquepts, Aquolls, and Saprists suborders, which are found primarily in northern areas of the state (Figure 5.1.2-2).

5.1.3. Geology

5.1.3.1 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 ground-water availability. Several of these elements are discussed in other sections of this PEIS, including Water Resources (Section 5.1.4), Human Health (Section 5.1.15), and Climate Change (Section 5.1.14).

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

- Section 5.1.3.3, Environmental Setting: Physiographic Regions[21] and Provinces[22]
- Section 5.1.3.4, Surface Geology
- Section 5.1.3.5, Bedrock Geology[23]
- Section 5.1.3.6, Paleontological Resources[24]
- Section 5.1.3.7, Fossil Fuel and Mineral Resources
- Section 5.1.3.8, Geologic Hazards[25]

5.1.3.2 Specific Regulatory Considerations

The Proposed Action must meet the requirements of NEPA and other applicable laws and regulations. Applicable federal laws and regulations that apply to geology are detailed in Appendix C, Environmental Laws and Regulations. A list of applicable state laws and regulations is included in Table 5.1.3-1.

Table 5.1.3-1: Relevant Indiana Geology Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Indiana Building Code	Indiana Department of Homeland Security (IDHS)	Provides seismic guidelines for buildings

5.1.3.3 Environmental Setting: Physiographic Regions and Provinces

The concept of physiographic regions was created in 1916 by geologist Nevin Fenneman as a way to describe areas of the United States based on common landforms (i.e., not climate or vegetation). Physiographic regions are areas of distinctive topography, geography, and geology. Important physiographic differences between adjacent areas are, in a large portion of cases, due to differences in the nature or structure of the underlying rocks. There are eight distinct

[21] Physiographic regions: Areas of the United States that share commonalities based on topography, geography, and geology (Fenneman, 1916).
[22] Physiographic provinces: Subsets within physiographic regions (Fenneman, 1916).
[23] Bedrock: Solid rock beneath the soil and superficial rock (USGS, 2015d).
[24] Paleontology: “Study of life in past geologic time based on fossil plants and animals” (USGS, 2015e).
[25] Geologic Hazards: Any geological or hydrological process that poses a threat to people and/or their property, which includes but is not limited to volcanic eruptions, earthquakes, landslides, sinkholes, mudflows, flooding, and shoreline movements (NPS, 2013).

physiographic regions in the continental United States: 1) Atlantic Plain, 2) Appalachian Highlands, 3) Interior Plains, 4) Interior Highlands, 5) Laurentian Upland, 6) Rocky Mountain System, 7) Intermontane Plateaus, and 8) Pacific Mountain System. Regions are further sub-divided into physiographic provinces based on differences observed on a more local scale (Fenneman, 1916).

Indiana has one physiographic region: Interior Plains (Central Lowland and Interior Low Plateaus Provinces) (USGS, 2003b). The locations of these regions are shown in Figure 5.1.3-1 and their general characteristics summarized in the following subsections.

Interior Plains Region

The Interior Plains Region extends across much of the interior of the United States, roughly between the western edge of the Appalachian Highlands (near states including Ohio, Tennessee, and Alabama), and the eastern edge of the Rocky Mountain System (including states such as Montana, Wyoming, and Colorado) (Fenneman, 1916). Metamorphic[26] and igneous[27] rocks dating to the Precambrian Era (older than 542 million years ago [MYA]) underlie the entire region.[28] There is minimal topographic relief throughout the region, except for the Black Hills of South Dakota. During the Mesozoic Era, much of the Interior Plains were covered by the oceans, resulting in the formation of sedimentary[29] rocks, which lie on top of the Precambrian basement rocks. Erosion from the Rocky Mountains to the west and the Ozark/Ouachita Mountains to the east, also contributed to the formation of sandstone,[30] mudstone,[31] and clay (USGS, 2014a).

Within Indiana, the Interior Plains Region is composed of the Central Lowland and Interior Low Plateaus Provinces.

<u>Central Lowland Province</u> **–** Within Indiana, the Central Lowland includes the northern two-thirds of the state, and portions of southern Indiana, with the exception of a lobe that extends from just north of Bloomington south to the Ohio River (this area is the Interior Low Plateaus) (Figure 5.1.3-1). "[Indiana's] topography [within the Central Lowland] is characterized by vast flat plains" (National Climatic Data Center, 2015). The highest point within the Central Lowland and Indiana is Hoosier Hill at 1,257 feet ASL. This point is in Wayne County in eastern Indiana (USGS, 2005).

[26] Metamorphic Rocks: "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, 2015f).
[27] Igneous Rocks: "Rock formed when molten rock (magma) that has cooled and solidified (crystallized)" (USGS, 2015f).
[28] For consistency, this PEIS uses the University of California Berkeley Geologic Time Scale for all of the FirstNet PEIS state documents. Time scales differ among universities and researchers; FirstNet utilized a consistent time scale throughout, which may differ slightly from other sources. (University of California Museum of Paleontology, 2011)
[29] 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, 2014d)
[30] Sandstone: "Sedimentary rock made mostly of sand-sized grains" (USGS, 2015f).
[31] Mudstone: "A very fine-grained sedimentary rock formed from mud" (USGS, 2015f).

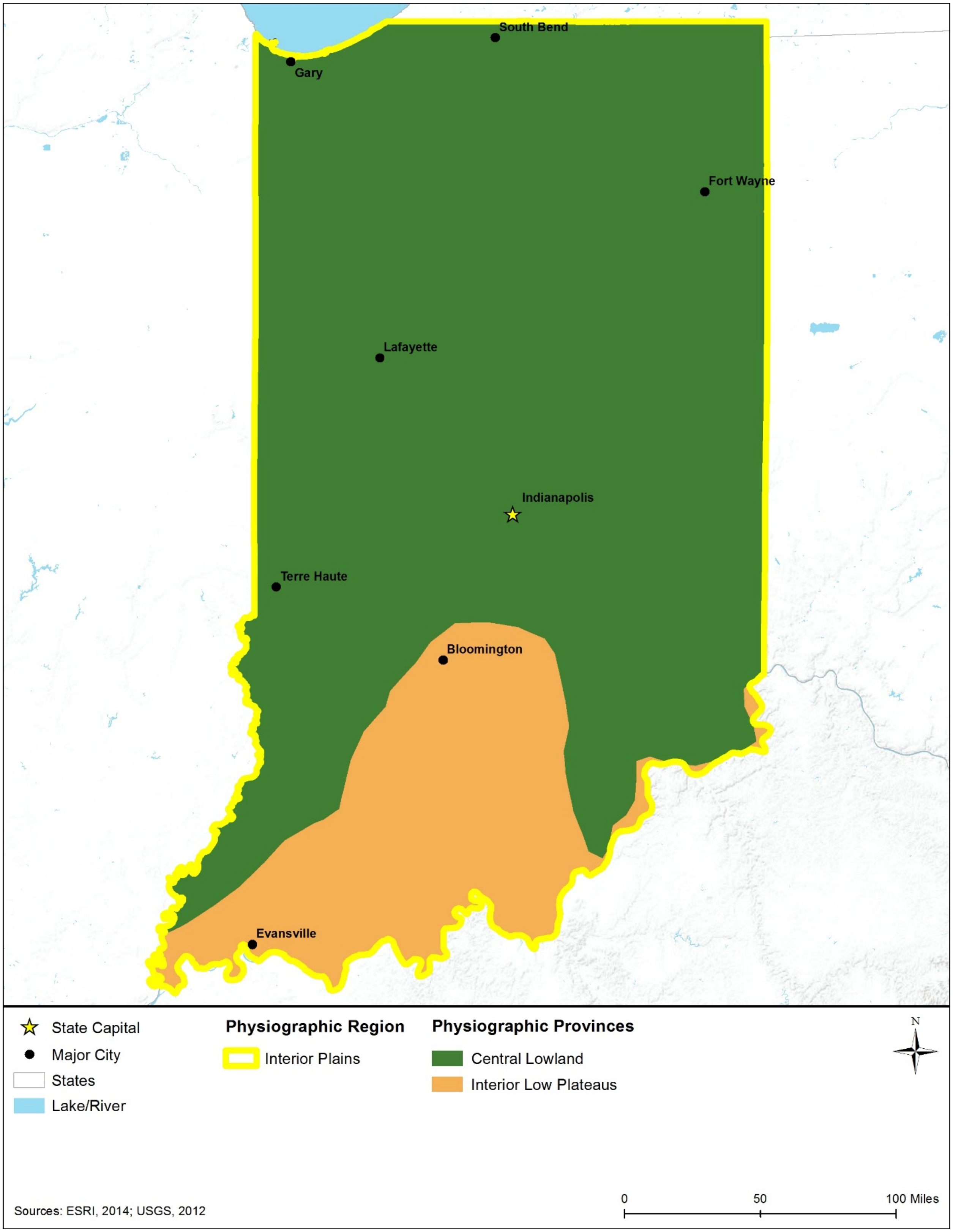


Figure 5.1.3-1: Physiographic Regions and Provinces of Indiana

Interior Low Plateaus – Elevations within the Interior Low Plateaus generally range between 500 and 1,000 feet (NPS, 2014a). Within Indiana, the Interior Low Plateaus comprise portions of the southern third of the state (from Bloomington south to the Ohio River) (Figure 5.1.3-1). Indiana's Interior Low Plateaus Province is characterized by a rugged topography that contains "hills, ridges, knolls, caves and waterfalls" (National Climatic Data Center, 2015).

5.1.3.4 Surface Geology

Surficial geology is characterized by materials such as till,[32] 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,[33] subsidence,[34] and erosion (Thompson, 2015).

Most of the surficial materials in Indiana are from deposits that formed between 21,000 and 13,600 years ago when the northern two-thirds of the state were covered by the last stage of continental glaciation. Sediment thickness ranges from zero to 500 feet throughout the state, with average depths of surficial deposits reaching 250 feet in central Indiana. Till deposits are common on the flat lands throughout the central portion of the state, while "outwash[35] [deposits are] prevalent in northern Indiana and along major river valleys that once served as meltwater drainages, notably the Eel, Kankakee, Whitewater, Wabash, White, and Ohio Rivers. Outwash deposits form broad, expansive aprons, kames[36] (mounds), eskers[37] (sinuous ridges), and line valley bottoms." Loess deposits are common throughout northern Michigan, particularly along the shores of Lake Michigan (Indiana Geological Survey, 2015a); loess deposits, some of which exceed five feet in thickness are particularly common in southwest Indiana in the Wabash River Valley (Indiana Geological Survey, 2010). Figure 5.1.3-2 depicts a generalized illustration of the surface geology for Indiana.

[32] 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, 2013c)
[33] Slope failure, also referred to as mass wasting, is the downslope movement of rock debris and soil in response to gravitational stresses.
[34] Subsidence: "Gradual settling or sudden sinking of the Earth's surface owing to subsurface movement of earth materials" (USGS, 2000).
[35] Outwash: "Glacial outwash is the deposit of sand, silt, and gravel formed below a glacier by meltwater streams and rivers" (USGS, 2015f).
[36] Kame: "A sand and gravel deposit formed by running water on stagnant or moving-glacier ice… Kames form on flat or inclined ice, in holes, or in cracks" (USGS, 2013c).
[37] Esker: "A meandering, water-deposited, generally steep-sided sediment ridge that forms within a subglacial or englacial stream channel" (USGS, 2013c).

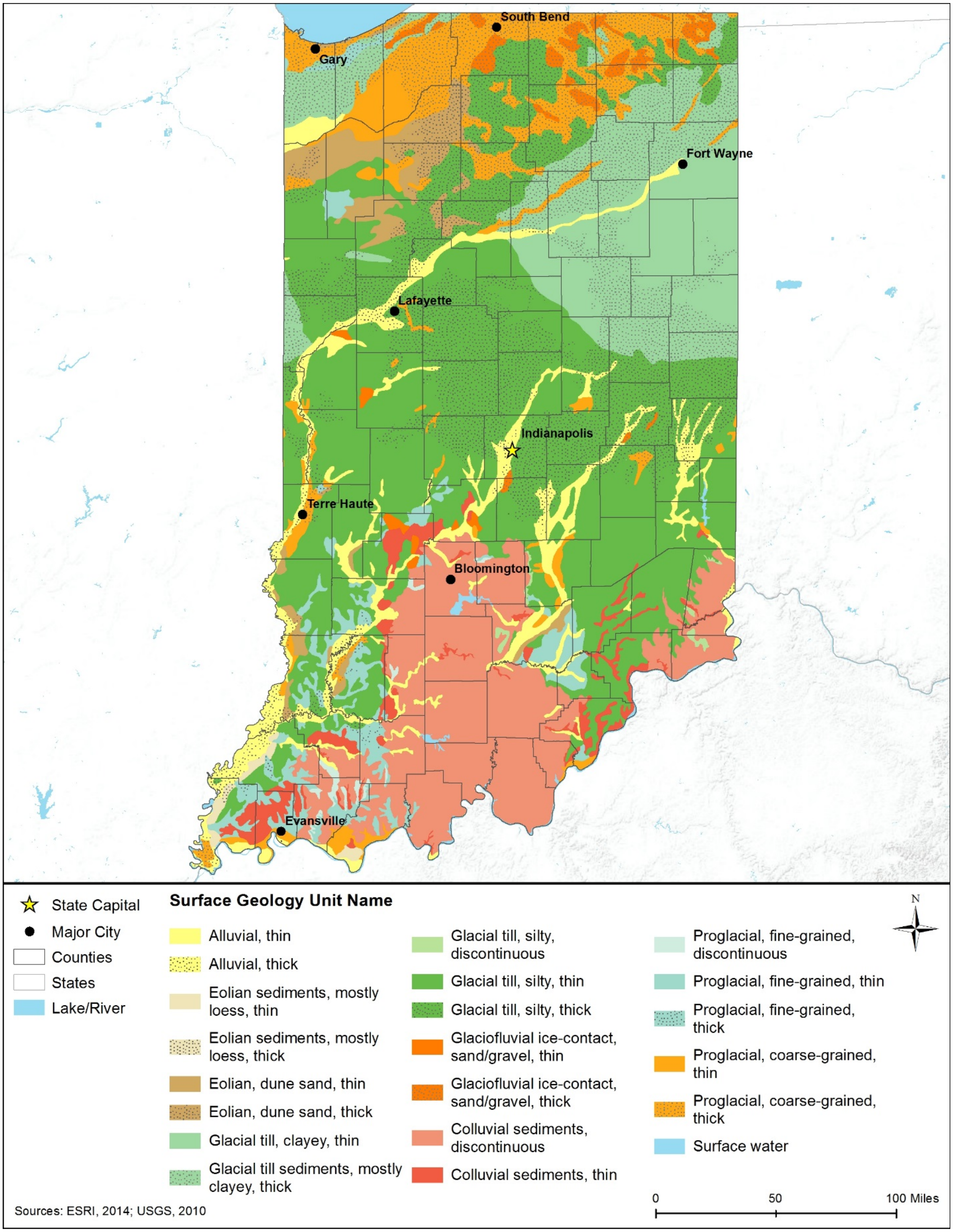


Figure 5.1.3-2: Generalized Surface Geology for Indiana

5.1.3.5 Bedrock Geology

Bedrock geology analysis, and "the study of distribution, position, shape, and internal structure of rocks" (USGS, 2015i) reveals important information about a region's surface and subsurface characteristics (i.e., three-dimensional geometry), including dip (slope of the formation),[38] rock composition, and regional tectonism.[39] 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 (NHDES, 2014).

Indiana's underlying bedrock dates to the Paleozoic Era (542 to 251 MYA) and dips to the southwest. As such, the underlying bedrock becomes younger moving from east to west across the state. Much of northern Indiana is underlain by Silurian (444 to 416 MYA) dolostone,[40] limestone,[41] siltstone,[42] and shale,[43] and Devonian (416 to 359 MYA) shale, limestone, and dolostone. Southwestern Indiana, on the other hand, is underlain by Mississippian (359 to 318 MYA) shale, sandstone, siltstone, limestone, and gypsum, and Pennsylvanian (318 to 299 MYA) shale, sandstone,[44] mudstone,[45] clay, coal, limestone, and conglomerate.[46] "Bedrock is exposed only in the south-central part of the state, which was not glaciated, and in localized areas along the Wabash River." Structural deformities, including faults, are present in some of Indiana's underlying bedrock, particularly in southwestern parts of the state. (Indiana Geological Survey, 2015b)

Figure 5.1.3-3 shows the general bedrock geology throughout Indiana.

[38] Dip: "A measure of the angle between the flat horizon and the slope of a sedimentary layer, fault plane, metamorphic foliation, or other geologic structure" (NPS, 2000).
[39] Tectonisms: "Structure forces affecting the deformation, uplift, and movement of the earth's crust" (USGS, 2016b).
[40] Dolostone: "A magnesium-rich carbonate sedimentary rock. Also, a magnesium-rich carbonate mineral ($CaMgCO_3$)" (USGS, 2015f).
[41] 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, 2015f).
[42] Siltstone: "A sedimentary rock made mostly of silt-sized grains" (USGS, 2015f).
[43] 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, 2015f)
[44] Sandstone: "Sedimentary rock made mostly of sand-sized grains" (USGS, 2015f).
[45] Mudstone: "A very fine-grained sedimentary rock formed from mud" (USGS, 2015f).
[46] Conglomerate: "A sedimentary rock made of rounded rock fragments, such as pebbles, cobbles, and boulders, in a finer-grained matrix. To call the rock a conglomerate, some of the constituent pebbles must be at least 2 mm (about 1/13th of an inch) across." (USGS, 2015f)

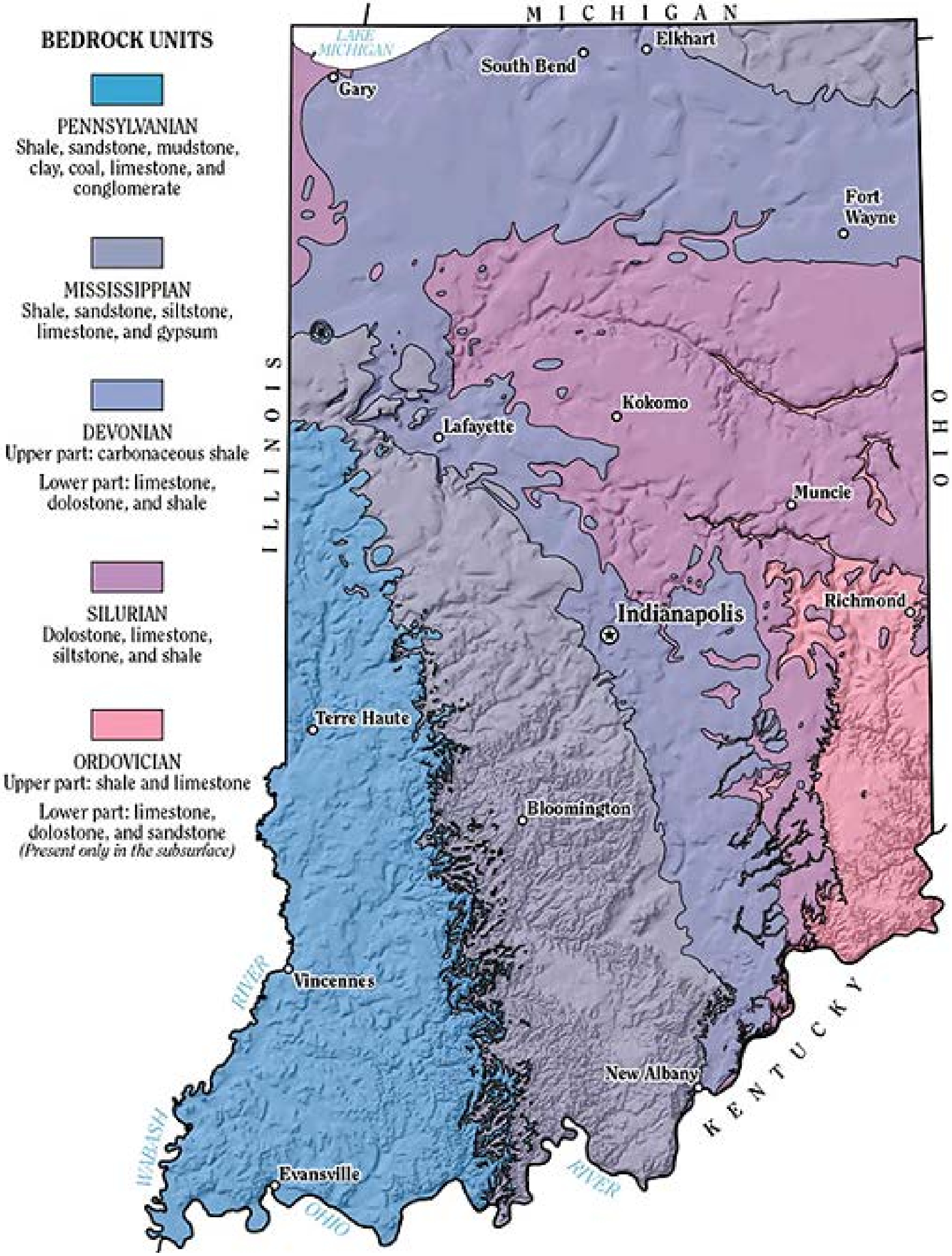


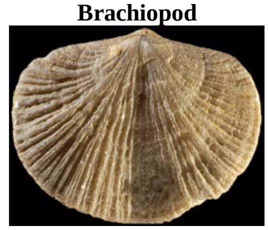
Figure 5.1.3-3: Generalized Bedrock Geology for Indiana

Source: (Indiana Geological Survey, 2015b)

5.1.3.6 Paleontological Resources

Most of Indiana's fossils are from marine organisms that lived during the Paleozoic Era (542 to 251 MYA). Marine seas covered Indiana during much of the Paleozoic Era. By the Carboniferous Period (359 to 299 MYA), as distant mountains eroded, fine sediments (e.g., muds and sands) were deposited at the bottom of the marine seas. Many fossils in Indiana are found in the sedimentary rocks that formed during this time. Indiana's most common fossil is the brachiopod.[47] Other common fossils in Indiana include bryozoans,[48] corals, crinoids,[49] bivalves,[50] gastropods,[51] and trace fossils (Indiana Geological Survey, 2015c) (The Paleontology Portal, 2015). By the Cenozoic Era (66 MYA to present), retreating and advancing glaciers scraped across northern Indiana. Fossils from the late Cenozoic Era include mammoths, mastodons, giant short-faced bears, and the stag moose (The Paleontology Portal, 2015). Indiana has no official state fossil (NPS, 2010).

Brachiopod



Source: (Indiana Historical Bureau, 2015)

5.1.3.7 Fossil Fuel and Mineral Resources

Oil and Gas

In 2013, Indiana produced nearly 2.4M barrels of oil and had one rotary rig in operation (EIA, 2015a). In July 2015, Indiana produced 189,000 barrels of crude oil, which ranked 24th nationwide for oil production (EIA, 2015e). Most of Indiana's oil fields are in the southwestern portion of the state in the Illinois Basin, which is composed of sandstone reservoirs up to 3,000 feet deep (IDNR, 2015p).

In 2014, Indiana produced 6,616 million cubic feet of natural gas from 895 wells, which ranked 24th nationwide for natural gas production (EIA, 2015a). Natural gas is produced in the southwest in the Illinois Basin, from sandstone reservoirs (IDNR, 2015p).

[47] Brachiopod: "Any member of a phylum of marine invertebrate animals called Brachiopoda. Brachiopods are sessile, bivalve organisms, but are more closely related to the colonial Bryozoa than the bivalved mollusks. Brachiopod diversity peaked in the Paleozoic, but some species survive." (Smithsonian Institution, 2016)

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

[49] Crinoid: "The common name for any echinoderm of the class Crinoidea, including sea lilies, feather stars, etc. Crinoids are common fossils in the Paleozoic and persist to the present. Many species have stalks and radiating arms and feed on particles in the water column." (Smithsonian Institution, 2016)

[50] Bivalves: "A mollusk with a soft body enclosed by two distinct shells that are hinged and capable of opening and closing" (Smithsonian Institution, 2016).

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

Minerals

As of 2015, Indiana's total nonfuel mineral production was valued at $916M, which ranked 28th nationwide (in terms of dollar value) (USGS, 2016a). This level of production accounted for about one percent of the total nationwide mineral production value. As of 2015, Indiana's leading nonfuel minerals were crushed stone, portland cement, lime, construction sand and gravel, and masonry cement. Indiana ranked second nationwide in dimension stone[52] production and ranked eighth in production output nationwide for crushed stone (USGS, 2016a). Other minerals produced in Indiana include common clay and shale, dimension stone, synthetic gypsum, gypsum, olivine, peat, perlite, sulfur, agricultural lime, aluminum plant, ball clay, industrial sand, lime, and steel (USGS, 2015b).

In 2013, Indiana produced 39,102 thousand short tons of coal, which ranked eighth nationwide for total coal production. Within Indiana, "bituminous coal[53] is produced from 18 surface and 9 underground mines located within the Illinois Basin" (EIA, 2015a). Coal within the Illinois Basin is typically found within sedimentary rocks from the Pennsylvanian Period (318 to 299 MYA) (USGS, 2013a). Bear Run Mine in southwestern Indiana has been one of the state's largest sources of coal (EIA, 2015a).

5.1.3.8 Geologic Hazards

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

Earthquakes

Areas of greatest seismicity in Indiana are concentrated in the northeast portions of the state. Between 1973 and March 2012, there were nine earthquakes of a magnitude 3.5 (on the Richter scale[54]) or greater in Indiana (USGS, 2014b), including a June 2002 magnitude 5.0 earthquake that occurred just west of Evansville (Indiana Geological Survey, 2015d). 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. Earthquakes can produce secondary flooding impacts resulting from dam failure (USGS, 2012a).

The shaking due to earthquakes can be significant many miles from its point of origin depending on the type of earthquake and the type of rock and soils beneath a given location. Crustal

[52] Dimension stone: "Natural rock material quarried for the purpose of obtaining blocks or slabs that meet specifications as to size (width, length, and thickness) and shape" (USGS, 2016b).

[53] Bituminous Coal: "A dense coal, usually black, sometimes dark brown, often with well-defined bands of bright and dull material, used primarily as fuel in steam-electric power generation, with substantial quantities also used for heat and power applications in manufacturing and to make coke. Bituminous coal is the most abundant coal in active U.S. mining regions. Its moisture content usually is less than 20 percent." (EIA, 2015c)

[54] The Richter scale is a numerical scale for expressing the magnitude of an earthquake on the basis of seismograph oscillations. The more destructive earthquakes typically have magnitudes between about 5.5 and 8.9; the scale is logarithmic and a difference of one represents an approximate thirtyfold difference in magnitude. (USGS, 2014g)

earthquakes, the most common in Indiana, 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 occur where Earth's tectonic plates collide. “When these plates collide, one plate slides (subducts) beneath the other, where it is reabsorbed into the mantle of the earth” (Oregon Department of Geology, 2015). Subduction zones are found off the coast of Washington, Oregon, and Alaska (USGS, 2014h). 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). Indiana is located far from any convergence boundaries, but is located in the middle of a tectonic plate.

Figure 5.1.3-4 depicts the seismic risk throughout Indiana; the box surrounding the range of colors shows the seismic hazards in the state. The map indicates levels of horizontal shaking (measured in Peak Ground Acceleration) 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 (percent g). Most pre-1965 buildings are likely to experience damage with exceedances of 10 percent g. Post-1985 buildings (in California) have experienced only minor damage with shaking of 60% g. (USGS, 2010)

Areas of greatest seismicity in Indiana are concentrated in the southwestern portion of the state due to its proximity to the New Madrid seismic zone[55] and the Wabash Valley fault system, a “90 [kilometer] long and 50 [kilometer] wide [series of faults] in southeastern Illinois, southwestern Indiana, and northwestern Kentucky.” In one location within the Wabash Valley, more than 475 feet of displacement has been caused by movement along a fault line (Rene & Stanonis, 1995). According the U.S. Geological Survey, “there is a 25 to 40 percent chance of a magnitude 6.0 or greater earthquake in the next 50 years for the central United States. There is a 7 to 10 percent chance of a repeat of events similar to the 1811-12 [New Madrid] earthquake[s]” (Indiana Geological Survey, 2015e), which registered between 7.3 and 7.5 on the Richter scale (USGS, 2012b).

[55] Although the New Madrid seismic zone is over 100 miles away from any point in Indiana, it is believed that the 1811-1812 New Madrid earthquakes produced the strongest ground shaking ever recorded near Evansville (USGS, 2012d).

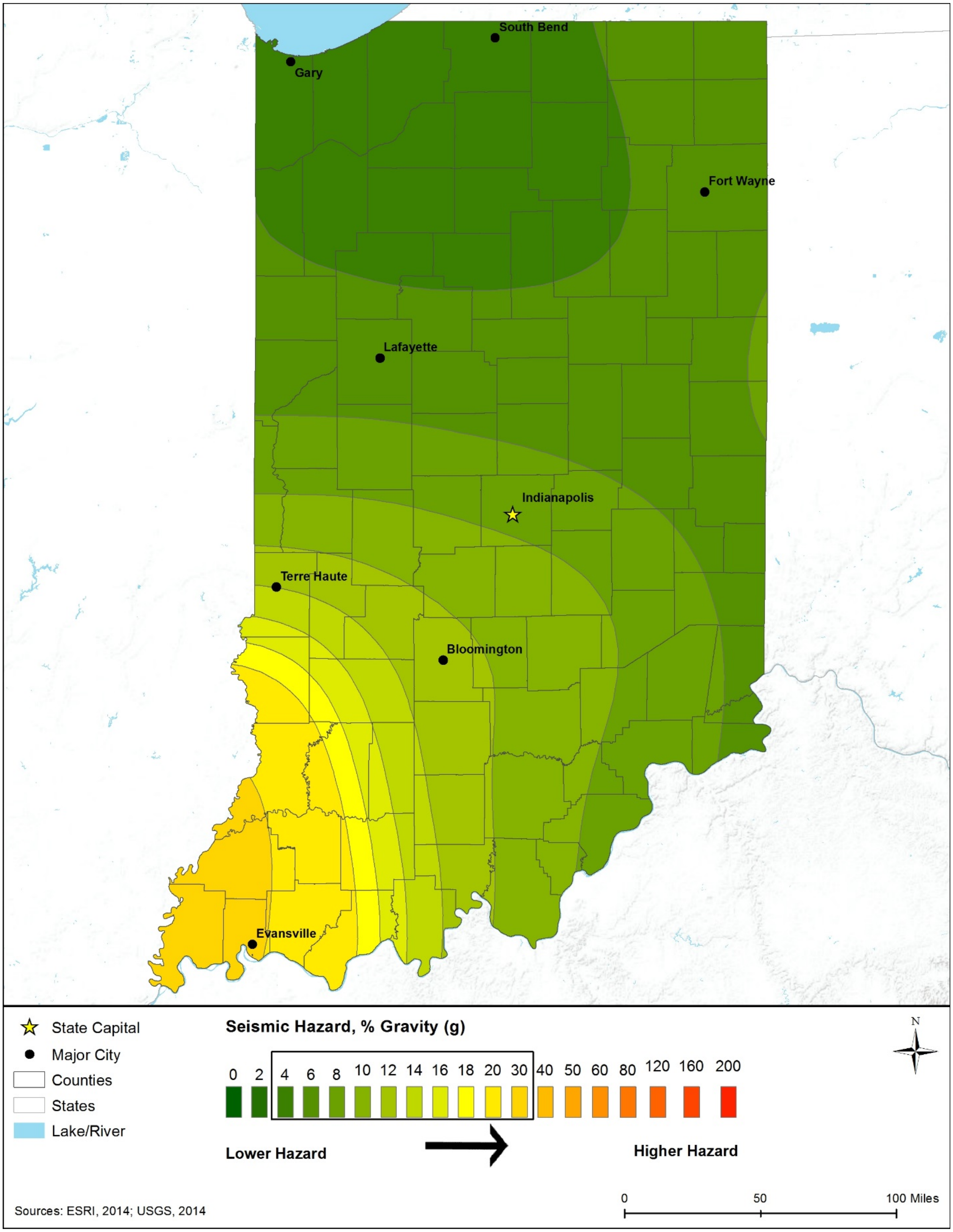


Figure 5.1.3-4: Indiana 2014 Seismic Hazard Map

Landslides

Portions of Indiana are susceptible to landslide events, particularly in the southeastern part of the state along the Ohio River (USGS, 2014e). "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).

The highest potential for landslides in Indiana's suburbs of the greater Cincinnati (Ohio) area in the southeastern area of the state. "The Cincinnati area is one of the most active spots in the country for landslides and has among the highest per capita costs to prevent and mitigate their effects." Specifically, areas underlain by the Kope Formation, which is composed largely of highly weathered shale with minimal amounts of limestone, are particularly susceptible to landslides. Landslide event types include creep,[56] translational,[57] and rotational[58] landslides (Potter, et al., 2013).

Portions of southwestern Indiana near the New Madrid seismic zone are moderately susceptible to land failure due to liquefaction[59] during a seismic event. Evidence of historic liquefaction has been observed along the Wabash River in Vincennes in the southwestern portion of the state. "[During an earthquake estimated at magnitude 7.0 that occurred about 6,100 years ago], sand and gravel from a buried terrace of the Wabash River was ejected onto the surface and simultaneously captured part of a tree that had been growing along the river bank at the time." (Indiana Geological Survey, 2015f).

Figure 5.1.3-5 shows landslide incidence and susceptibility throughout Indiana.

[56] Creep: "The imperceptibly slow, steady, downward movement of slope-forming soil or rock. Movement is caused by shear stress sufficient to produce permanent deformation, but too small to produce shear failure." (USGS, 2004)
[57] Translational Landslide: "The landslide mass moves along a roughly planar surface with little rotation or backward tilting" (USGS, 2004).
[58] Rotational Landslide: "A slide in which the surface of rupture is curved concavely upward and the slide movement is roughly rotational about an axis that is parallel to the ground surface and transverse across the slide" (USGS, 2004).
[59] Liquefaction: "The process of transforming saturated sand into a semi-liquid" (Indiana Geological Survey, 2015f).

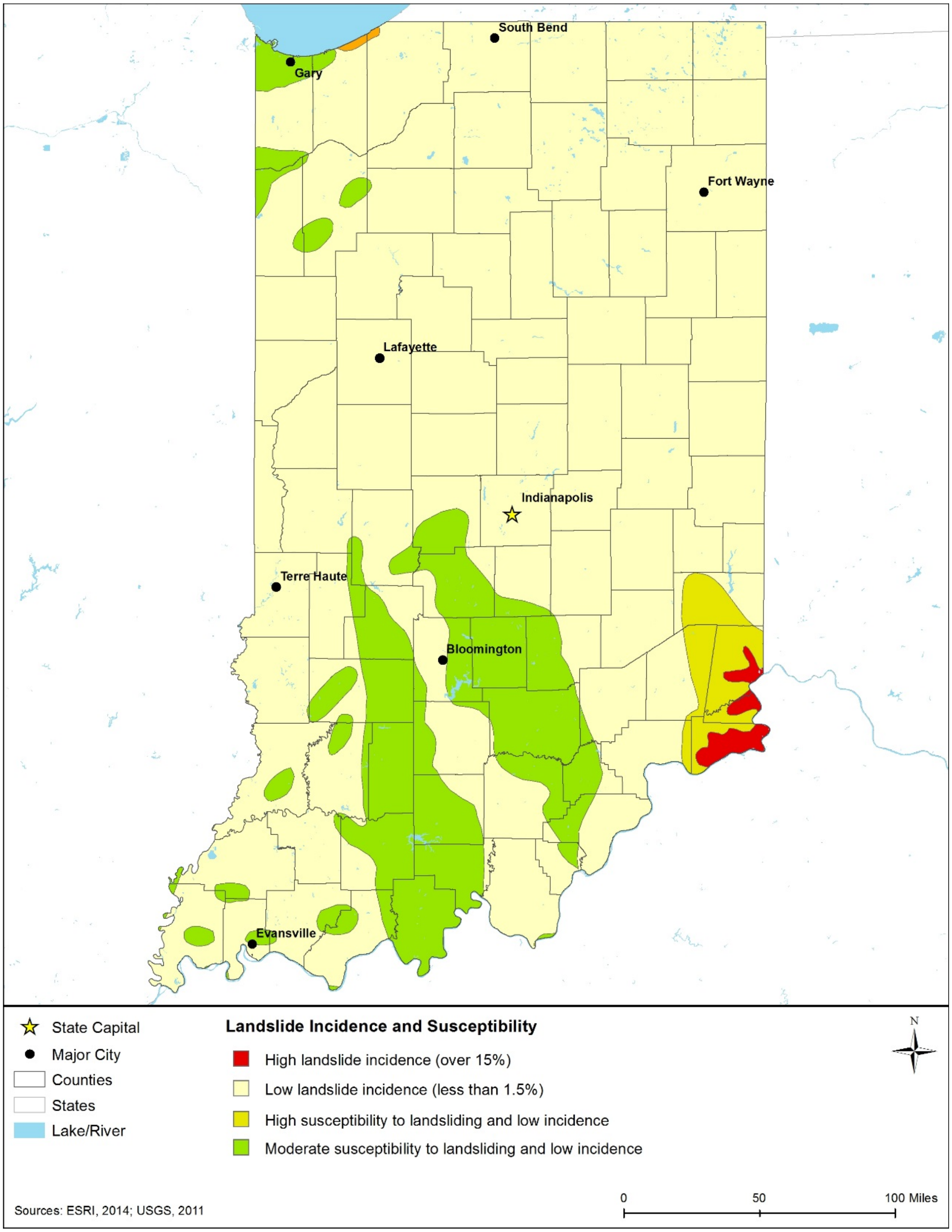


Figure 5.1.3-5: Indiana Landslide Incidence and Susceptibility Hazard Map[60]

[60] Susceptibility hazards not indicated in Figure 5.1.3-5 where same or lower than incidence. Susceptibility to landslides is defined as the probable degree of response of areal rocks and soils to natural or artificial cutting or loading of slopes, or to anomalously high precipitation. High, moderate, and low susceptibility are delimited by the same percentages used in classifying the incidence of landslides. Some generalization was necessary at this scale, and several small areas of high incidence and susceptibility were slightly exaggerated. (USGS, 2014e)

Land Subsidence

Land subsidence is a "gradual settling or sudden sinking of the Earth's surface owing to subsurface movement of earth materials" (USGS, 2000). Indiana is susceptible to land subsidence due to both mine collapse and karst[61] topography (Indiana Department of Homeland Security, 2014). Nationwide, the primary causes of land subsidence are attributed to aquifer system compaction, drainage of organic soils, underground mining, sinkholes, and thawing permafrost. More than 80 percent of subsidence in the United States is a consequence of 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 permanent lowering of the land surface elevation. (USGS, 2000)

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

Mine collapse constitutes one significant cause of land subsidence in parts of Indiana. Coal mines are prevalent throughout much of western and southwestern Indiana (Indiana Department of Homeland Security, 2014). More than 194,000 acres throughout the state are underlain by coal mines, many of which have been abandoned. "In Indiana, sinkholes [resulting from mine collapse] may exceed 25 feet in depth and involve the downward movement of as much as 500 cubic yards of unconsolidated sediments. Sinkholes generally occur where mines are less than 150 feet in depth, but shallow sag-type subsidence can occur at depths down to and exceeding 450 feet" (Indiana Geological Survey, 2015g).

In Indiana, a significant cause of land subsidence is the collapse of karst, which has resulted in the formation of caves and sinkholes. Karst topography is particularly common in the southern areas of the state along both the Mitchell and Muscatatuck Plateaus, where groundwater directly infiltrates into carbonate[62] bedrock layers. The Mitchell Plateau is composed of "Mississippian limestones and extends from the eastern part of Owen County southward to the Ohio River in Harrison County," while, further to the east, the Muscatatuck Plateau is made up of Silurian (444 to 416 MYA) limestone (Indiana Geological Survey, 2015h). Figure 5.1.3-6 shows the location of areas in Indiana that are susceptible to land subsidence due to karst topography.

[61] Karst Topography: "A distinctive landscape (topography) that can develop where the underlying bedrock, often limestone or marble, is partially dissolved by surface or groundwater" (USGS, 2015f).
[62] Carbonate: "A sedimentary rock made mainly of calcium carbonate ($CaCO_3$). Limestone and dolomite are common carbonate sedimentary rocks." (USGS, 2015f)

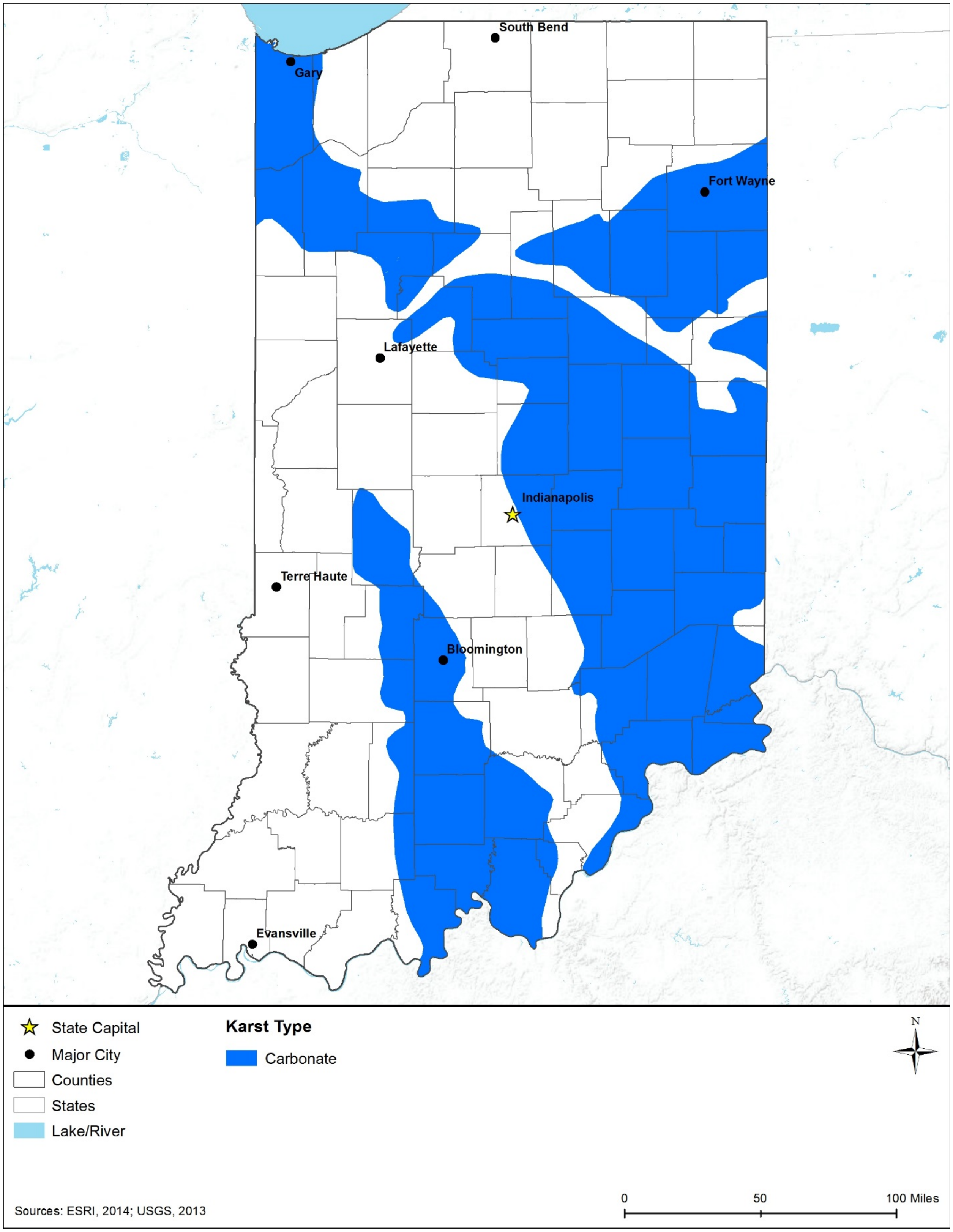


Figure 5.1.3-6: Karst Topography in Indiana

5.1.4. Water Resources

5.1.4.1 Definition of the Resource

Water resources are defined as all surface water bodies and groundwater systems including streams, rivers, lakes, floodplains, aquifers, and other aquatic habitats (wetlands are discussed separately in Section 5.1.5). 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, 2014i).

5.1.4.2 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 5.1.4-1 identifies the relevant laws and regulations for water resources in Indiana.

Table 5.1.4-1: Relevant Indiana Water Laws and Regulations

State Law/ Regulation	Regulatory Agency	Applicability
Indiana General Water Statutes	Indiana Department of Natural Resources (IDNR)	All general water statutes, including water rights, surface water; water appropriations, emergency regulation, and others.[a]
Indiana Pollutant Discharge Elimination System	IDEM	Any construction activities that disturb one or more acres of surface soil.
Flood Control Act	IDNR	Any placement of structure within a 100-year floodplain.
Navigable Waterways Act	IDNR	Construction of any permanent structures in Lake Michigan including cables in navigable waters of the state.
Clean Water Act (CWA) Section 401	IDEM	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 IDEM indicating that the proposed activity will not violate water quality standards.

[a] For more information on Indiana General Water Statutes, see http://www.in.gov/dnr/water/2453.htm#statutes.

5.1.4.3 Environmental Setting: Surface Water

Surface water resources are lakes, ponds, rivers, and streams. Indiana has "63,130 miles of rivers and streams, over 575 lakes, ponds, and reservoirs, over 1,530 square miles of estuaries, and 59 miles of Great Lakes coastline" (IDEM, 2014a). These surface waters supply drinking water; provide aquatic habitat; and support recreation, tourism, agriculture, fishing, power generation, and manufacturing across the state (IDNR, 1996).

Watersheds

Watersheds, or drainage areas, consist of surface water and all underlying groundwater, and encompass an area of land that drains streams and rainfall to a common outlet (e.g., reservoir, bay). Indiana's waters (lakes, rivers, and streams) are divided into 10 major watersheds, or drainage basins (Figure 5.1.4-1). For more information and for additional maps about Indiana's watersheds see www.in.gov/idem/nps/files/indiana_watershed_planning_guide.pdf (IDEM, 2015p).

All of the watersheds in Indiana except for the northeastern portion of the state flow into the Mississippi River watershed. The Lake Michigan, St. Joseph River, Kankakee River, and Maumee River watersheds encompass northern Indiana. The Wabash River; White River, West Fork; White River, East Fork; and Whitewater River watersheds encompass central Indiana. The Wabash River Watershed is the largest watershed in Indiana and drains two thirds of Indiana's 92 counties. The watershed contains urban centers and agricultural operations. Southern Indiana is comprised of the Patoka River, Ohio River, and southern portion of the Wabash River watersheds (IDEM, 2015p).

Freshwater

As shown in Figure 5.1.4-1, there are nine major rivers in Indiana: Kankakee, Tippecanoe, Wabash, Mississinewa, White, Whitewater, East Fork White, Blue, and Ohio. The Wabash River is Indiana's official state river and flows 475 miles west across northern Indiana to Illinois, where it forms the western border between Indiana and Illinois, before joining the Ohio River. The Tippecanoe, Mississinewa, White, East Fork White rivers are tributaries of the Wabash River (IDNR, 2015r). The Ohio River forms the southern border between Indiana and Kentucky. There is a total of 63,130 miles of streams and rivers within Indiana and more than 575 publicly owned lakes, reservoirs, and ponds (IDEM, 2014a).

Lake Michigan is just over 22,000 square miles in size, the largest of all of the Great Lakes. Indiana has 59 miles of Lake Michigan shoreline (IDEM, 2014a).

5.1.4.4 Sensitive or Protected Waterbodies

Wild and Scenic Rivers

Indiana does not have any federally designated National Wild and Scenic Rivers (National Wild and Scenic Rivers System, 2015a).

State Designated Critical Resource Waters

Indiana has designated waterbodies as outstanding state resource water. The Indiana Code defines outstanding state resource water as "waterbodies that have unique or special ecological, recreational, or aesthetic significance." The purpose of this designation is to prevent degradation and allow for future development or projects if they contribute to an overall improvement in water quality (Indiana General Assembly, 2015a). The Indiana Administrative Code identifies 14 outstanding state resource waters with three of them within the Great Lakes System (Indiana General Assembly, 2015b), as listed in Indiana Appendix A, Water Resources - Table A-1.

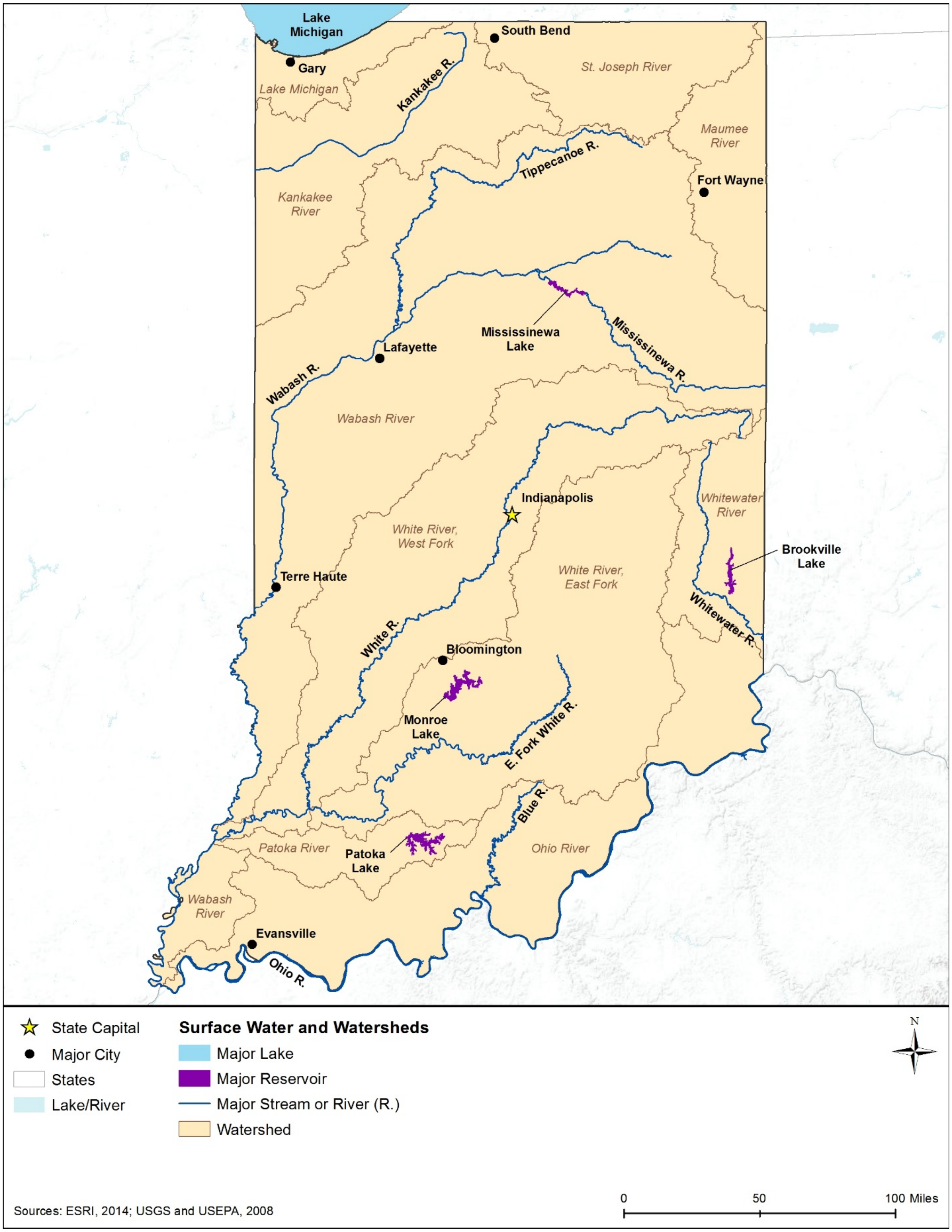


Figure 5.1.4-1: Major Indiana Watersheds and Surface Waterbodies

5.1.4.5 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,[63] the causes of impairment, and probable sources. Table 5.1.4-2 summarizes the water quality of Indiana's assessed major waterbodies by category, percent impaired, designated use,[64] cause, and probable sources. Figure 5.1.4-3 shows the Section 303(d) waters in Indiana as of 2014.

As shown in Table 5.1.4-2, various sources affect Indiana's waterbodies, causing impairments. More than half of Indiana's assessed rivers and streams are impaired and almost all of the lakes, reservoirs, and ponds are impaired. Designated uses of these impaired waterbodies include full body contact, human health and wildlife, public water supply, and warm water aquatic life. All of Indian's Lake Michigan shoreline is impaired for full body contact, human health and wildlife, and warm water aquatic life. Mercury and polychlorinated biphenyls (PCBs) have affected all 59 miles of Indiana's Lake Michigan shoreline (USEPA, 2015a).

Table 5.1.4-2: Section 303(d) Impaired Waters of Indiana, 2014

Water Type[a]	Amount of Waters Assessed[b] (Percent)	Amount Impaired (Percent)	Designated Uses of Impaired Waters	Top Causes of Impairment	Top Probable Sources for Impairment
Rivers and Streams	54%	58%	recreation, human health and wildlife, public water supply, and warm water aquatic life	*E. coli*, PCBs, and mercury	nonpoint source[c], crop production with subsurface drainage, livestock grazing or feeding operations, and municipal discharges
Lakes, Reservoirs, and Ponds	49%	96%	recreation, human health and wildlife, public water supply, and warm water aquatic life	mercury, PCBs, taste and odor, chlorophyll-A	industrial point source discharge, and nonpoint source
Great Lakes shoreline	100%	100%	recreation, human health and wildlife, and warm water aquatic life	mercury, PCBs, and *E. coli*	municipal discharges and non-point sources

[a] Some waters may be considered for more than one water type.
[b] Indiana has not assessed all waterbodies within the state.
[c] Nonpoint source: a source of pollution that does not have an identifiable, specific physical location or a defined discharge point. Non-point source pollution includes nutrients that run off croplands, lawns, parking lots, streets and other land uses. It also includes nutrients that enter waterways via air pollution groundwater, or septic systems (USEPA, 2015b).
Source: (USEPA, 2015a)

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

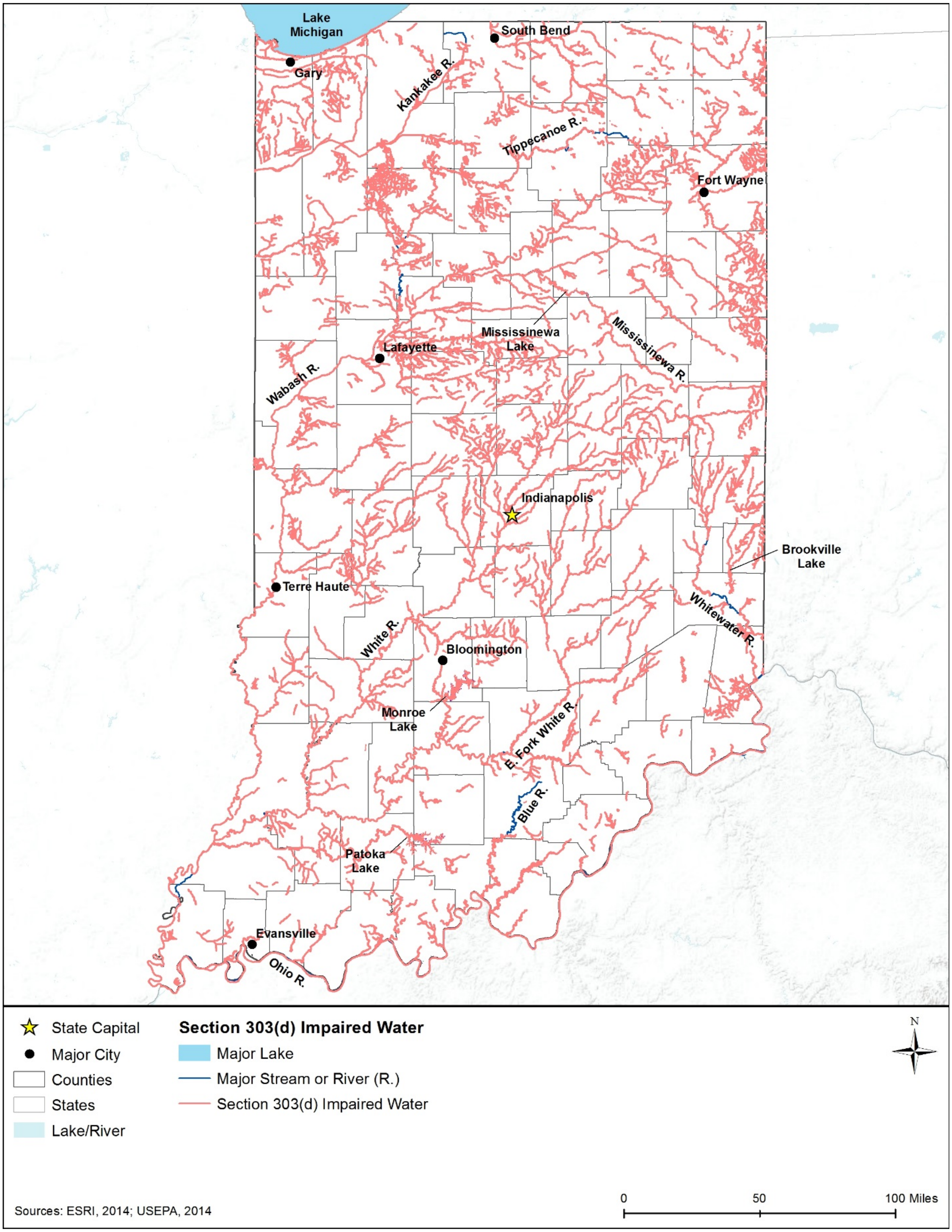


Figure 5.1.4-3: Section 303(d) Impaired Waters of Indiana, 2014

IDEM uses a watershed approach to improve water quality. IDEM implements a series of programs that include monitoring, developing and implementing water quality standards, reducing nonpoint source pollution, and controlling point source pollution. The IDEM also coordinates closely with the Lake Michigan Coastal Program. An objective of the program is to reduce and prevent nonpoint source pollution from entering Lake Michigan (IDEM, 2014a).

5.1.4.6 Floodplains

The Federal Emergency Management Agency (FEMA) defines a floodplain or flood-prone area as “any land area susceptible to being inundated by water from any source” (44 Code of Federal Regulations [CFR] 59.1) (FEMA, 2000). 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, 2014d).

There are two primary types of floodplains in Indiana.

- **Riverine and lake floodplains** occur along rivers, streams, or lakes where overbank flooding may occur, inundating adjacent land areas. In mountainous areas, floodwaters can build and recede quickly, with fast moving and deep water. Flooding in these areas can cause greater damage than typical riverine flooding due to the high velocity of water flow, the amount of debris carried, and the broad area affected by floodwaters. Whereas, flatter floodplains may remain inundated for days or weeks, covered by slow-moving and shallow water (FEMA, 2014a).
- **Coastal floodplains** in Indiana border the shoreline of Lake Michigan. Coastal flooding can occur when strong wind and storms increase water levels on the adjacent shorelines (FEMA, 2013). Lake coastal flooding can occur in Indiana when strong winds and storms increase water levels on the shores of Lake Michigan. In addition, a storm surge event that takes place during high tide can cause floodwaters to exceed normal tide levels.

The Great Flood of 2008

While still recovering from damage due to floods in January and February 2008, more flood damage occurred in June 2008. In late May and early June, a massive storm brought nine tornadoes, hail, straight-line winds, and flood producing rains. Rainfall totals for June ranged from 3 to 22 inches with some areas receiving more than two feet. Flood damages exceeded $1 billion, affected more than 25,000 people, and fatally injured four people. Structural damage affected hospitals, business, residential areas, roads, transportation infrastructure, and utilities. The Great Flood of 2008 was one of the most expensive natural disasters in Indiana's history (IDNR, 2008).

Source: (USGS, 2008)

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, 2015a). There are several causes of flooding in Indiana, often resulting in loss of life and damage to property, infrastructure, agriculture, and the environment. These include severe rain events, severe and intense storm events, dam failure, and levee failure (Indiana Department of Homeland Security, 2014).

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 highest repetitive loss payments, the communities with flood problems are Indianapolis, Carroll County, Fort Wayne, Vigo County, and Tippecanoe County (Indiana Department of Homeland Security, 2014).

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 441 communities in Indiana through the National Flood Insurance Program (NFIP) (FEMA, 2014c). Established to reduce the economic and social cost of flood damage by subsidizing insurance payments, the NFIP encourages communities “to adopt and enforce floodplain management regulations and to implement broader floodplain management programs” and allows property owners in participating communities to purchase insurance protection against losses from flooding (FEMA, 2015). As an incentive, communities can voluntarily participate in the NFIP Community Rating System (CRS), which is a program that rewards communities by reducing flood insurance premiums in exchange for doing more than the minimum NFHWAFIP requirements for floodplain management. As of May 2014, Indiana had 22 communities participating in the CRS (FEMA, 2014b).[65]

5.1.4.7 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

[65] A list of the 22 CRS communities can be found in the FEMA CRS report dated May 1, 2014 (FEMA, 2014b) and additional program information is available from FEMA’s NFIP CRS website (www.fema.gov/national-flood-insurance-program-community-rating-system).

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.

Indiana's principal aquifers consist of carbonate-rock[66] and sandstone aquifers[67] and sand and gravel aquifers of alluvial and glacial origin.[68] Generally, the water quality of Indiana's aquifers is suitable for drinking and daily water needs (USGS, 1995). Statewide, the most serious threats to groundwater quality include fertilizer applications, confined animal feeding operations, underground storage tanks, landfills constructed prior to 1989, septic systems, shallow Class V injection wells, industrial facilities, material spills, salt storage, and road salting (IDEM, 2014a).

Table 5.1.4-3: provides details on aquifer characteristics in the state; Figure 5.1.4-4 shows Indiana's principal and sole source aquifers.

Table 5.1.4-3: Description of Indiana's Principal Aquifers

Aquifer Type and Name	Location in State	Groundwater Quality
Aquifers of Alluvial and Glacial Origin These aquifers consist mainly of the sand, gravel, and bedrock eroded by the glaciers.	Throughout the state	Suitable for most uses. Water is generally hard with some areas of high iron concentration.
Mississippian aquifers These aquifers consist mainly of thick-bedded limestones and sandstones with shale and siltstone.	Central to southeast portion of Indiana	Dissolved-solids concentrations and hardness is extremely variable. Water is moderately hard to very hard. Slight acidity in groundwater partially dissolves the limestone, thus increasing the concentration of calcium and magnesium.
Silurian-Devonian aquifers These aquifers consist mainly of limestone and dolomite.	Eastern portion of the state	Generally, the water is adequate for most uses. Iron and sulfate concentrations are locally high, and the water is hard.

Source: (Moody, Carr, Chase, & Paulson, 1986) (USGS, 1995)

[66] 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).

[67] 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)

[68] 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, 2015a).

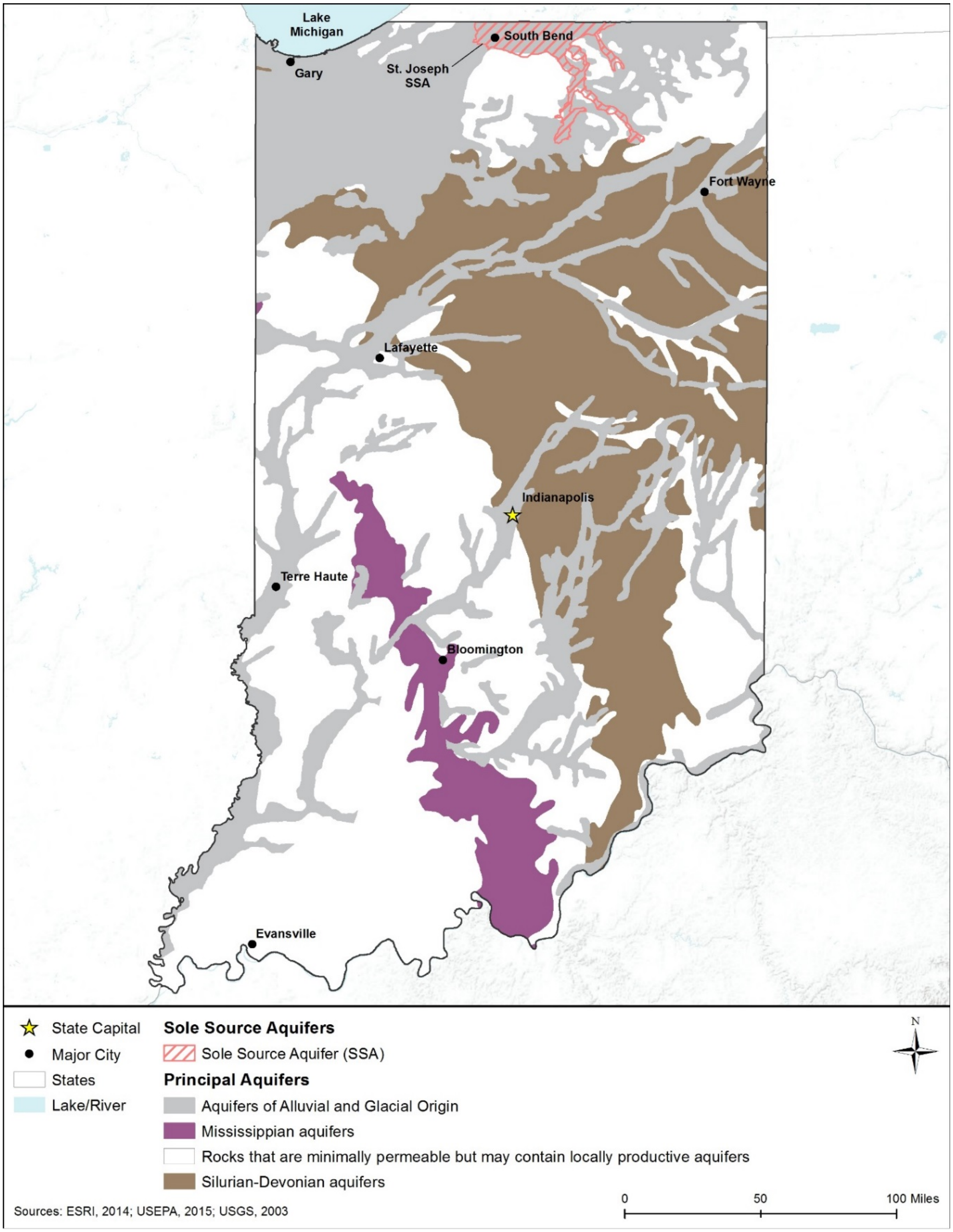


Figure 5.1.4-4: Principal and Sole Source Aquifers of Indiana

Sole Source Aquifers

The U.S. Environmental Protection Agency (USEPA) defines sole source aquifers (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, 2015s). Indiana has one designated SSA in northern Indiana (USEPA, 2015d). 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, 2015s).

5.1.5. Wetlands

5.1.5.1 Definition of the Resource

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

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

5.1.5.2 Specific Regulatory Considerations

Appendix C, Environmental Laws and Regulations, describes the pertinent federal laws protecting wetlands in detail. Table 5.1.5-1 summarizes the major Indiana state laws and permitting requirements relevant to the state's wetlands.

Table 5.1.5-1: Relevant Indiana Wetlands Laws and Regulations

State Law / Regulation	Regulatory Authority	Applicability
CWA Section 404 permit, Nationwide Permit (NWP) Indiana regional conditions	U.S. Army Corps of Engineers (USACE), Detroit District	Preconstruction notification is required for activities in acid bogs, acid seems, circumneutral[a] bogs[b], circumneutral seeps, cypress swamps, fens[c], forested fens, forested swamps, shrub swamps, sinkhole swamps, wet floodplain forests, and wet prairies.
		Wetlands outside of permanently maintained rights of way that are impacted must be restored to their original wetland type. Wetlands within a permanently maintained right of way that are impacted must be restored. Preconstruction notification is required for all stream crossings. Utility lines crossing federal navigation projects must be buried at least 6 feet below the authorized federal channel depth.
State Isolated Wetlands Program	Indiana Department of Environmental Management (IDEM)	Required for any activity in a wetland including dredging, excavation, and filling of a wetland.
CWA Section 401	IDEM	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 IDEM indicating that the Proposed Action will not violate water quality standards.
Indiana Pollutant Discharge Elimination System	IDEM	Any construction activities that disturb one or more acres of surface soil.

[a] Circumneutral describes a water body with a pH between 5.5 and 7.4 (USGS, 2013d).
[b]Bogs are acidic wetlands that form thick organic (peat) deposits up to 50 feet deep or more. They have little groundwater influence and are recharged through precipitation. (APA, 2013)
[c] 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, 2012e).

5.1.5.3 Environmental Setting: Wetland Types and Functions

The U.S. Fish and Wildlife Service's (USFWS) National Wetlands Inventory (NWI) mapping adopted a national Wetlands Classification Standard (WCS) that classifies wetlands according to shared environmental factors, such as vegetation, soils, and hydrology, as defined in Cowardin et al. (Cowardin, et al., 1979)). The WCS includes five major wetland systems: Marine, Estuarine, Riverine, Lacustrine, and Palustrine (as detailed in Table 5.1.5-2). The first four of these include both wetlands and deepwater habitats but the Palustrine includes only wetland habitats (USFWS, 2015a).

- The Marine System consists of open ocean, continental shelf, including beaches, rocky shores, lagoons, and shallow coral reefs. Normal marine salinity (saltiness) to hypersaline (more than 30 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 are usually semi-enclosed by land but have open, partly obstructed, or sporadic access to the

open ocean, and the ocean water is at least occasionally diluted by freshwater runoff from the land."

- "Riverine System includes all wetlands and deepwater habitats contained within a channel with two exceptions (1) wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens, and (2) habitats with water containing ocean-derived salts in excess of 0.5 ppt."
- Lacustrine System includes inland water bodies that are situated in topographic depressions, lack emergent trees and shrubs, have less than 30 percent vegetation cover, and occupy greater than 20 acres. Includes lakes, larger ponds, sloughs, lochs, bayous, etc.
- "Palustrine includes all nontidal wetlands dominated by trees, shrubs, persistent emergents, or emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 percent." The system is characterized based on the type and duration of flooding, water chemistry, vegetation, or substrate characteristics (soil types) (Cowardin, et al., 1979) (FGDC, 2013).

Three of these systems, Palustrine, Riverine, and Lacustrine are present in Indiana, as detailed in Table 5.1.5-2. In Indiana, the main type of wetlands are palustrine (freshwater) wetlands found in the northeastern part of the state, including extensive wetlands in and near the Indiana Dunes National Lakeshore, as shown in Table 5.1.5-2. Riverine and lacustrine wetlands comprise approximately three percent of the wetlands in the state, and therefore, they are not discussed in this PEIS.

Table 5.1.5-2 uses 2014 NWI data to characterize and map Indiana wetlands on a broad-scale.[69] The data is not intended for site-specific analyses and is not a substitute for field-level wetland surveys, delineations, or jurisdictional determinations, which may be conducted, as appropriate, at the site-specific level once those locations are known. The map codes and colorings in Table 5.1.5-2: correspond to the wetland types in the figures.

Table 5.1.5-2: Indiana Wetland Types, Descriptions, Location, and Amount, 2014

Wetland Type	Map Code and Color	Description[a]	Occurrence	Amount (acres)[b]
Palustrine forested wetland	PFO	PFO wetlands contain woody vegetation that are at least 20 feet tall. Floodplain forests and hardwood swamps are examples of PFO wetlands.	Forested lowlands within the state	554,388

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

Wetland Type	Map Code and Color	Description[a]	Occurrence	Amount (acres)[b]
Palustrine scrub-shrub wetland	PSS	Woody vegetation less than 20 feet tall dominates PSS wetlands. Thickets and shrub swamps are examples of PSS wetlands.	Throughout the state, often on river and lake floodplains	
Palustrine emergent wetlands	PEM	PEM wetlands have erect, rooted, green-stemmed, annual, water-loving plants, excluding mosses and lichens, present for most of the growing season in most years. PEM wetlands include freshwater marshes, wet meadows, fens, prairie potholes, and sloughs.	Northern part of the state	148,038
Palustrine unconsolidated bottom	PUB	PUB and PAB wetlands 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	146,156
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[70], and other miscellaneous wetlands are included in this group.	Abandoned fields, depressions (seeps), along hillsides and highways	454
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	2,182
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, but including any areas with abundant submerged or floating-leaved aquatic vegetation. These wetlands are generally less than 8.2 feet deep.	Throughout the state	26,842
			TOTAL	**878,060**

[a] The wetlands descriptions are based on information from the Federal Geographic Data Committee (FGDC)'s Classification of Wetland and Deepwater Habitats of the United States. Based on Cowardin, et.al, 1979, some data have 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, 2015am).

Palustrine Wetlands

In Indiana, palustrine wetlands include the majority of vegetated freshwater wetlands (freshwater marshes, swamps, bogs, and ponds). Common tree types found in palustrine forested wetlands

[70] 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)

(PFO) in Indiana are bald cypress *(Taxodium distichum)*, green ash *(Fraxinus pennsylvanica)*, silver maple *(Acer saccharinum)*, and overcup oak *(Quercus lyrata)*. Palustrine scrub-shrub wetlands (PSS) in Indiana consist of species such as willows (*Salix sp.*), dogwoods (*Cornus spp.*), arrowwoods (*Viburnum spp.*), highbush blueberries (*Vaccinium spp.*), buttonbush (*Cephalanthus occidentalis*), swamp rose (*Rosa palustris*), and saplings of trees such as red maple (*Acer rubrum*). PFO and PSS are the most common type of palustrine wetlands within Indiana. Palustrine emergent wetlands (PEM), or freshwater marsh, fen, and slough[71], in Indiana support diverse plant and animal populations. Common PEM marsh plants in Indiana include flat sedge *(Cyperus spp.)*, spike rush *(Eleocharis spp.)*, rushes *(Juncus spp.)* and sedges *(Carex spp.)*.

Palustrine wetlands also include the shallow water zones of lakes, rivers, and ponds and aquatic beds formed by water lilies and other floating-leaved or free-floating plants. These are the easiest wetlands to recognize and occur throughout the state.

The IDNR estimates that the state originally had approximately 5.6 million acres of wetlands circa 1780. Most of the wetlands were converted for farming and infrastructure (roads and cities). In state's wetland report estimated approximately 813,000 acres of wetlands in the mid-1980s has lost most of its wetlands. Based on the IDEM 1980 wetland inventory, the wetland ratios of palustrine wetlands were, with PFO/PSS being the dominant wetland type (67 percent), followed by PEM (7 percent), PUB/PAB (ponds) (12 percent), and other palustrine wetlands (3 percent). (IDEM, 2015d) Based on the USFWS NWI 2014 analysis, ratios have shifted slightly, with PFO/PSS being the dominant wetland type (65 percent), followed by PEM (17 percent), PUB/PAB (ponds) (17 percent), and other palustrine wetlands (less than one percent) (USFWS, 2014a). There are currently about 849,036 acres of palustrine (freshwater) wetlands in the state (USFWS, 2014a). Main threats to palustrine wetlands in Indiana include pollutants from urban runoff, agricultural conversion, and invasive species (IDEM, 2015e).

Lacustrine Wetlands

Lacustrine wetlands are distributed throughout Indiana. There are approximately 26,842 acres of lacustrine wetlands in the state (USFWS, 2015a).

Riverine Wetlands

The wetlands occur in broad valleys and have fine textured sediments deposited by peak flows in the spring. Surface water in this region is temporary, due to the lowering of the water table, and surface and groundwater withdrawal, unless augmented by human activities. There are approximately 2,182 acres of riverine wetlands in the state (USFWS, 2015a).

[71] Slough: "swamp or shallow lake system, usually a backwater to a larger body of water" (NOAA, 2014).

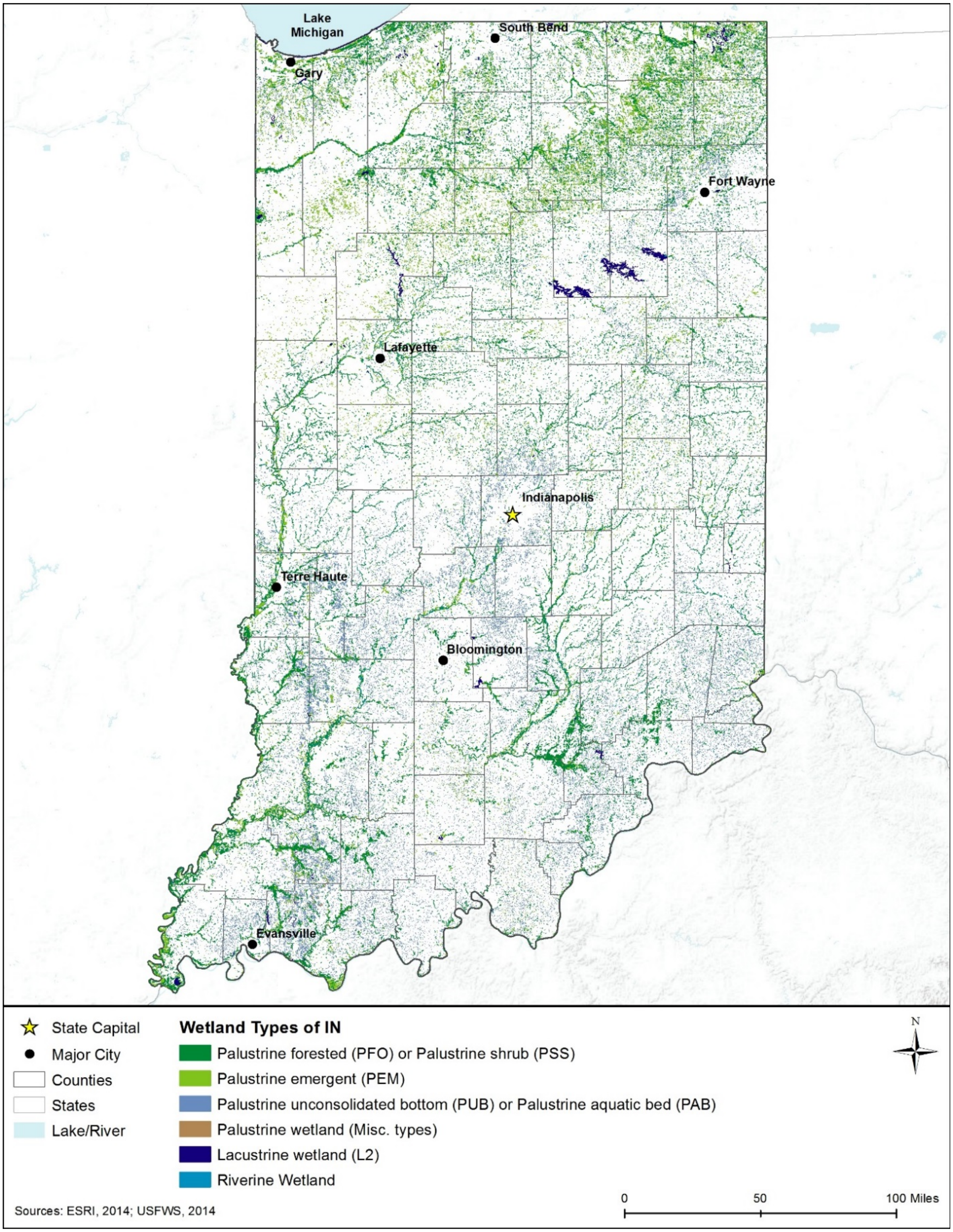


Figure 5.1.5-1: Wetlands by Type, in Indiana, 2014

5.1.5.4 Wetlands of Special Concern or Value

A group of wetland types known as 'Rare and Ecologically Important Wetland Types' receive priority protection in Indiana under 327 IAC 17-1-3(3)(B) and IC 13-11-2-25.8(a)(3)(B). These wetlands include acid bog, acid seep, circumneutral bog, circumneutral seep, cypress swamp, dune and swale, fen, forested fen, forested swamp, marl beach, muck flat, panne, sand flat, sedge meadow, shrub swamp, sinkhole pond, sinkhole swamp, wet floodplain forest, wet prairie, and wet sand prairie. Proposed impacts to these wetlands cannot be approved under the Regional General Permit or Nationwide Permit programs in Indiana. Similarly, these types of wetlands receive higher protection under Indiana's isolated wetland regulations (IC 13-11-2-25.8). If a remnant of the original wetland type remains then the wetland is still a *rare and ecologically important type.* These wetlands are described in Table 5.1.5-3.

Table 5.1.5-3: Indiana's Rare and Ecologically Important Wetland Types

Wetland Type	Description	Occurrence
Acid bog	An acidic wetland of kettle holes in glacial terrain. Bogs can be graminoid (*Carex spp.* and *Sphagnum spp.*) or low shrub (*Chamaedaphne calyculata* and *Betula pumila*). The graminoid bog can be a floating, quaking mat. The soils in acid bogs are saturated and acidic peat. Bogs have non-flowing or very slow flowing water. The water level fluctuates seasonally. When a sphagnum mat floats, it rises and falls with the water table.	Northern Indiana
Acid seep	Bog-like wetland typically found in unglaciated hill regions. This community is a small groundwater-fed wetland located primarily in upland terrain with acidic soil. A thin layer of muck may lie over a mineral substrate. This seep community is characterized by flowing water during at least part of the year.	Southern Indiana
Circumneutral bog	Bog-like wetland that receives groundwater. Circumneutral bogs can be a mosaic of tall shrub bog, graminoid bog, and other communities. The soils are usually peat, or other low nutrient organic substrates, which are saturated and circumneutral to slightly acid. Circumneutral bogs have non-flowing or very slow flowing water. The water level fluctuates seasonally.	Northern Indiana
Circumneutral seep (or seep-spring)	A groundwater-fed wetland on organic soil. Primarily herbaceous including species such as marsh marigold (*Caltha palustris)* and skunk cabbage *(Symplocarpus foetidus)* with a scattered tree canopy. Typically situated on or near the base of a slope. The soil is typically circumneutral muck and characterized by slowly flowing water during at least part of the year.	Scattered throughout Indiana
Bald cypress swamps	Seasonally to permanently inundated wetlands found in depressions and sloughs of large bottomlands associated with the Wabash/Ohio River system. Poorly to very poorly drained soils characterize this environment. Bald cypress *(Taxodium distichum)* is present, and green ash *(Fraxinus pennsylvanica)*, silver maple *(Acer saccharinum)*, and overcup oak *(Quercus lyrata)* are usually present.	Extreme southwest Indiana

Wetland Type	Description	Occurrence
Dune and swale	An ecological system consisting of a mixture of upland (black oak sand savanna, dry to mesic sand prairie) and wetland (pond, panne, sedge meadow, marsh, wet prairie) natural communities. These communities occur in long, narrow, linear complexes, with the dry communities occupying sand ridges, and the wet communities occurring in the intervening swales. Black oak *(Quercus velutina)*, paper birch *(Betula papyrifera)*, jack pine *(Pinus banksiana)*, and prairie vegetation typically occur on the ridges, and sedges *(Cyperaceae)*, reeds *(Poaceae)*, and marsh/aquatic vegetation line are found in the swales. Water levels are directly influenced by groundwater, with the interdunal swales controlled largely by lateral flow through porous beach ridges.	Extreme northwest Indiana, near Lake Michigan
Fen	Nutrient-rich, grass- and sedge[72]-dominated emergent wetlands that are recharged from groundwater and have continuous running water.	Central and northern Indiana
Forested fen	Tree-dominated wetland on organic soil which receives groundwater. Forested fens are often a mosaic of treed areas, tall shrub areas, and herbaceous areas. A tall shrub layer is often well developed in forested fens. Indicative species typically include tamarack *(Larix laricina)*, black ash *(Fraxinus nigra)*, yellow birch *(Betula alleghaniensis)*, poison sumac *(Toxicodendron vernix)*, and red maple *(Acer rubrum)*. Forested fens occur in wet lowlands, where moraines meet outwash features or depressions. Forested fens have saturated, poorly to very poorly drained soils that are often muck, but some seasonal flooding can occur in forested fens that are especially level. This community is a late successional stage of fen or circumneutral bog.	Northern Indiana
Forested swamp	Seasonally inundated to intermittently exposed wetland of large river bottoms. Forested swamps do not receive direct flow from river flooding except under exceptional circumstances. Forested swamps occur in depressions, sloughs, and large bottomlands, typically dominated by tree species such as swamp cottonwood *(Populus heterophylla)*, green ash, and swamp white oak *(Quercus bicolor)*. In northern Indiana important tree species include black ash, yellow birch, and red maple. Poorly to very poorly drained and aerated soils characterize the swamp environment. Soils usually are mineral not muck or peat.	Throughout Indiana
Marl beach	Fen-like community located on the marly muck shorelines of lakes. Marl precipitate is evident. A thin layer of water is present in spring, but dries down in summer.	Extreme northern Indiana, primarily in the northeast
Muck flat	Shoreline and lake community possessing a unique flora of sedges and annual plants, many of which are found on the Atlantic and Gulf Coastal Plains. This community is found at the margins of lakes or covering shallow basins with a peat substrate. Muck flats can float on the water surface, but during high water periods are usually inundated. The water level of a basin fluctuates during a season or from year to year in response to the amount of precipitation. This exposes bare substrate needed for germination by species of the community.	Northern Indiana

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

Wetland Type	Description	Occurrence
Panne	Groundwater fed herbaceous wetland occupying interdunal swales near Lake Michigan. Located on the lee side of the first or second line of dunes from the lakeshore. The soil is wet, calcareous sand.	In counties bordering Lake Michigan
Sand flat	Shoreline and lake community possessing a unique flora of sedges and annual plants, many of which are also found on the Atlantic and Gulf Coastal Plains. This community is found at the margins of lakes or covering shallow basins and has a sand substrate. During high water periods sand flats at the margins of lakes or ponds are inundated. The water level of a basin fluctuates during a season or from year to year in response to the amount of precipitation.	Northern Indiana, and in the Plainville Sand Section of southwest Indiana
Sedge meadow	An herbaceous wetland typically dominated by graminoid species such as flat sedge *(Cyperus spp.)*, spike rush *(Eleocharis spp.)*, rushes *(Juncus spp.)*, and sedges *(Carex spp.)*. Sedge meadow is an herbaceous wetland of stream margins and river floodplains, and lake margins or upland depressions. Streamside sedge meadows are frequently flooded in the spring and early summer. Sedge meadows of lake margins and depressions often contain standing water during wet months and after heavy rains; during dry periods, the water level is at or just below the substrate. Usually occupies the ground between a marsh and the uplands, or a shrub swamp or wet forest. Periodic high water can kill trees and shrubs invading sedge meadows.	Northern half of the state
Shrub swamp	Shrub-dominated wetland that is seasonally inundated to intermittently exposed. This community occurs in depressions and the substrate in either mineral soils or muck, as opposed to peat which is characteristic of bogs. Shrub swamp is characterized by non-flowing or very slowly flowing water with levels that fluctuate seasonally. Shrub swamps are persistent, though considered successional. Two opportunistic native shrubs, sandbar willow (*Salix exigua*) and gray dogwood *(Cornus racemosa)*, by themselves, are not indicative of shrub swamps.	Throughout Indiana
Sinkhole ponds	Water-containing depressions in karst topography.	Found in the Mitchell Karst Plain in south-central Indiana
Sinkhole swamps	Depressions in karst topography dominated by tree or shrub species.	Sinkhole swamps are found in the Mitchell Karst Plain in south-central Indiana.
Wet floodplain forest	Broadleaf deciduous forest of river floodplains. Wet floodplain forests occur in depressions and flats on narrow to wide floodplains and also on recently exposed substrates that are frequently flooded. Wet floodplain forests are frequently flooded and may have standing water seasonally to permanently present.	Wet floodplain forests occur statewide
Wet prairie	Herbaceous wetland typically dominated by prairie cordgrass *(Spartina pectinata)*, bluejoint *(Calamagrostis canadensis)*, and sedges. Vegetation height is often 2 to 3 meters. Wet prairies occur in deep swales and the substrate ranges from very deep black mineral soils (which are high in organic matter) to muck. Ponding in spring lasts for several weeks prior to drainage.	In the Grand Prairie Natural Region, the Tipton Till Plain and the Bluffton Till Plain, with a few examples found in the Northern Lakes Natural Region

Wetland Type	Description	Occurrence
Wet sand prairie	An herbaceous wetland typically dominated by prairie cordgrass, bluejoint, and sedges. Vegetation height is often 2 to 3 meters. Wet lowland prairies occur in deep swales and the substrate is sand, sometimes mixed with muck. Flooding is a regular springtime occurrence in wet sand prairie and may last several weeks.	Northwest Indiana and in the Plainsville Sands area

Source: (IDEM, 2014b)

Important Wetland Sites in Indiana

Important wetland sites in Indiana are often protected under easements, agreements, or other programs. Wetlands protected under easements or agreements through voluntary government programs and resource conservation groups are found across the state. These include Natural Resources Conservation Service (NRCS) Agricultural Conservation Easement Program, and easements managed by natural resource conservation groups such as state land trusts, The Nature Conservancy, USFWS, and Little River Wetlands Project, Inc. According to the National Conservation Easement Database, a national electronic repository of government and privately held conservation easements (http://conservationeasement.us/), NRCS holds more than 70,340 acres in conservation easements in Indiana (NCED, 2015).

5.1.6. Biological Resources

5.1.6.1 Definition of the Resource

This section describes the biological resources of Indiana. Biological resources include terrestrial[73] vegetation, wildlife, fisheries and aquatic[74] habitats, and threatened[75] and endangered[76] species as well as species of conservation concern. Wildlife habitat and associated biological ecosystems are also important components of biological resources. Indiana supports a wide diversity[77] of biological resources ranging from large tracts of contiguous hardwood forests in the southern portion of the state to wetlands, bogs, and prairies in the northern portion of the state. Each of these topics is discussed in more detail below.

5.1.6.2 Specific Regulatory Considerations

The federal laws relevant to the protection and management of biological resources in Indiana are summarized in detail in Appendix C, Environmental Laws and Regulations. Table 5.1.6-1 summarizes major state laws relevant to the biological resources of Indiana.

[73] Terrestrial: "Pertaining to land" (USEPA, 2015r).
[74] Aquatic: "Pertaining to water" (USEPA, 2015r).
[75] 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)).
[76] 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)).
[77] Diversity: "An ecological measure of the variety of organisms present in a habitat" (USEPA, 2015r).

Table 5.1.6-1: Relevant Indiana Biological Resources Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Indiana Nongame and Endangered Species Conservation Act (Indiana Code [IC] 14-22-34)	IDNR	Protects endangered and threatened species and their habitats. A review of the Indiana listed species is required every 5 years, ensuring that it is kept up-to-date.
Aquatic Invasive Species Possession Rules (IAC 9-6-7)	IDNR	Requires transport permits for certain species and deems it illegal possess, propagate, buy, sell, barter, trade, transfer, loan, or release into public or private waters prohibited exotic species in order to protect against harmful invasive species and to ensure the health and viability of native and recreational species.
Indiana Noxious Weed Law (IC 15-16-7-2)	Indiana Department of Agriculture	Each county has a county weed control board to develop and coordinate a program for the control and eradication of noxious weeds.
Indiana Exotic Weed Law (IC 14-8-2-87.5).	IDNR	Deems it illegal to buy, sell, offer for sale, distribute or plant seeds, plants or plant parts of exotic weeds without a permit issued by the IDNR.
Indiana Administrative Code IAC 9-5-1	IDNR	Regulates collection, take, and possession of reptiles and amphibians in Indiana.
IC 14-24 (Entomology and Plant Pathology)	IDNR	Prohibits anyone from collecting, transporting, importing, exporting, moving, buying, selling, distributing, propagating or releasing any living insect pests, plant diseases, or plant material infested with insect pests or plant diseases.

5.1.6.3 Terrestrial Vegetation

The distribution of flora[78] within the state is a function of the characteristic geology,[79] soils, climate,[80] and water of a given geographic area and correlates with distinct areas identified as ecoregions.[81] 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; they depict a general area with similar ecosystem types, functions, and qualities (National Wildlife Federation, 2015) (USDA, 2015a) (World Wildlife Fund, 2015). Ecoregion boundaries often coincide with physiographic[82] regions of an area. In Indiana, the climate is roughly similar throughout the state. The three main geographic regions of Indiana include the Northern Lakes and Moraines, the Central Till Plains, and the Southern Hills and Lowlands. The ecoregions mapped by the USEPA are the

[78] The plants of a particular region, habitat, or geological period.

[79] 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 ground-water availability.

[80] 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, 2015r)

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

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

most commonly referenced, although individual states and organizations have also developed ecoregions that may differ slightly from those designated by the USEPA.

The USEPA divides North America into 15 broad Level I ecoregions. These Level I ecoregions are further divided into 50 Level II ecoregions. These Level II ecoregions are further divided into 182 smaller Level III ecoregions. This Section provides an overview of the terrestrial vegetation resources for Indiana at USEPA Level III. (USEPA, 2016d)

As shown in Figure 5.1.6-1, the USEPA divides Indiana into six Level III ecoregions. The six ecoregions support a variety of different plant communities, and boundaries for these ecoregions are considered transitional. In general, the vegetation is more forested and the topography more rugged in the southern portion of the state, and prairie fauna and the topographical influences of glaciers are more common in the northern part of Indiana. Table 5.1.6-2 provides a summary of the general abiotic characteristics, vegetative communities, and the typical vegetation found within each of the six Indiana ecoregions (Woods et al, 1998).

Communities of Concern

Indiana 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[83] that could result from implementation of a Proposed Action.

The IDNR 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 IDNR ranking system assesses rarity using a state rank (S1, S2, S3, S4, S5) that indicates its rarity within Indiana. Communities ranked as an S1 by the IDNR are considered critically imperiled and of the greatest concern. This rank is typically based on the range of the community, the number of occurrences, the viability of the occurrences, recent trends, and the vulnerability of the community. As new data become available, ranks are revised as necessary to reflect the most current information (IDNR, 2015a).

[83] Community: "In ecology, an assemblage of populations of different species within a specified location in space and time. Sometimes, a particular subgrouping may be specified, such as the fish community in a lake or the soil arthropod community in a forest" (USEPA, 2015r).

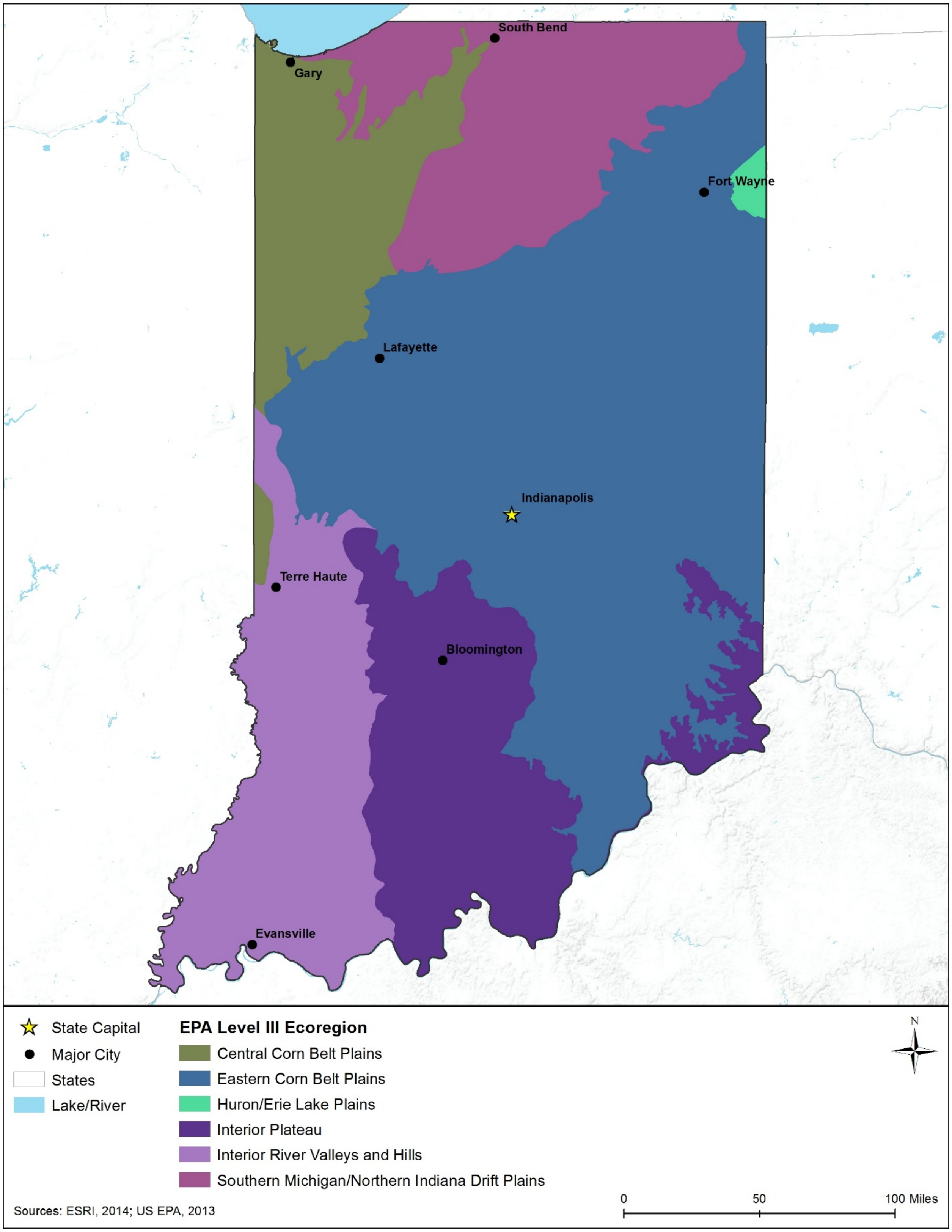


Figure 5.1.6-1: USEPA Level III Ecoregions of Indiana

Table 5.1.6-2: USEPA Level III Ecoregions of Indiana

Ecoregion Number	Ecoregion Name	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
Geographic Region: Northern Lakes and Moraines				
54	Central Corn Belt Plains	Composed of a vast glaciated plains once dominated by prairie. Marshes and pothole lakes are common.	Tall-grass prairie in uplands and river valleys and moraines containing forests	**Forbs/Grasses –** Big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), prairie dropseed (*Sporobolus heterolepis*), prairie violet (*Viola pedatifida*)
56	Southern Michigan/Northern Indiana Drift Plains	A region containing numerous natural lakes combined with a flat agricultural dominated plain. The region is also characterized by numerous marshes and northern swamp forests.	Northern Swamp Forest	**Hardwood Trees** – Silver maple (*Acer saccharinum*), red maple (*Acer rubrum*), green ash (*Fraxinus pennsylvanica*), American elm (*Ulmus americana*)
Geographic Region: Central Till Plains				
55	Eastern Corn Belt Plains	A rolling glaciated plain with more natural tree cover and lighter colored soils compared to the Central Corn Belt Plains. Land use is dominated by extensive corn, soybean and livestock production.	Beech Maple Forest	**Hardwood Trees** – Sugar maple (*Acer saccharum*), American beech (*Fagus grandifolia*), basswood (*Tilia*)
57	Huron/Erie Lake Plains	A fertile flat plain containing scattered relic sand dunes and beach ridges. Natural soil drainage is poor and contained numerous elm-ash swamp forests before cropland conversion.	Elm-Ash Swamp Forest, Swamp Oak Forest	**Hardwood Trees –** White Ash (*Fraxinus americana*), American elm, swamp white oak (*Quercus bicolor*), silver maple, and bur oak (*Quercus macrocarpa*)
Geographic Region: Southern Hills and Lowlands				
55	Eastern Corn Belt Plains	A rolling glaciated plain with more natural tree cover and lighter colored soils compared to the Central Corn Belt Plains. Land use is dominated by extensive corn, soybean and livestock production.	Beech Maple Forest	**Hardwood Trees –** Sugar maple, American beech, basswood

Ecoregion Number	Ecoregion Name	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
72	Interior River Valleys and Hills	This region is between the forested Ozark Highlands and the flatter and less forested Central Corn Belt. This glacier-carved region is characterized by wide and flat-bottomed valleys.	Beech-Maple Forests, Woodlands, Marshes and Swamps	**Hardwood Trees –** Sugar maple, American beech, silver maple, American elm, green ash, basswood, red oak (*Quercus rubra*), cottonwood (*Populus deltoids*), bitternut hickory (*Carya cordiformis*), white oak (*Quercus alba*), river birch (*Betula nigra*)
71	Interior Plateau	Greater relief and elevation than other ecoregions in the state. Soils are primarily derived from loess and residuum of underlying sandstone, siltstone, shale, and limestone (glacial till uncommon). Remains mostly forested.	Oak-Hickory Forest	**Hardwood Trees –** black oak (*Quercus velutina*), white oak, bur oak, northern pin oak (*Quercus ellipsoidalis*), chestnut oak (*Quercus prinus*), pignut hickory (*Carya glabra*), bitternut hickory, shagbark hickory (*Carya ovata*)

Sources: (USEPA, 2015r) (Fenneman, 1916)

Eighteen natural communities are ranked as S1 communities[84] in Indiana; these communities represent the rarest terrestrial habitat in the state (IDNR, 2015a). These communities occur throughout the all three geographic regions of the state.

Nuisance and Invasive Plants

There are a large number of undesirable plant species that are considered nuisance and invasive[85] plants. 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 areas, forest management, natural, and other open areas (U.S. Government Printing Office, 2011). The U.S. government has designated certain plant species as noxious weeds in accordance with the Plant Protection Act of 2000 (7 U.S.C. 7701 *et seq.*). As of September 2014, 112 federally recognized noxious weed species have been catalogued in the U.S. (88 terrestrial, 19 aquatic, and 5 parasitic) (USDA, 2014), of which nine are known to occur in Indiana.

Noxious weeds and other invasive plants pose a large threat to Indiana's agricultural and natural resources. Noxious weeds can have adverse ecological and economic impacts to these resources by displacing native species, degrading wildlife habitat, and increasing soil erosion.[86] The Indiana Noxious Weed Law (IC 15-16-7-2) stipulates that the IDA be responsible for the establishment of the statewide noxious weed list and updates to that list, as necessary. In addition, the Act further stipulates that each county is responsible for implementing and enforcing noxious weed management through a county weed control board. Indiana also regulates exotic weeds under the Exotic Weed Law (IC 14-8-2-87.5). A total of nine state-listed noxious weeds/complexes are regulated in Indiana. Of these species/complexes, seven are terrestrial and two are aquatic species. The following species by vegetation type are regulated in Indiana.

- **Aquatic –** purple loosestrife (*Lythrum salicaria*), Brazilian elodea (*Egeria densa*)
- **Shrubs –** multiflora rose (*Rosa multiflora*)
- **Terrestrial Forbs and Grasses –** Canada thistle (*Cirsium arvense*), Johnson grass (*Sorghum halepense*), Columbus grass (*Sorghum almum*), Bur cucumber (*Sicyos angulatus*), Shattercane (*Sorghum bicolor*), Marijuana (*Cannabis spp.*)

[84] S1 – Communities at high risk because of extremely limited and/or rapidly declining population numbers, range, and/or habitat, making it highly vulnerable to global extinction or extirpation in the state (IDFW, 2015).

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

[86] Erosion: "The general process or the group of processes whereby the materials of Earth's crust are loosened, dissolved, or worn away and simultaneously moved from one place to another, by natural agencies, which include weathering, solution, corrosion, and transportation" (USEPA, 2015r).

5.1.6.4 Terrestrial Wildlife

This section discusses the terrestrial wildlife species in Indiana, divided among mammals[87], birds,[88] reptiles,[89] amphibians,[90] and invertebrates.[91] 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, nongame animals, game birds, waterfowl, and migratory birds as well as their habitats within Indiana. 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. According to Indiana University of Indiana Extension (UIE) the state is home to approximately 57 mammal species, 55 reptile species, 41 amphibian species, 413 resident and migratory bird species, and an unknown number invertebrates (IDNR, 2015j). (Indiana Audubon Society, 2015)

Mammals

Common and widespread mammalian species in Indiana include the white-tailed deer (*Odocoileus virginianus*), raccoon (*Procyon lotor*), Virginia opossum (*Didelphis virginiana*), eastern cottontail (*Sylvilagus floridana*), woodchuck (*Marmota monax*), and eastern chipmunk (*Tamias striatus*). Mammals such as the bobcat (*Lynx rufus*) and river otter (*Lutra canadensis*) are uncommon or rare in Indiana due to restricted habitat or secretive behavior (IDNR, 2015j).

In Indiana, white-tailed deer are classified as big game species, whereas small game species include small mammals (e.g., squirrels and rabbits), furbearers, and upland and migratory game bird. The following species of furbearers may be legally hunted or trapped in the Indiana: raccoon, red fox (*Vulpes vulpes*), gray fox (*Urocyon cinereoargenteus*), opossum, coyote (*Canis latrans*), muskrat (*Ondatra zibethicus*), long–tailed weasel (*Mustella spp.*), striped skunk (*Mephitis mephitis*), beaver (*Castor canadensis*), mink (*Mustela vison*), and river otter. The badger (*Taxidea taxus*) and bobcat are protected species in Indiana (IDNR, 2015l).

Indiana has identified 21 mammals as Species of Greatest Conservation Need (SGCN). Three of these species, all bats, are federally listed as endangered under the ESA. Section 5.1.6.6, Threatened and Endangered Species, identifies these protected species. The SGCN list consists of at-risk species that are rare or declining, and can provide funding from State Wildlife Grants for efforts to reduce their potential to be listed as endangered. Although these species have been targeted for conservation, they are not currently under legal protection, with the exception of

[87] 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, 2015r).

[88] Birds: “Warm-blooded vertebrates possessing feathers and belonging to the class Aves” (USEPA, 2015r).

[89] Reptile: “Cold-blooded, air-breathing vertebrates belonging to the class Reptilia, usually covered with external scales or bony plates” (USEPA, 2015r).

[90] 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, 2015r)

[91] Invertebrates: “Animals without backbones: e.g., insects, spiders, crayfish, worms, snails, mussels, clams, etc.” (USEPA, 2015r).

those also listed under the ESA or the Indiana NGESCA. The SGCN list is updated periodically and is used by the elve to focus their conservation efforts and as a basis for implementing their State Wildlife Action Plan (SWAP) (IDNR, 2015m).

Birds

The number of native bird species documented in Indiana varies according to the timing of the data collection effort, changes in bird taxonomy[92], and the reporting organization's method for categorizing occurrence and determining native versus non-native status. Further, the diverse ecological communities (i.e., forests, prairies, large rivers and lakes, plains, etc.) found in Indiana support a large variety of bird species.

As of 2013, 413 species of resident and migratory birds have been documented in Indiana. Among the 413 extant[93] species in Indiana, 48 SGCN have been identified (IDNR, 2015m).

Indiana is located within the Mississippi Flyway. Covering the entire state of Indiana, the Mississippi Flyway spans from the Gulf of Mexico to the Canadian boreal forest. Large numbers of migratory birds utilize this flyway 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 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 Indiana, as can be seen in Table 5.1.6-2 (NAS, 2015). 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. They link global and continental bird conservation priorities to local sites that provide critical habitat for native bird populations. IBA priority areas are based on a number of specific criteria. Generally, global IBAs are sites determined important for

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

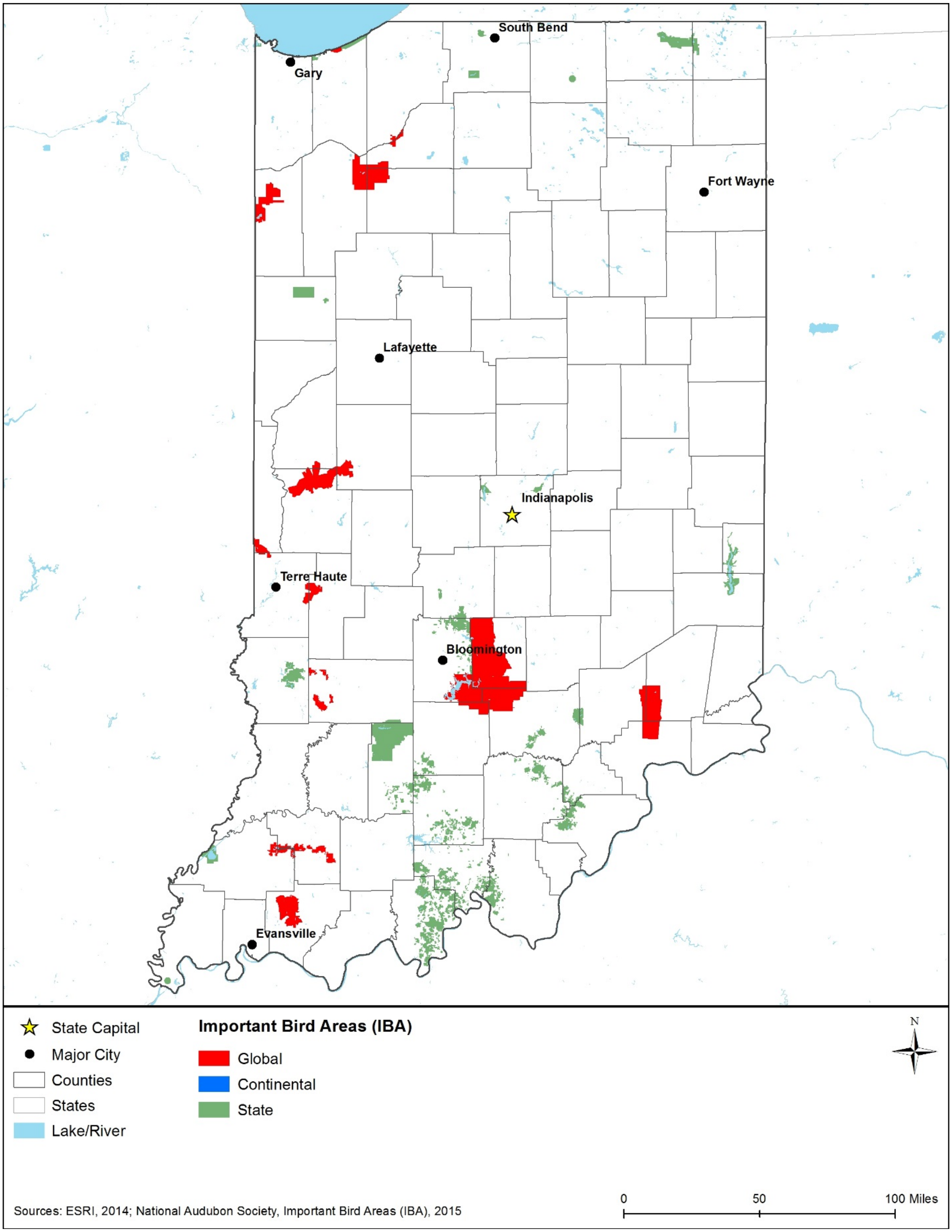


Figure 5.1.6-2: Important Bird Areas (IBA) of Indiana

globally rare species or support bird populations at a global scale. Continental IBAs are sites determined important for continentally rare species or support bird populations at a continental scale, but do not meet the criteria for a global IBA. State IBAs are sites determined important for state rare species or support local populations of birds.

According to the Indiana chapter of the National Audubon Society (NAS), a total of 41 IBAs have been identified in Indiana, including breeding,[94] migratory stop-over, feeding, and over-wintering areas, and a variety of habitats such as native grasslands, forests, and wetland/riparian[95] areas (NAS, 2015). These IBAs are widely distributed throughout the state, although the largest concentrations of IBAs in the region around Lake Michigan and the southern tip of Indiana near the confluence of the Ohio and Wabash Rivers. Many of these IBA's are an important migration stop and breeding ground for many waterfowl species.

A number of threatened and endangered birds are located in Indiana. Section 5.1.6.6, Threatened and Endangered Species, identifies these protected species.

Reptiles and Amphibians

A total of 55 native reptile and 41 amphibian species occur in Indiana, including 23 salamanders, 18 frogs and toads, 16 turtles, six lizards, and 33 snakes (IDNR, 2015j). These species occur in a wide variety of habitats throughout the state. Of the 96 native reptile and amphibian species, 13 amphibian and 19 reptile SGCN have been identified (IDEM, 2015o) (IDNR, 2015m). Collection, take, and possession of Indiana reptile and amphibian species is regulated under Indiana Administrative Code IAC 9-5-1.

There is one threatened and endangered reptile located in Indiana. Section 5.1.6.6, Threatened and Endangered Species, identifies this protected species.

Invertebrates

Indiana is home to an unknown number of invertebrates, including a wide variety of bees, hornets, wasps, butterflies, moths, beetles, flies, dragonflies, damselflies, spiders, mites, and nematodes. These invertebrates provide an abundant food source for mammals, birds, reptiles, amphibians, and other invertebrates. Terrestrial invertebrates listed as SGCN in Indiana total 497 species. "Although these species are not protected by Indiana statute, these species are included in the SWAP in order to facilitate a wider perspective on wildlife conservation and include these important organisms in the planning process" (IDNR, 2015m). In the United States, one third of all agricultural output depends on pollinators.[96] In natural systems, the size and health of the pollinator population is linked to ecosystem health, with a direct relationship between pollinator diversity and plant diversity. "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 Indiana invertebrates. Given this lack of

[94] Breeding range: "The area utilized by an organism during the reproductive phase of its lifecycle and during the time that young are reared" (USEPA, 2015r).
[95] Riparian: "Referring to the areas adjacent to rivers and streams with a differing density, diversity, and productivity of plant and animal species relative to nearby uplands" (USEPA, 2015r).
[96] Pollinators: "Animals or insects that transfer pollen from plant to plant" (USEPA, 2015r).

information on invertebrate species within the state, Indiana has chosen to focus identification on SGCN.

Invasive Wildlife Species

Indiana has adopted regulations that prohibit or regulate the possession, transport, importation, sale, purchase, and introduction of select terrestrial wildlife species. Indiana regulations are limited to invasive insects. Invasive insects pose a large threat to Indiana's forest and agricultural resources. Insect pests and plant diseases are regulated under the IC 14-24 (Entomology and Plant Pathology). The regulation applies to all insect pests and plant diseases and is not limited to specific species. Species such as the gypsy moth (*Lymantria dispar*), hemlock woolly adelgid (*Adelges tsugae*), emerald ash borer (*Agrilus planipennis*), and Asian longhorn beetle (*Anoplophora glabripennis*) are known to cause irreversible damage to native forests. Feral hogs (*Sus scrofa*) adversely impact several native large and small mammals. They feed on young mammals, destroy native vegetation resulting in erosion and water resource concerns, and could carry/transmit disease to livestock and humans (IDNR n.d.). Also, mute swans (*Cygnus olor*) could impact native waterfowl and wetland birds causing nest abandonment or impacts to rearing young due to their aggressive behavior. In addition, quarantines have been enacted in an effort to reduce the spread of many plant pests. Currently, federal quarantines are in place that restrict the transport of plant materials with the potential to contain the emerald ash borer (USDA, 2015b).

5.1.6.5 Fisheries and Aquatic Habitat

This section discusses the aquatic wildlife species in Indiana, including freshwater fish and invertebrates. A summary of non-native and/or invasive aquatic species is also presented. A distinctive feature of the Indiana landscape with regard to aquatic wildlife is the large river ecosystem of the Ohio River. No essential fish habitat (EFH) identified by the Magnuson-Stevens Fishery Conservation and Management Act exists in Indiana. There are no federally listed species of fish in the state.

Freshwater Fish

Indiana is home to approximately 209 species of freshwater fish grouped into 31 families, ranging in size from small darters and minnows to larger species such as salmon and sturgeon. A brief description of those families that contain common species, notable sport fish species, or species of concern is listed below (IDNR, 2015j).

Indiana is home to 13 species of freshwater catfishes, including the brown bullhead (*Ameiurus nebulosus*), black bullhead (*Ameriurus melas*), and the yellow bullhead (*Ameiurus natalis*). In addition, Indiana is home to five species of madtom, three of which are listed as SGCN. All are smaller members of the catfish family that rarely reach an adequate size to be targeted by fishermen. Larger members of the catfish family include the channel catfish (*Ictalurus punctatus*), flathead catfish (*Pylodictis olivaris*), and the blue catfish (*Ictalurus furcatus*). These species are widespread throughout the state and can be found in almost any habitat (IDNR, 2015j) (IDNR, 2015m).

Approximately 57 species of minnow occur in Indiana. The minnows/carps family contains the largest number of species in Indiana. Five of these species, including three species of shiner, are listed as SGCN. Common and widely distributed minnow species in Indiana include the common carp (*Cyprinus carpio*), creek chub (*Semotilus atromaculatus*), and common shiner (*Notropis cornutus*). Minnows are not typically a popular sportfish, but are a commercially important fish and an important prey source for larger fish and other wildlife (IDNR, 2015j) (IDNR, 2015m).

Thirty-three species of perches occur in Indiana, with 29 of these being darters. Seven species of darter are listed as SGCN. Darters are small members of the perch family that are not considered to be sport fish. Walleye (*Etheostoma fusiforme*) and sauger (*Sander canadensis*) are larger members of the perch family and are important sport fish in Indiana. These species are common in the large rivers, lakes, and reservoirs throughout the state (IDNR, 2015j) (IDNR, 2015m).

Three species of pike occur in Indiana waters: the muskellunge (*Esox masquinongy*), northern pike (*Esox Lucius*), and the redfin pickeral (*Esox americanus*). Red fin pickerel are smaller members of the pike family and are typically found in densely vegetated swamps. Northern pike and muskellunge are native to the northern glacial lakes of Indiana, but were introduced into other areas of the state to create fishing opportunities and are now found in bays of lakes and reservoirs with dense weed growth and submerged logs. Both the muskellunge and northern pike are voracious predators, which has made them a sport fish avidly sought after by fishermen (IDNR, 2015j) (IDNR, 2015m).

There are two species of the sturgeon family in Indiana: the shovelnose sturgeon (*Scaphirhynchus platorynchus*) and the lake sturgeon (*Acipenser fulvescens*). The lake sturgeon is listed as a SGCN. Because of their scarcity, sturgeon are no longer an important commercial fish species (Kraft et al. 2006). The depression in populations of sturgeon is the result of over-collection of these species for caviar beginning in early colonial times and loss of habitat (IDNR, 2015j) (IDNR, 2015m).

The sunfish family includes 17 species in Indiana, many of which are common throughout the state and highly popular with sport fishermen. One species, the bantam sunfish (*Lepomis symmetricus)* is listed as a SGCN. The most commonly encountered species are the bluegill (*Lepomis macrochirus*), black crappie (*Pomoxis nigromaculatus*), largemouth bass (*Micropterus salmoides*), and smallmouth bass (*Micropterus dolomieu*). These sunfish species live in a wide variety of habitats, including rocky, cool lakes streams, and reservoirs (IDNR, 2015j) (IDNR, 2015m).

Indiana waters are home to 11 species of the trout family including the brook trout (*Salvelinus fontinalis*), brown trout (*Salmo trutta*), rainbow trout (*Oncorhynchus mykiss*), and lake trout (*Salvelinus namaycush*). Two species, the lake whitefish (*Coregonus clupeaformis*) and the cisco (*Coregonus artedi*), are listed as a SGCN. Indiana is also home to coho salmon (*Oncorhynchus kisutch*) and Chinook salmon (*Oncorhynchus tshawytscha*). The majority of these species inhabit the cold waters of Lake Michigan in northwestern Indiana. Trout and Salmon are popular game fish avidly sought after by fishermen (IDNR, 2015j) (IDNR, 2015m).

Shellfish and Other Invertebrates

A total of 80 freshwater mussels are indigenous to the waters of Indiana. However, a number of these species have not been documented in the state for quite some time and are assumed to be extirpated from Indiana waters. In Indiana, 24 species of freshwater mussels are listed as SGCN (IDNR, 2015j) (IDNR, 2015m). River diversions, impoundments, and dredging activities are the primary threats to freshwater mussel species (IDNR, 2015m). A number of threatened and endangered invertebrates are located in Indiana. Section 5.1.6.6, Threatened and Endangered Species, identifies these protected species.

Freshwater mussels are an important food source for many wildlife species such as waterfowl, fish, muskrat, and other furbearers. Mussels are also important water quality indicators, as they often require streams with a high oxygen content that have not been degraded by sedimentation.

Aside from a multitude of freshwater invertebrates whose adult forms are terrestrial insects (e.g., flies, beetles, etc.), other well-known Indiana freshwater invertebrates include a variety of crayfish, fairy shrimp, amphipods, and pillbug species.

Invasive Aquatic Species

Indiana has adopted regulations that prohibit or regulate the possession, transport, importation, sale, purchase, and introduction of select aquatic invasive species. According to IAC 9-6-7 Aquatic Invasive Species Possession Rules, it is illegal to possess, sell, import, or release the following species into the waters of the state.

- **Aquatic Invertebrates –** Zebra mussels (*Dreissena polymorpha, D. bugensis*), quagga mussel *(Drissena sp.*), or Asiatic clam (*Corbicula sp.*)
- **Fish –** Black carp (Mylopharyngodaon piceus), European rudd (Scardinius erythophthalmus), Round goby (Neogobius melanostomus), Tubenose goby (Proterhinus marmoratus), Ruffe (Gymnocephalus cernuus), Silver carp (Hypophthalmichthys molitrix), Bighead carp (Hypophthalmichthys nobilis), exotic catfish, and Snakeheads (Family: Channidae)

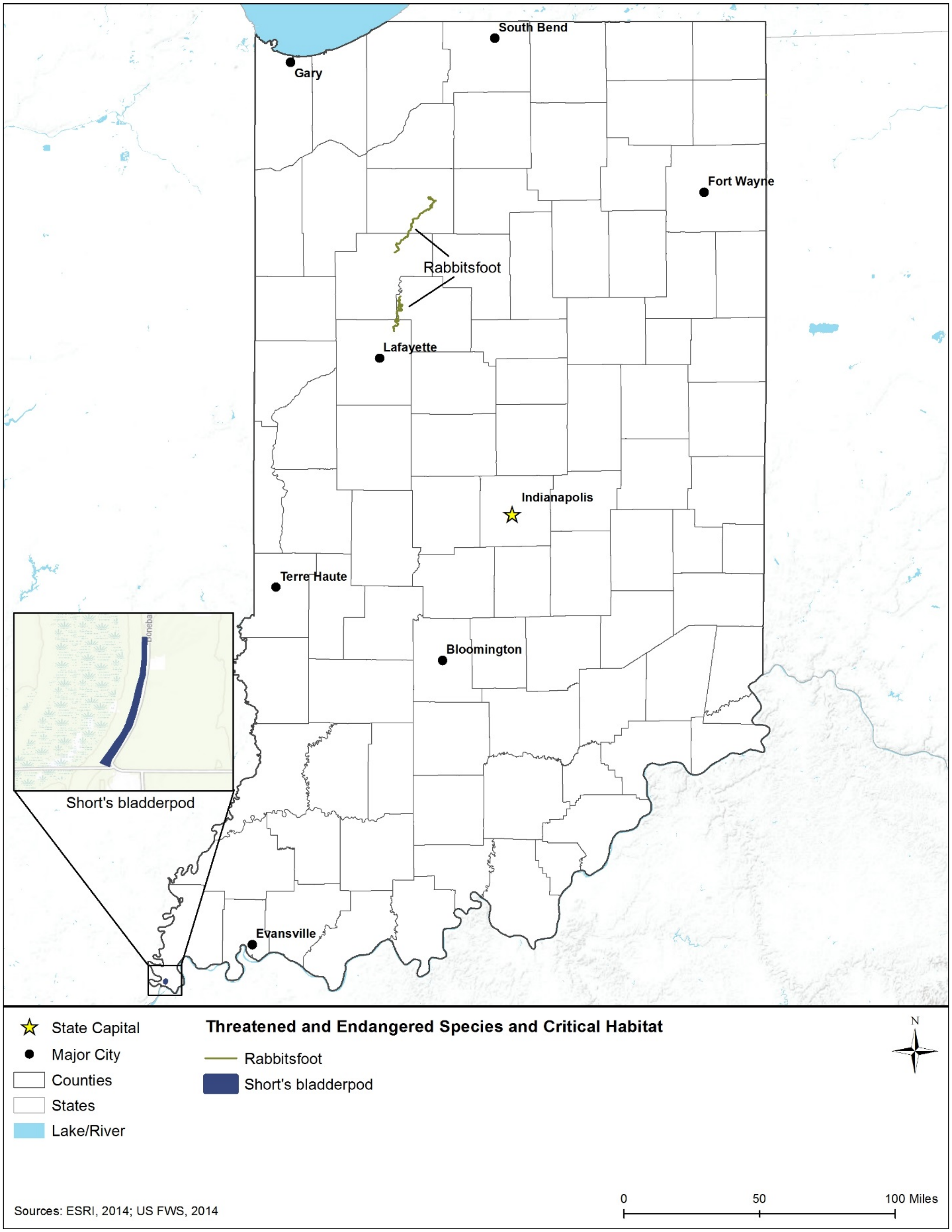


Figure 5.1.6-3: ESA Designated Critical Habitat for the Rabbitsfoot and Short's Bladderpod in Indiana

5.1.6.6 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 Indiana. The USFWS has identified 18 federally endangered and seven federally threatened species known to occur in Indiana. Of these 25 federally listed species, two of them have designated critical habitat[97] (USFWS, 2015ao). There are no candidate species[98] identified by USFWS as occurring within the state (USFWS, 2015b). The 25 federally listed species include three mammals, one reptile, three birds, 12 invertebrates, and six plants (USFWS, 2015c), and are discussed in detail under the following sections. There are no federally listed fish species in Indiana.

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

Mammals

Two endangered and one threatened mammal species are federally listed for Indiana as summarized in Table 5.1.6-3. The gray bat (*Myotis grisescens)* occurs in southern Indiana. The Indiana bat (*Myotis sodalis*) and the northern long-eared bat (*Myotis septentrionalis*) occur throughout Indiana. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Indiana is provided below.

[97] 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)).

[98] Candidate species are plants and animals that the USFWS has "sufficient information on their biological status and threats to propose them as endangered or threatened under the ESA, but for which development of a proposed listing regulation is precluded by other higher priority listing activities" (USFWS, 2014e).

Table 5.1.6-3: Federally Listed Mammal Species of Indiana

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Indiana	Habitat Description
Gray Bat	*Myotis grisescens*	E	No	Year-round in caves and mines both during hibernation and summer, foraging near waterbodies and shorelines; Utilize forested corridors to travel. Found in 5 counties in southern Indiana, next to the Ohio River.
Indiana Bat	*Myotis sodalis*	E	No	Hibernate in caves and mines, with swarming in surrounding wooded areas; summer roosting and foraging habitat in wooded stream corridors and forests/woods. Found statewide in Indiana.
Northern Long-eared Bat	*Myotis septentrionalis*	T	No	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn; roosts and forages in upland forests and woods. Found throughout Indiana.

[a] E = Endangered, T = Threatened

Source: (USFWS, 2015c)

Gray Bat. The grey bat is medium sized, insectivorous[99] bat weighing approximately 7 to 16 grams and it is longer than any other *Mytosis*. The gray bats have dark gray fur after molt in July or August and then the fur transitions to a chestnut brown. This species was federally listed as endangered in 1976 (41 FR 17736 17740, April 28, 1976). Regionally, this species is known to occur in limited geographic regions of limestone karst within southeastern states from Kansas and Oklahoma east to Virginia and North Carolina (USFWS, 1997a) (USFWS, 2015d). In Indiana, the gray bat is known to occur in five counties in the south of the state, adjacent to the Ohio River (USFWS, 2015d).

The gray bats live in caves all year, they hibernate in deep vertical caves in the winter, and roost in caves scattered along rivers the rest of the year. Most caves are in limestone karst regions and near rivers where these bats could feed on flying aquatic and terrestrial insects. Current threats to this species include human disturbance, habitat loss and degradation due to flooding, and commercialization of caves such as adding gates that alter the air flow, humidity, and temperature of caves (USFWS, 1997a).

Photo credit: USFWS

Figure 5.1.6-4: Gray Bat

Indiana Bat. The Indiana bat is a small, insectivorous mammal measuring approximately 3.0 to 3.5 inches in length with a wingspan of 9.5 to 10.5 inches. The Indiana bats have dull grayish chestnut fur and strongly resembles the more common little brown bat (*Myotis lucifugus)* (USFWS, 2006) (VGIF, 2015). The Indiana bat was originally federally listed as "in danger of extinction" under early endangered species legislation in 1967 (32 FR 4001, March 11, 1967) and was incorporated into the ESA as an endangered species (16 U.S.C §1531 *et seq*.). In 2009, only 387,000 Indiana bats were known to exist in its

[99] Insectivorous: "An animal that feeds on insects" (USEPA, 2015r).

range, less than half of the population of 1967 (USFWS, 2015e). Regionally, this species is currently found in the central portion of the eastern U.S., from Vermont west to Wisconsin, Missouri, and Arkansas, and south and east to northwest Florida. The Indiana bat is known to occur statewide in Indiana, and specifically important populations occur in Big Wyandotte Cave in Crawford County and Ray's Cave in Greene County in the southcentral and southwestern parts of the state (USFWS, 2007a) (USFWS, 2015e). Critical habitat was established in 1977 (42 FR 47840 47845, September 22, 1977) in Big Wyandotte Cave of Crawford County and Ray's Cave of Greene County in Indiana (USFWS, 1977).

In the fall, the Indiana bats migrate to their hibernation sites in caves and abandoned mines in order to mate and build up fat reserves for hibernation season in the winter. In the summer, 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 (USFWS, 2012a). The threats to this species include the disturbance and intentional killing of hibernating and maternity colonies, disturbances to air flow in caves from the improper installation of security gates, habitat fragmentation and degradation, the use of pesticides or other environmental contaminants, and White Nose Syndrome (USFWS, 2004) (USFWS, 2015e). White Nose Syndrome is a rapidly spreading fungal disease that afflicts hibernating bats (USGS-NWHC, 2015).

Northern Long-eared Bat. The northern long-eared bat is a brown furred, insectivorous bat with long ears. This bat is medium-sized, relative to other members of the genus *Myotis*, reaching a total length of 3 to 3.7 inches in length (USFWS, 2015f). The northern long-eared bat was listed as endangered in 2013 (78 FR 72058 72059, Dec. 02, 2013) and was relisted as threatened in 2015 (80 FR 17973 18033, April 02, 2015). In the U.S., its range includes most of the eastern and north central states (USFWS, 2015g). In Indiana, the northern long-eared bat is known to occur throughout the state (USFWS, 2015g).

Photo credit: USFWS

Figure 5.1.6-5: Northern Long-Eared Bat

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, 2015f).

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, 2015g). 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, 2015f).

Reptiles

One threatened reptile species is federally listed for Indiana as summarized in Table 5.1.6-4. The copperbelly water snake (*Nerodia erythrogaster neglecta*) occurs in north central and northeastern Indiana. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Indiana is provided below.

Table 5.1.6-4: Federally Listed Reptile Species of Indiana

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Indiana	Habitat Description
Copperbelly Water Snake	*Nerodia erythrogaster neglecta*	T	No	Wooded and permanently wet areas such as oxbows, sloughs, brushy ditches, and floodplain woods. Found in 3 counties in northcentral and northeastern Indiana.

[a] T = Threatened

Source: (USFWS, 2015c)

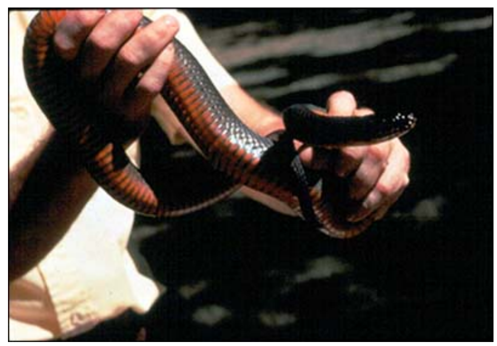


Photo credit: USFWS

Figure 5.1.6-6: Copperbelly Water Snake

Copperbelly Water Snake. The copperbelly water snake is a non-venomous snake that grows 2-4 feet in length. It has a solid, dark back and is named for the color of its belly, which is a bright red. Females of this snake species grow to be larger than the males, with animals measuring 30 inches being female (USFWS, 2015h). The northern population of the copperbelly water snake was listed as threatened in 1997 (62 FR 4183 4192, January 29, 1997) (USFWS, 2015h). These snakes inhabit shallow or floodplain wetland with nearby upland forests and hibernate from late October to early April underground, in forested wetlands, and nearby areas. They are known to travel from one wetland to the next, and require a large territory, perhaps requiring hundreds of acres (USFWS, 2008a). As the weather warms, the copperbelly water snakes emerge and become active, mating in the spring and young are born in the late fall in or near the winter burrows (USFWS, 2015h).

This snake occurs in two geographic populations – the northern population, which is protected by the Endangered Species Act, and the southern population, which is not. Both of these populations occur in Indiana, with the protected population known in three counties in the northcentral and northeast regions of the state (USFWS, 2015i).

Threats to the copperbelly water snake are primarily related to habitat fragmentation, as wetland/upland habitats have been destroyed for development and agriculture (USFWS, 2015h). Wetland/upland habitat of sufficient size is an issue, as these snakes require wetland complexes that cover many acres (USFWS, 2008a). Human destruction and collection, road crossings and poor habitat management are also threats to this snake population (USFWS, 2008a).

Birds

One endangered and two threatened bird species are federally listed for Indiana as summarized in Table 5.1.6-5. The least tern (*Sterna antillarum*) occurs in southwestern Indiana. The piping plover (*Charadrius melodus*) and the red knot (*Calidris canutus rufa*) occur in northwestern corner of Indiana. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Indiana is provided below.

Table 5.1.6-5: Federally Listed Bird Species of Indiana

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Indiana	Habitat Description
Least Tern	*Sterna antillarum*	E	No	Unvegetated sandbars near rivers, reservoirs and other open water habitat; found in Gibson, Greene, and Spencer counties, southwestern Indiana.
Piping Plover	*Charadrius melodus*	T	No	Open, sparsely vegetated beaches composed of sand or gravel on islands or shorelines of inland lakes or rivers; found on the shores of Lake Michigan in Lake, La Porte, and Porter counties, in the northwestern corner of Indiana.
Red Knot	*Calidris canutus rufa*	T	No	Intertidal marines, estuaries, and bays; found on the shores of Lake Michigan in Lake County, in the northwestern corner of Indiana.

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

Least Tern. The least tern is the smallest member of the gull and tern family. The birds are approximately 9 inches in length. Unlike gulls, terns will dive into the water for small fish. The body of least terns is predominately gray and white, with black streaking on the head. Least terns have a forked tail and narrow pointed wings. Least terns less than a year old have less distinctive black streaking on the head and less of a forked tail (USFWS, 2015k). The species was federally listed as endangered in 1985 (50 FR 21784 21792, May 28, 1985). Regionally, this species occurs across the central U.S. in 18 states. In Indiana, it can be found in Gibson, Greene, and Spencer counties, in the southwestern part of the state (USFWS, 2015k).

Suitable habitat for least terns consists of relatively unvegetated sandbars near rivers, reservoirs and other open water habitat. The primary threat to this species is the destruction and degradation of habitat. Nest disturbance and predation can also be factors. The primary causes of habitat loss historically have been dam construction, recreational activities, and the alteration of flow regimes along major river systems (USFWS, 2013b).

Piping Plover. The piping plover is a small, sand-colored migratory shorebird. It is approximately 6.5 to 7 inches in length with a wingspan up to 19 inches and weighs between 1.5 to 2.3 ounces. 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, Dec 11, 1985). Regionally, the piping plover occurs in the Northern Great Plains, along the Atlantic Coast, and in the Great Lakes Area within the U.S. (USFWS, 2001). In Indiana, it can be found on the shores of Lake Michigan in Lake, La Porte, and Porter counties, in the northwestern corner of the state (USFWS, 2015l).

This species feeds in the shorelines of ponds, lagoons, and salt marshes. They feed on worms, fly larvae, beetles, crustaceans, and other aquatic macroinvertebrates (USFWS, 1996). The preferred habitat are wide, open, sandy beaches with little vegetation. This species nests in small creeks or wetlands and create shallow nest lined with pebbles or broken shells. The female would lay an average of two to four eggs and both female and male care for them until eggs hatch (USFWS, 1996) (USFWS, 2001). Piping plovers breed in three geographic regions of North America, composed of two separate subspecies. Those breeding on the Atlantic Coast of the U.S. and Canada are of the subspecies *C. m. melodus*, whereas the other subspecies, *C. m. circumcinctus*, includes two distinct populations, one which breeds on the Northern Great Plains of the U.S. and Canada, and the other which breeds on the Great Lakes (USFWS, 2015s). Current threats to this species include habitat loss and degradation, human disturbance, pets, predation, flooding from storms, and environmental contaminants (USFWS, 1996) (USFWS, 2001).

Red Knot. The red knot is a medium-sized shorebird; it is approximately 9 inches in length with a wing span up to 20 inches, making it among the largest of the small sandpipers (USFWS, 2005a). It was recently federally listed as a threatened species in 2014 (79 FR 73705 73748, Dec 11, 2014). The red knot migrates annually from its breeding grounds above the Arctic Circle to the tip of South America where it winters. During spring and fall migration, the red knot travels in "non-stop segments of 1,500 miles and more, ending at stop sites called "staging areas." Some have been documented to fly more than 9,300 miles from south to north every spring and return south in autumn (USFWS, 2005a) (USFWS, 2014b). In Indiana, it can be found on the shores of Lake Michigan in Lake County, in the northwestern corner of the state(USFWS, 2005a)

The preferred habitat are estuaries and bays. Mussel beds are important food sources for the red knot. The red knots eat mussels and other mollusks mostly all year, however during migration season they eat horseshoe crab (*Limulus polyphemus*) (USFWS, 2005a). Current threats to the red knot include sea level rise, climate change, and reduced food availability at their migration stopover sites (USFWS, 2014b).

Invertebrates

Eleven endangered and one threatened invertebrate species are federally listed for Indiana as summarized in Table 5.1.6-6. The snuffbox mussel (*Epioblasma triquetra*) occurs in central and northern Indiana. The rabbitsfoot (*Quadrula cylindrica cylindrica*) occurs in central Indiana. The northern riffleshell (*Epioblasma torulosa rangiana*) occurs in northeast and northwest portions of Indiana. The white catspaw pearlymussel (*Epioblasma obliquata perobliqua*) occurs in northeastern Indiana. The Mitchell's satyr butterfly (*Neonympha mitchellii*) occurs in northern Indiana. The Karner blue butterfly (*Lycaeides melissa samuelis*) occurs in northwestern corner of Indiana, and the clubshell (*Pleurobema clava*) occurs in northwestern Indiana. The fanshell (*Cyprogenia stegaria*) and the rough pigtoe (*Pleurobema plenum*) occur in southern Indiana. The fat pocketbook (*Potamilus capax*) occurs in southwestern corner of Indiana. The sheepnose mussel (*Plethobasus cyphyus*) and the rayed bean (*Villosa fabalis*) occur in throughout Indiana. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Indiana is provided below.

Table 5.1.6-6: Federally Listed Invertebrate Species of Indiana

Common Name	Scientific Name	Federal Status[a]	Critical Habitat in Indiana	Habitat Description
Clubshell	*Pleurobema clava*	E	No	Clean, loose sand and gravel in rivers or stream beds of up to four inches in depth. Found in specific branches or tributaries of the Maumee and Wabash Rivers in 10 counties in northwestern Indiana.
Fanshell	*Cyprogenia stegaria*	E	No	Large rivers with sand and gravel and moderate current. Found in tributaries of the Wabash River in 10 counties, in southern Indiana.
Fat Pocketbook	*Potamilus capax*	E	No	Streams, tributaries, and channels with sand, mud, or gravel, or substrates. Found in 7 counties in the southwestern corner of Indiana.
Karner Blue Butterfly	*Lycaeides melissa samuelis*	E	No	Pine barrens and oak savannas on sandy soils and containing wild lupines (Lupinus perennis), the only known food plant of larvae. Found in Lake and Porter counties, in the northwestern corner of Indiana.
Mitchell's Satyr Butterfly	*Neonympha mitchellii*	E	No	Rare wetlands called fens; low nutrient wetlands that receive carbonate rich groundwater. Found in Lagrange and La Porte counties, in northern Indiana.
Northern Riffleshell	*Epioblasma torulosa rangiana*	E	No	Clean, firmly packed, coarse sand and gravel in riffles and streams. Found in De Kalb and Pulaski counties, in the northeast and northwest portions of Indiana.
Rabbitsfoot	*Quadrula cylindrica cylindrica*	T	Yes; Carroll, Pulaski, Tippecanoe, and White counties, Indiana.	Shallow areas of streams and rivers with sand and gravel along the banks. Found in 12 counties in central Indiana.
Rayed Bean	*Villosa fabalis*	E	No	Small headwater creeks and wave-washed areas of glacial lakes with aquatic vegetation; found in 12 counties throughout Indiana.

Common Name	Scientific Name	Federal Status[a]	Critical Habitat in Indiana	Habitat Description
Rough Pigtoe	*Pleurobema plenum*	E	No	Shoal areas of medium to large rivers, burying itself in the sand or gravel river bottom. Found in Lawrence and Martin counties, in southern Indiana.
Sheepnose Mussel	*Plethobasus cyphyus*	E	No	Shallow shoal habitats above course sand and gravel in large rivers and streams with moderate to swift currents. Found in 24 counties throughout Indiana.
Snuffbox Mussel	*Epioblasma triquetra*	E	No	Shoal habitats with swift current over sand and gravel in small to medium sized creeks, lakes, and rivers. Found in eight counties in central and northern Indiana.
White Catspaw Pearlymussel	*Epioblasma obliquata perobliqua*	E	No	Fast flowing riffles and runs over coarse gravel and sand, in small to medium-sized streams. Found in Fish Creek in De Kalb County, in northeastern Indiana.

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

Clubshell Mussel. The clubshell mussel is a federally endangered species as designated in 1993 *(*58 FR 5638 5642, January 22, 1993*)*. This brown colored mussel was historically found in the Ohio River and Maumee River basins from Pennsylvania and West Virginia to Minnesota and Michigan, but now exists in 8 to 10, small, isolated populations. In Indiana, the species is found in specific branches or tributaries of the Maumee and Wabash Rivers in 10 counties in the northwestern part of the state (USFWS, 1994) (USFWS, 2015m).

Preferred habitat for the clubshell is clean, loose sand and gravel in rivers or stream beds of up to four inches in depth. The clubshell is occurs in less than five percent of its historic range and is only found in portions of 13 streams. This species requires clean, flowing streams or small rivers to fertilize and hatch their eggs and sufficient populations of host fish where the larvae further develop until they settle in the stream bed. Threats to the species include agricultural and industrial pollution, invasive species, and changes in stream flow or impacts to fish hosts (USFWS, 1997b).

Fanshell. The fanshell is a medium-sized freshwater mussel with a subcircular light green to yellow shell with green rays (USFWS, 1991). It was federally listed as endangered in 1990 (55 FR 25591 25595, June 21, 1990). Regionally, this species in known to occur from Virginia west to Illinois and in Alabama with a non-essential experimental population in Tennessee. In Indiana, the species is known to occur in 10 counties, largely in the southern portion of the state in tributaries of the Wabash River (USFWS, 1991) (USFWS, 2015n).

Suitable habitat for the fanshell consist of large rivers with sand and gravel and moderate current. For their reproductive cycle, these mussel require stable, undisturbed habitat and host fish to complete the mussel’s larvae development. The current threats to the fanshell include dams and reservoirs, as both dams and reservoirs flood suitable habitat location reducing the abundance of sand and gravel along with the presence of host fish. Additionally, water quality degradation is another threat to the survival of the fanshell. Silt and pollution from dredging, agriculture, and industrial runoff have become a major cause for the reduction of these mussels (USFWS, 1997c).

Fat Pocketbook. The fat pocketbook is a mussel with a globose shell. This species has as smooth shell that is typically yellowish brown and lacks rays (USFWS, 1989). This species was listed as endangered in 1976 (41 FR 24062 24067, June 14, 1976).

Regionally, this species is known or believed to occur in Arkansas, Illinois, Indiana, Kentucky, Louisiana, Mississippi, and Missouri (USFWS, 2015o). In Indiana, it can be found in seven counties in the southwestern corner of the state (USFWS, 2015o). This species is typically found in streams, tributaries, and channels with sand, mud, or gravel, or substrates (USFWS, 2007b).

Threats to this species includes habitat loss and degradation due to water impoundment, channel maintenance, and dredging (USFWS, 2007b). The creation of impoundments in the fat pocketbook's range has inundated habitats and altered water flow (USFWS, 2007b). Dredging may lead to the accidental removal of individuals, increased erosion, and reduce habitat stability.

Karner Blue Butterfly. The Karner blue butterfly is a small butterfly, with a wingspan of about 1 inch long. The male's wings are a silvery or dark blue color, while the female's wings are grayish brown on the outer portions of the wing to blue on the topside, with bands of orange crescents inside the narrow black border of the wing. The Karner blue butterfly was federally listed as endangered in 1992 *(*57 FR 59236 59244, Dec 14, 1992*)* (USFWS, 2015p).

Regionally, its range extends across 12 states from Minnesota to Maine (USFWS, 2008b). In Indiana, it can be found in Lake and Porter counties, in the northwestern corner of the state (USFWS, 2015p). Two hatches occur every year, one approximately in April, and another in June. It inhabits pine barrens and oak savannas on sandy soils that contain wild lupine (*Lupinus perennis*), which is the staple food for the caterpillars. This limited food source restricts the Karner blue butterfly's distribution. Primary threats to this species include habitat loss and degradation from land development and the lack of natural disturbances from fire and grazing. These disturbances would normally maintain the early successional communities required by this species and wild lupine (USFWS, 2008b).

Mitchell's Satyr Butterfly. The Mitchell's satyr butterfly is a medium sized butterfly that has a wingspan of approximately 1.75 inches. Its wings are mostly all brown with multiple black circular spots and silver center on the lower region of both wings (USFWS, 1999). The Mitchell's satyr butterfly was federally listed as endangered in 1991 (56 FR 28825 28828, 06/25/1991). Regionally, it is known or believed to occur in Alabama, Indiana, Michigan, Mississippi, Ohio, and Virginia. In Indiana, it can be found in Lagrange and La Porte counties, in the northern part of the state (USFWS, 2015q).

Suitable habitats for the Mitchell's satyr butterfly are very restricted. These species require rare wetlands called fens. These wetlands are low nutrient wetlands that receive carbonate rich groundwater and are suitable to feed the Mitchell's satyr caterpillars as their diet consist of sedges which are various grassy plants. Little is known about the reproduction cycle but it is known that it is similar to most butterflies. The eggs are laid in leaves and hatch into caterpillars in a week, after a year the caterpillars hibernate during winter and develop to butterflies in the spring. Current threats to the survival of this species include loss of habitats, pesticides and pollutants, and butterfly collections. The habitats that this species depend on are being removed for development or are being degraded by pollution from agriculture and runoff (USFWS, 1999).

Northern Riffleshell. The northern riffleshell 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, Jan. 22, 1993). It is regionally known to occur in Indiana, Kentucky, Michigan, Ohio, Pennsylvania, and West Virginia. In Indiana, it can be found in De Kalb and Pulaski counties, in the northeast and northwest portions of the state.

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 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, 2010) (USFWS, 2015r).

Rabbitsfoot Mussel. The rabbitsfoot mussel 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, 2015u). 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 10 of the populations that exists are considered to be large enough to be viable in the long term (USFWS, 2011a) (USFWS, 2015t). Regionally, it is known or believed to occur throughout the central U.S. in 12 states. In Indiana, it can be found in 12 counties in the central part of the state (USFWS, 2015u).

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,* and *Notropis* (USFWS, 2011a).

Critical habitat was designated in 2015 (80 FR 24691 24774, April 30, 2015), in Carroll, Pulaski, Tippecanoe, and White Counties (USFWS, 2015v). 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, 2011a).

Rayed Bean Mussel. The rayed bean mussel is a small, freshwater mussel, usually less than 1.5 inches long. Its shell is green, yellowish-green, or brown colored with greenish lines (USFWS, 2015w). 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 Indiana, Michigan, New York, Ohio, Pennsylvania, and Virginia. In the lower Great Lakes systems it is known to occur in 10 streams (USFWS, 2012b). In Indiana, it can be found in 12 counties throughout the state (USFWS, 2015w).

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, 2012b). 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, 2012c).

Rough Pigtoe. The rough pigtoe is a somewhat triangular-shaped freshwater mussel. The mussel appears inflated, and has a dirty-yellow or rust-colored shell marked by uneven growth markings. The rough pigtoe was federally listed in 1976 (41 FR 24062 24067, June 14, 24067). It is only known to occur in five streams around the Mississippi watershed, including the Tennessee, Cumberland, Clinch, Green, and Barren Rivers (USFWS, 1984). Regionally, the species' range extends from western Virginia to north Alabama and southern Indiana. In Indiana, it can be found in Lawrence and Martin counties, in the southern part of the state (USFWS, 2015x).

The rough pigtoe is primarily observed in shoal areas of medium to large rivers, burying itself in the sand or gravel river bottom. Threats to the rough pigtoe include damming, the buildup of sediments, and pollution which result in habitat degradation for the species (USFWS, 1984). A recent threat includes suffocation and competition from the tiny, prolific, and exotic zebra mussel species (*Dreissena polymorpha*) (USFWS, 2015an).

Sheepnose Mussel. The sheepnose mussel is a medium sized freshwater mussel that usually grows about 5 inches. The sheepnose shell is a light yellow to dull yellowish brown with darker ridges (USFWS, 2012d). 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 mostly along the Mississippi River, but has been eliminated from two-thirds of the location where it once occurred and now only occurs in 25 streams (USFWS, 2012d) (USFWS, 2015y). Regionally, it is known or believed to occur across the central U.S. in 13 states. In Indiana, it can be found in 24 counties throughout the state (USFWS, 2015y).

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. 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, 2012d).

Snuffbox Mussel. The snuffbox mussel 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, 2012e). This species was federally listed as endangered in 2012 (77 FR 8632 8665, February 14, 2012) (USFWS, 2015z). 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, 2012e). Regionally, it is known or believed to occur across the central U.S. in 14 states. In Indiana, it can be found in eight counties in central and northern portions of the state (USFWS, 2015z).

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 required with a sufficient population of host fish such as logperch (*Percina caprodes*) and several other darters. 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, 2012e).

White Catspaw Pearlymussel. The white catspaw is a small to medium sized freshwater mussel with an exterior shell colored greenish yellow to greenish brown with green rays, and a white interior shell. It is egg-shaped and has small, triangular hinge teeth (USFWS, 1990). The White catspaw was federally listed as endangered in 1976 (41 FR 24062 24067, June 14, 1976).

Regionally, this species is known to or is believed to occur in Indiana and Ohio. In Indiana, it can be found in Fish Creek in De Kalb County, in the northeastern portion of the state (USFWS, 2015aa). It inhabits fast flowing riffles and runs over coarse gravel and sand, in small to medium-sized streams. Threats to the White catspaw are channelization for flood control and gravel dredging, construction, siltation, and runoff pollution (USFWS, 1990).

Plants

Three endangered and three threatened plant species are federally listed for Indiana as summarized in Table 5.1.6-7. The eastern prairie fringed orchid (*Platanthera leucophaea*) occurs in northwestern Indiana. The Mead's milkweed (*Asclepias meadii*) and the pitcher's thistle (*Cirsium pitcheri*) occur in the northwestern corner of Indiana. The running buffalo clover (*Trifolium stoloniferum*) occurs in southeastern Indiana. The Short's goldenrod (*Solidago shortii*) occurs in southern Indiana. The Short's bladderpod occurs in the southwestern corner of Indiana (*Physaria globosa*). Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Indiana is provided below.

Table 5.1.6-7: Federally Listed Plant Species of Indiana

Common Name	Scientific Name	Federal Status[a]	Critical Habitat in Indiana	Habitat Description
Eastern Prairie Fringed Orchid	*Platanthera leucophaea*	T	No	Wetlands and prairies with full sunlight. Found in White County, in northwestern Indiana.
Mead’s Milkweed	*Asclepias meadii*	T	No	Grasslands and stable prairie habitats. Found in Lake County in the northwestern corner of Indiana.
Pitcher's Thistle	*Cirsium pitcheri*	T	No	Active grassland dunes in sporadic population clumps; found on the shoreline of Lake Michigan in Lake and Porter counties in the northwestern corner of Indiana.

Common Name	Scientific Name	Federal Status[a]	Critical Habitat in Indiana	Habitat Description
Running Buffalo Clover	*Trifolium stoloniferum*	E	No	Disturbed mesic habitats with filtered sunlight; found in Dearborn, Ohio, Ripley, and Switzerland counties in southeastern Indiana.
Short’s Bladderpod	*Physaria globosa*	E	Yes; 20 units in Posey County, Indiana.	Steep, rocky wooded slopes, fragmented rock areas, and along the tops, bases, and ledges of cliffs and bluffs. Found in Posey County, in the southwestern corner of Indiana.
Short's Goldenrod	*Solidago shortii*	E	No	A variety of dry and mostly open areas in full sun or partial shade. Found in Harrison County, in southern Indiana.

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

Eastern Prairie Fringed Orchid. The eastern prairie fringed orchid, also known as the eastern prairie orchid, grows between 8 to 40 inches in height with a stalk of up to 40, white flowers, each with three fringed lips and a nectar tube. The species was federally listed as threatened in 1989 *(*54 FR 39857 39863, September 28, 1989*)*. Regionally, this species is known to occur sparsely from Maine south to Georgia and eastern to Illinois. In Indiana, it can be found in White County, in the northwestern part of the state (USFWS, 2015ab).

The prairie orchid grows in a variety of habitats, from wetlands to prairies and requires full sun. Seedlings require soil fungi (called mycorrhizae) to establish themselves and develop more complete root systems. Seed capsules mature over the growing season and are dispersed by the wind from late August through September. Plants may only flower once every few years (USFWS, 2015ac). Threats to the eastern prairie orchid include altered hydrology, invasive plant species, succession to woody vegetation, foot traffic, and collection (USFWS, 2012f).

Mead’s Milkweed. Mead’s milkweed is a tallgrass herb characterized by a single stem which grows up to 16 inches tall, and was listed as threatened in 1988 (53 FR 33992 33996, September 1, 1988). The species has hairless leaves, a white wax coating, and a singular cluster of flowers at the top (USFWS, 2005b). Regionally, it is known or believed to occur in Illinois, Indiana, Iowa, Kansas, Missouri, and Wisconsin. In Indiana, it can be found in Lake County in the northwestern corner of the state (USFWS, 2015ad).

Habitat for the species include drought- and fire-adapted upland tallgrass prairie or glade/barren habitat, which include stable prairie habitats. Threats to the species include habitat loss from farming and commercial development, habitat fragmentation which reduce genetic diversity and pollinators, and hay mowing, which occurs in agricultural areas and can eliminate the early stages of the species’ lifecycle (USFWS, 2005b).

Pitcher’s Thistle. The Pitcher’s thistle is an approximately 3 foot tall thistle which has many branches extending from one stem, with light pink flowers which develop from silvery leaf clusters after five to eight years of growth (USFWS, 2002). The species was listed as threatened in 1988 (53 FR 27137 27141, July 18, 1988). Regionally, the Pitcher’s thistle lines the coastlines of Lake Superior, Lake Michigan, and Lake Huron, from Michigan through Indiana and Illinois to Wisconsin. Within Indiana, it can be found on the shoreline of Lake Michigan in Lake and Porter counties in the northwestern corner of the state (USFWS, 2015ae).

Habitat for the Pitcher's thistle includes early successional beaches and active grassland dunes along freshwater shorelines, consisting of clumped populations which can be separated by large gaps in between occurrences. Threats to the species include development, recreation, erosion from high lake levels, and invasive non-native plants and insects (USFWS, 2002).

Running Buffalo Clover. The running buffalo clover is a perennial species with leaves exhibiting three leaflets and white flowers that are about 1 inch wide. This species produces runners which extend horizontally from the base of stems and can produce roots at every node (USFWS, 2015af). The running buffalo clover was federally listed as endangered in 1987 (52 FR 21478 21481, June 5, 1987).

The running buffalo clover is known or believed to occur in Arkansas, Indiana, Kentucky, Missouri, Ohio, and West Virginia. In Indiana, it can be found in Dearborn, Ohio, Ripley, and Switzerland Counties in the southeastern part of the state (USFWS, 2015ag). This species prefers disturbed mesic habitats with filtered sunlight, however this species has been located in a variety of other habitat types. The main threat to this species is direct and indirect human disturbance. Human disturbance that impacts this species includes development, removal of wildlife, and the introduction of non-native species (USFWS, 2011b).

Short's Bladderpod. The Short's bladderpod is a plant in the mustard family that can grow up to 20 inches in height. It gets its name from the globe-shaped fruits it produces. Small yellow flowers grow in clusters on top of solitary or groups of stems from April to June (USFWS, 2015ah). The Short's bladderpod was federally listed as endangered in 2014 (79 FR 44712 44718, August 1, 2014). Regionally, this species is known or believed to occur in Indiana, Kentucky, and Tennessee. In Indiana, it can be found in Posey County, in the southwestern corner of the state (USFWS, 2015ai). Critical habitat was established in 2014 (79 FR 50989 51039, August 26, 2014) in 20 units in Posey County, Indiana (USFWS, 2014c).

It inhabits steep, rocky wooded slopes, fragmented rock areas, and along the tops, bases, and ledges of cliffs and bluffs. It usually grows near rivers or streams and on south to west facing slopes. The area it inhabits in Indiana is unique; it grows within the Shawnee Hills section of the Interior Low Plateau Physiographic Province in a narrow strip of vegetation between a road and a forested bank of a cypress slough (USFWS, 2015ah). Threats to the Short's bladderpod include construction and maintenance of roads, soil erosion due to flooding and water level manipulation, shading due to forest succession, and competition due to invasive, nonnative place species (USFWS, 2014d).

Short's Goldenrod. The Short's goldenrod is a perennial herb with a single or multiple ribbed stems growing from 1.5 to 4 feet in height. The leaves grow alternately and crowded, and are largest near the middle of the stem, becoming smaller towards the top. The small, yellow flowers grow in groups of 10 to 14 on small stalks (USFWS, 1988). The Short's goldenrod was federally listed as endangered in 1985 (50 FR 36085 36089, September 5, 1985).

Regionally, it is known or believed to occur in Indiana and Kentucky. In Indiana, it can be found in Harrison County, in the southern part of the state (USFWS, 2015al). It inhabits a variety of dry and mostly open areas in full sun or partial shade. It usually grows in cedar glades, open eroded areas, and edges of woodlands. Threats to the Short's goldenrod include competition from exotic invasive species, an increase in visitors to the Blue Licks Battlefield State Resort Park, and further changes in land use such as agricultural practices, succession, and construction (USFWS, 2007c).

5.1.7. Land Use, Recreation, and Airspace

5.1.7.1 Definition of the Resources

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

Land Use and Recreation

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

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

Descriptions of land uses are presented in three primary categories: forest and woodlands, agricultural, and developed. Descriptions of land ownership are presented in four main categories: private, federal, state, and tribal. Descriptions of recreational opportunities are presented in a regional fashion, highlighting areas of recreational significance within 12 identified regions.

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 FAA is charged with the safe and efficient use of the nation's airspace and has established criteria and limits to its use.

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

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

5.1.7.2 Specific Regulatory Considerations

Land use planning in Indiana is the primary responsibility of local governments (i.e., county). The main planning tools for local governments include the comprehensive plan, zoning ordinance, and subdivision ordinance. The land use code for each county sets forth the authority for each of these tools, as granted to the counties by state-enabling legislation. The comprehensive plan proposes land uses and locations of public facilities and utilities and projects long-term population growth. The zoning ordinance sets forth the rules used to govern the land by dividing localities into zoning districts and establishes allowable uses within the districts (e.g., agriculture, industry, commercial use). The subdivision ordinance manages the process for dividing large land parcels into smaller lots.

Because the nation's airspace is governed by federal laws, there are no specific Indiana state laws that would alter the existing conditions relating to airspace for this PEIS. Indiana State Code, Title 8 Utilities and Transportation, Article 21 Aeronautics; and Article addresses safety of the airspace and flight safety at public airports to include obstructions to airspace (Indiana General Assembly, 2015c) (Indiana General Assembly, 2015d).

5.1.7.3 Land Use and Ownership

For the purposes of this analysis, Indiana is classified into primary land use groups based on land coverage type, such as forest and woodlands, agricultural, developed land, and public land/surface water/other land covers. Land ownership within Indiana is classified into four main categories: private, federal, state, and tribal land.

Land Use

Table 5.1.7-1 identifies the major land uses by coverage type in Indiana. Agricultural land comprises the largest portion of land use, with 64 percent of the land area in Indiana occupied by this category. Forest and woodland is the second largest area of land use, with 24 percent of the total land area. Developed areas account for approximately 10 percent of the total land area in Indiana. The remaining percentage of land includes public land, surface water, and other land covers, shown in Figure 5.1.7-1, that are not associated with specific land uses (USGS, 2011).

Table 5.1.7-1: Major Land Use in Indiana by Coverage Type

Land Use	Square Miles[a]	Percent of Land
Agricultural Land	22,757	64%
Forest and Woodland	8,527	24%
Developed Land	3,705	10%
Public Land, Surface Water, and other Land Covers	837	2%

[a] Square miles are rounded to the nearest whole number. The maps and tables are prepared from the analysis of GIS data and imagery; a margin of error may result 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. Other federal or state data sources may have slightly different totals.
Source: (USGS, 2011)

Agricultural Land

Agricultural land exists throughout the state on 22,757 square miles, or 64 percent of the total land area (USGS, 2011). Approximately 58,695 farms exist in Indiana, with an average size of 0.4 square miles (USDA, 2012a). Indiana’s top agricultural products are grains, oilseeds, beans, and peas (64 percent of total agricultural receipts); hogs and pigs (11 percent of total agricultural receipts); poultry and eggs (10 percent of total agricultural receipts); and milk from cows (6 percent of total agricultural receipts) (USDA, 2012b).

Forest and Woodland

Forest and woodland areas can be found throughout the state, many of them interspersed with, and adjacent to, agricultural areas. The largest concentrations of forested areas are located throughout southern portion of the state in the Southern Plains and Lowlands geographic regions. This area is comprised of rugged hills covered by deciduous and coniferous forests that support a wood-based industry that primarily produces furniture Figure 5.1.7-1) (USGS, 2011). Approximately 95 percent of Indiana’s forests contain hardwood species, such as oak, hickory, elm, ash, and cottonwood (IDNR, 2015g). Section 5.1.6 presents additional information about terrestrial vegetation.

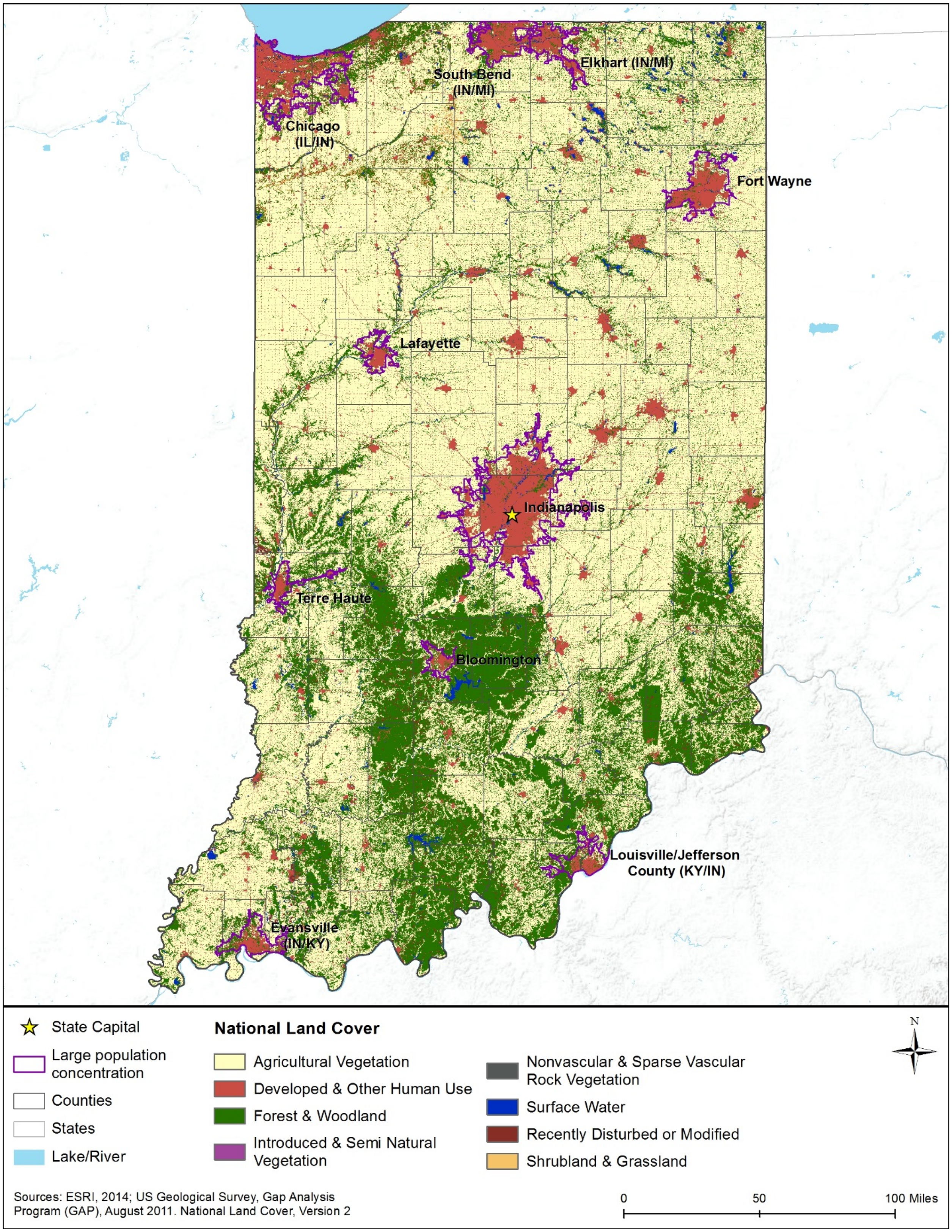


Figure 5.1.7-1: Land Use Distribution by Coverage Type

National Forests

One national forest, the Hoosier National Forest, exists in Indiana. The forest is located in the southern portion of the state and covers 314 square miles, representing four percent of the state's total forestland (USGS, 2014c). The forest is managed for multiple uses and values, including recreation activities (e.g., camping, hiking), timber production, and maintenance of fish and wildlife habitat.

State Forests

The IDNR manages 14 state forests, which are scattered primarily across the southern portion of the state and cover approximately 244 square miles. These forests are managed for multiple uses and values, including timber production, recreation, and fish and wildlife habitat protection. Table 5.1.7-2 presents the names and associated square miles of each of the 14 state forests (IDNR, 2015g).

Table 5.1.7-2: Indiana State Forests

State Forest	Square Miles
Ferdinand State Forest	12
Clark State Forest	39
Greene-Sullivan State Forest	14
Harrison-Crawford State Forest	38
Jackson-Washington State Forest	28
Martin State Forest	12
Morgan-Monroe State Forest	40
Owen-Putnam State Forest	10
Pike State Forest	8
Salamonie River State Forest	1.5
Selmier State Forest	0.5
Yellowwood State Forest	38
Starve-Hallow State Recreation Area	0.5
Deam Lake State Recreation Area	2
Total	**243.5**

Source: (IDNR, 2015g)

Private Forest and Woodland

The large majority of Indiana's forests and woodlands (approximately 87 percent) are owned collectively by 190,000 private landowners (IDNR, 2015g). Private forestlands indirectly provide some public benefit, including forest products, wildlife habitat, scenic beauty, and outdoor recreation opportunities. Scattered throughout the state, forests and woodlands on private lands often border agricultural fields, suburban neighborhoods, and national forests. For additional information regarding forest and woodland areas, see Section 5.1.6, Biological Resources and Section 5.1.8, Visual Resources.

Developed Land

Developed land in Indiana is concentrated within major metropolitan areas and surrounding cities, towns, and suburbs Figure 5.1.7-1). Although only 10 percent of Indiana's land is developed, these areas are highly utilized for residential, commercial, industrial, recreational, and government purposes. Table 5.1.7-3 lists the top five developed metropolitan areas within the state and their associated population estimates.

Table 5.1.7-3: Top Five Developed Metropolitan Areas (2014 estimate)

Metropolitan Area	Population Estimate
Indianapolis, IN	848,788
Chicago, IL/IN	589,492
Fort Wayne, IN	258,522
South Bend, MI/IN	241,870
Evansville, IN/KY	200,768
Total Estimated Population of Metropolitan Areas	**2,833,105**
Total State Estimated Population	**6,596,855**

Source: (U.S. Census Bureau, 2012)

5.1.7.4 Land Ownership

Land ownership within Indiana has been classified into four main categories: private, federal, state, and tribal (Figure 5.1.7-2).[100]

Private Land

The large majority of land in Indiana is privately owned (approximately 34,486 square miles or 96 percent of the total land in the state) (Figure 5.1.7-2), with most of this land falling under the land use categories of agricultural, forest and woodland, and developed (Figure 5.1.7-1). Highly developed, urban, metropolitan areas transition into suburban, agriculture, and woodland areas, which then transition into more wild and remote areas. Private land exists in all regions of the state.[101]

Federal Land

The federal government manages 729 square miles, or approximately two percent, of land in Indiana, including national forests, national wildlife refuges, and military facilities (Figure 5.1.7-2) (CEQ, 1997). Four federal agencies manage the majority of federal lands throughout the state (Table 5.1.7-4) (USGS, 2014c). There may be other federal lands, but they are not shown on the map due to their small size relative to the entire state.

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

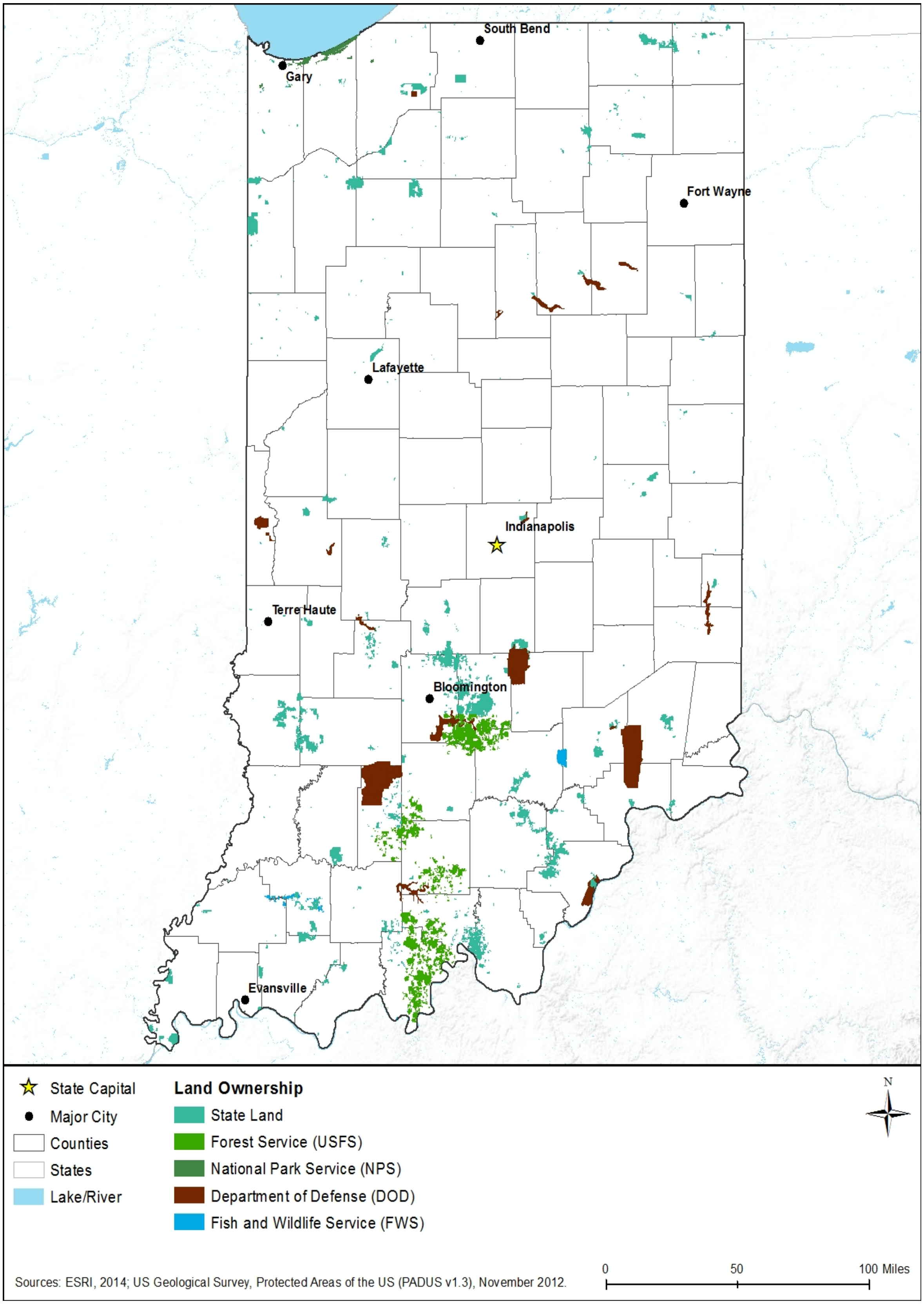


Figure 5.1.7-2: Land Ownership Distribution

Table 5.1.7-4: Federal Land in Indiana

Agency	Square Miles	Representative Type
Department of Defense (DOD)	365	Military Installations and Lakes
U.S. Forest Service (USFS)	314	Forests and Wilderness
National Park Service (NPS)	26	National Historic Park, National Memorial, and National Lakeshore
U.S. Fish and Wildlife Service (USFWS)	24	Wildlife Refuges
Total	**729**	

Source: (USGS, 2014c)

The following is a brief description of federal land ownership in Indiana:

- The Department of Defense (including the Army Corps of Engineers) manages 365 square miles of land and surface water comprised of the Indiana Arsenal Army Ammunition Plant, Grissom Air Force Base, Fort Benjamin Harrison, Crane Naval Weapons Support Center, Camp Atterbury Military Reservation, Jefferson Proving Ground, Newport Army Ammunition Plant, La Porte Outdoor Training Facility, and eight lakes (Patoka, Monroe, Brookville, Cagles Mill, Cecil M. Harden, Mississinewa, Salamonie, and Huntington Lakes) (USGS, 2014c).
- The USFS manages 314 square miles of land comprised of the Hoosier National Forest (USGS, 2014c).
- The NPS manages 26 square miles of land comprised of the George Rogers Clark National Historic Park, Lincoln Boyhood National Memorial, and Indiana Dunes National Lakeshore (NPS, 2015a).
- The USFWS manages 24 square miles of land comprised of three national wildlife refuges: Big Oaks, Muscatatuck, and Patoka River National Wildlife Refuges (USGS, 2014c).

State Land[102]

Indiana owns and manages approximately 611 square miles of land, or approximately 1.6 percent of the total land in the state Figure 5.1.7-3 (USGS, 2014c). The IDNR manages the large majority of these lands within 14 state forests, 34 state parks and lakes, 26 state fish and wildlife areas, and over 250 state nature preserves (IDNR, 2015b). State forests in Indiana are scattered across primarily the southern portion of the state and cover approximately 244 square miles. These forests are managed for multiple uses and values, including timber production, recreation, and fish and wildlife habitat protection (Table 5.1.7-2). Indiana's state parks are managed by the Division of State Parks (within the Division of Natural Resources) for general recreation. The 26 fish and wildlife areas are managed for fishing, hunting, and other recreational activities. Indiana's nature preserves cover 72 square miles and are scattered throughout the state. These areas are preserved as pristine natural areas for the public to enjoy and appreciate (IDNR, 2015b).

Tribal Land

There are no federally-recognized American Indian tribes or reservations currently in Indiana.

[102] State land use data for tables and narrative text were derived from specific state sources and may not correspond directly with USGS data that was used for developing maps and figures.

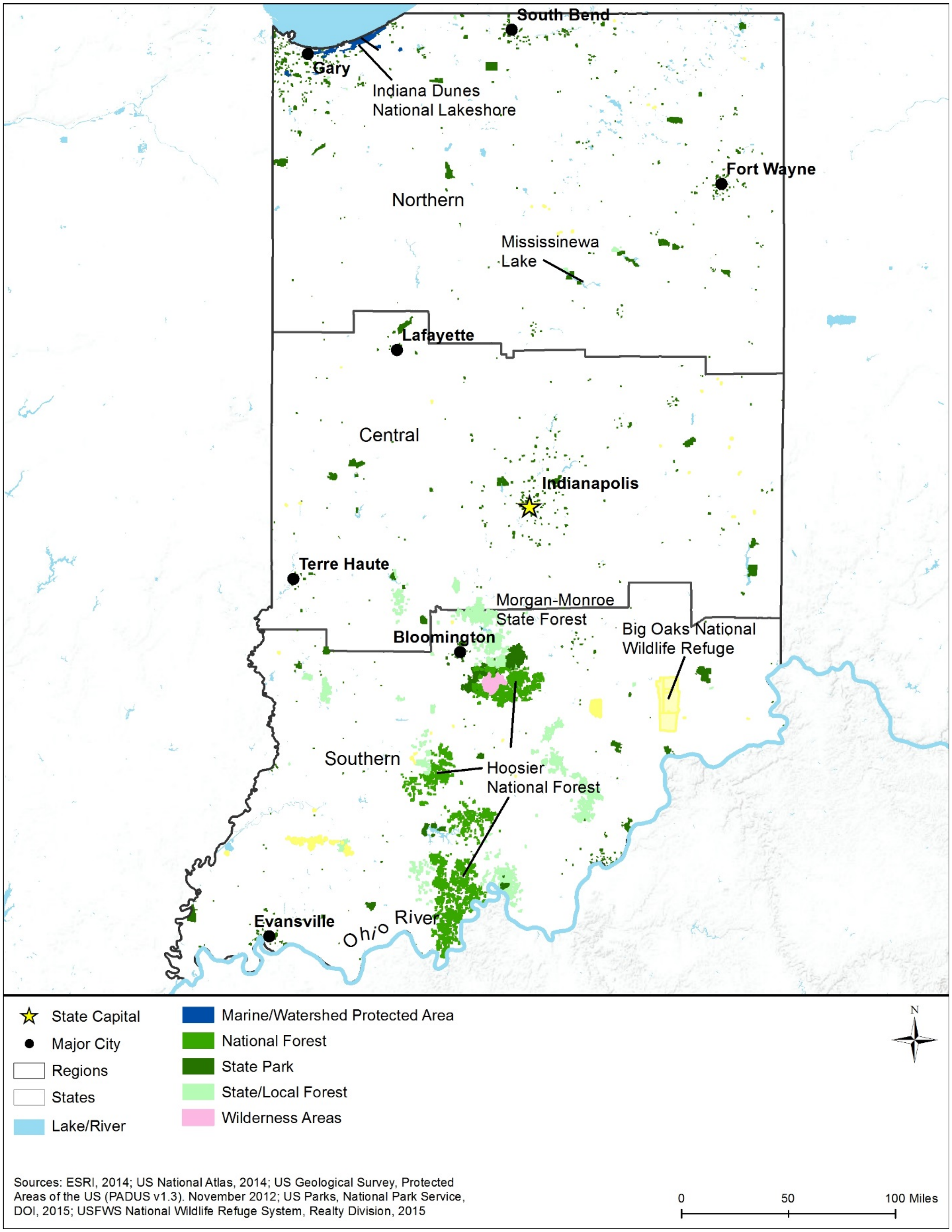


Figure 5.1.7-3: Indiana Recreation Resources

5.1.7.5 Recreation

Indiana is a geographically flat state with major recreation areas surrounding manmade reservoirs. The state is known for professional sports, especially auto racing. Indianapolis is best known as the home of the Indianapolis Motor Speedway, host of the Indianapolis 500 and other internationally-known races, with a capacity for nearly 400,000 fans (Indianapolis Motor Speedway, 2015). 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 lake or river access points. Availability of community-level facilities is typically commensurate to the population's needs.

This section discusses recreational opportunities available at various locations throughout Indiana. For information on visual resources, see Section 5.1.8, Visual Resources, and for information on the historical significance of locations, see Section 5.1.11, Cultural Resources.

Northern Region

Indiana's Northern Region is bordered by Illinois to the west, Lake Michigan and Michigan to the north, and Ohio to the east (see Figure 5.1.7-3).[103] Northern Indiana is known for small lakes, sand dunes, and ridges. The Indiana Dunes National Lakeshore, 15 miles along Lake Michigan, has swimming, beachcombing, boating, fishing, and other water activities; hiking, horseback riding, and other trail use; and camping and picnicking (NPS, 2015f).

The Mississinewa Lake, a reservoir, is one of the recreation hubs within the Northern Region. Indiana and the U.S. Army Corps of Engineers (USACE) operate nine recreation areas on the lake, with activities including swimming beaches, boating, fishing, and other water activities; hiking, bicycling, cross-country skiing, horseback riding, and other trail use; and camping and picnicking. (USACE, 2015)

Central Region

The Central Region is bordered on the west by Illinois and the Ohio River on the east, with the Wabash River a major defining feature (see Figure 5.1.7-3).

State Parks in the Central Region include Fort Harrison, Mounds, Summit Lake, Whitewater Memorial, Shades, and Turkey Run. Activities within the parks include: swimming, boating, fishing, ice fishing, and other water activities; hiking, bicycling, horseback riding, and other trail use; and camping and picnicking. Fort Harrison State Park also has a golf course. (IDNR, 2016a).

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

Southern Region

The Sothern Region is bordered the Wabash River to the west and the Ohio River to the east and south (see Figure 5.1.7-3). The region consists of hills and valleys, and is known for exposed rock formations.

Hoosier National Forest is in portions across the Southern Region of Indiana, known for features including canyons with sandstone formations, rock shelters, bluffs, and recreational lakes. The forest has swimming beaches, boating, fishing, and other water activities; hiking, horseback riding, and other trail use; camping and picnicking; and seasonal licensed hunting (USFS, 2015).

Lake Monroe, a reservoir, is surrounded by several recreation areas. Indiana operates eight state recreation areas on Lake Monroe with swimming beaches, boating, fishing, and other water activities; hiking, snowmobiling, and other trail use; camping; and seasonal licensed hunting (IDNR, 2015h). Just north of Monroe Lake, Yellowwood State Forest is known for the Horsemen's Camp and associated extensive horse trails; other activities include: hiking, leaf peeping, and other trail use; camping, picnicking, and gold panning; fishing and boating; and seasonal licensed hunting (IDNR, 2015c).

5.1.7.6 Airspace

The FAA uses the NAS to provide for aviation safety. The NAS includes Special Use Airspace (SUA) consisting of Restricted Areas, Warning Areas, and Military Operation Areas (MOAs). The FAA controls the use of the NAS with various procedures and practices (such as established flight rules and regulations, airspace management actions, and air traffic control procedures) to ensure the safety of aircraft and protection of the public.

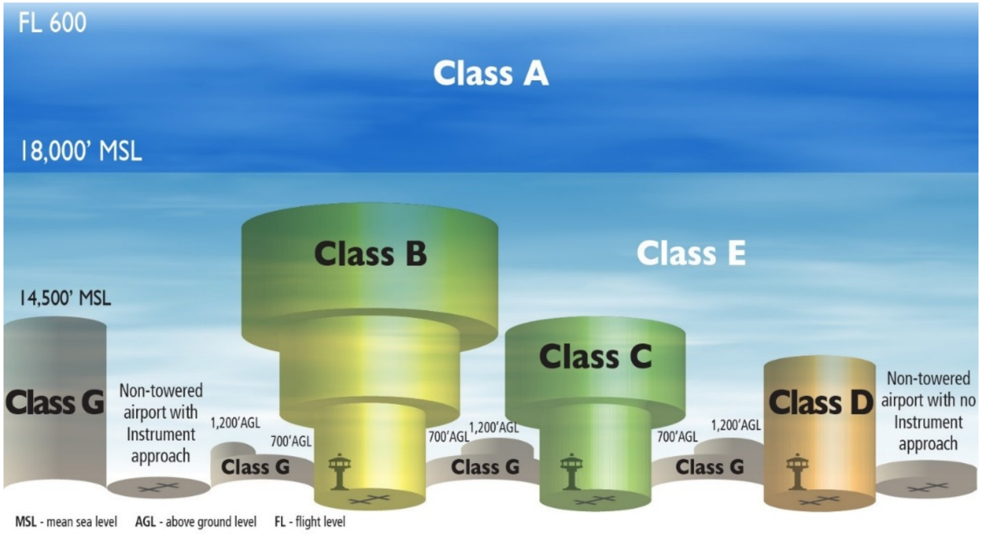
Airspace Categories

There are two categories of airspace or airspace areas:

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

Within each of these two categories, there are four types of airspace: controlled, uncontrolled, special use, and other airspace. The categories and types of airspace are dictated by the complexity or density of aircraft movements, the nature of the operations conducted within the airspace, the level of safety required, and the national and public interest. Figure 5.1.7-4 depicts the different classifications and dimensions for controlled airspace. Air Traffic Control (ATC)[104] service is based on the airspace classification (FAA, 2008).

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



Source: Derived from (FAA, 2008)

Figure 5.1.7-4: National Air Space Classification Profile

Controlled Airspace

- **Class A:** Airspace from 18,000 feet to 60,000 feet Mean Sea Level (MSL).[105] 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).[106]
- **Class B:** Airspace from the surface up to 10,000 feet MSL near the busiest airports with heavy traffic operations. The airspace is tailored to the specific airport in several layers. An ATC clearance is required for all aircraft to operate in this area.
- **Class C:** Airspace from the surface to 4,000 feet above the airport elevation surrounding the airport. Applies to airports with an operational control tower, serviced by a radar approach control, and certain number of IFR operations or total number of passengers boarding aircrafts. Airspace is tailored in layers, but usually extends out to 10 NM from 1,200 feet to 4,000 feet above the airport elevation. Entering Class C airspace requires radio contact with the controlling ATC authority, and an ATC clearance is ultimately required for landing.
- **Class D:** Airspace from the surface to 2,500 feet above the airport elevation surrounding airports with an operational control tower. Airspace area is tailored. Aircraft entering the airspace must establish and maintain radio contact with the controlling ATC.
- **Class E:** Controlled airspace not designated as Class A, B, C, or D. Class E airspace extends upward from the surface or a designated altitude to the overlying or adjacent controlled airspace (FAA, 2008).

[105] 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" (Merrriam Webster Dictionary, 2015).
[106] IFR – Rules for the conduct of flights under instrument meteorological conditions (FAA, 2015a).

Uncontrolled Airspace

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

Special Use Airspace

SUA designates specific airspace that confines or imposes limitations on aircraft activities (See Table 5.1.7-6).

Table 5.1.7-5: 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 Federal Register and are depicted on aeronautical charts."
Restricted Areas	"Airspace identified by an area on the surface of the earth within which the flight of aircraft, while not wholly prohibited, is subject to restrictions. Activities within these areas must be confined because of their nature or limitations imposed upon aircraft operations that are not a part of those activities or both. Restricted areas denote the existence of unusual, often invisible, hazards to aircraft such as artillery firing, aerial gunnery, or guided missiles. Penetration of restricted areas without authorization from the using or controlling agency may be extremely hazardous to the aircraft and its occupants. Restricted areas are published in the Federal Register and constitute 14 CFR Part 73."
Warning Areas	"Airspace of defined dimensions, extending from three NM from the U.S. coast, which contains activity that may be hazardous to nonparticipating aircraft. The purpose of such warning areas is to warn non-participating pilots of the potential danger. A warning area may be located over domestic or international waters or both."
MOAs	"Airspace of defined vertical and lateral limits established for separating certain military activities (e.g., air combat maneuvers, air intercepts, testing, etc.) from IFR traffic. Whenever an MOA is in use, non-participating IFR traffic may be cleared through a MOA if IFR separation can be provided by ATC. Otherwise, ATC will reroute or restrict nonparticipating IFR traffic."
Alert Areas	"Depicted on aeronautical charts to inform non-participating pilots of areas that may contain a high volume of pilot training or an unusual type of aerial activity. Pilots should be particularly alert when flying in these areas. All activity within an alert area must be conducted in accordance with CFRs, without waiver, and pilots of participating aircraft and pilots transiting the area are responsible for collision avoidance."
Controlled Firing Areas (CFAs)	"Activities that, if not conducted in a controlled environment, could be hazardous to nonparticipating aircraft. The distinguishing feature of the CFA, as compared to other special use airspace, is that its activities are suspended immediately when spotter aircraft, radar, or ground lookout positions indicate an aircraft might be approaching the area. There is no need to chart CFAs since they do not cause a nonparticipating aircraft to change its flight path."
National Security Areas (NSA)	"Airspace of defined vertical and lateral dimensions established at locations where there is a requirement for increased security and safety of ground facilities. Pilots are requested to voluntarily avoid flying through the depicted NSA. When it is necessary to provide a greater level of security and safety, flight in NSAs may be temporarily prohibited by regulation under the provisions of 14 CFR Section 99.7. Regulatory prohibitions are issued by System Operations, System Operations Airspace and Aeronautical Information Manual (AIM) Office, Airspace and Rules, and disseminated via Notices to Airmen (NOTAM). Inquiries about NSAs should be directed to Airspace and Rules."

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

Other Airspace Areas

Other airspace areas, explained in Table 5.1.7-6, 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 5.1.7-6: Other Airspace Designations

Type	Definition
Airport Advisory	There are three types: • Local Airport Advisory – Operated within 10 statute (5,280 feet/mile) miles of an airport where there is a Flight Service Station (FSS) located on an airport, but no operational control tower. The FSS advises the arriving and departing aircraft on particular conditions. • Remote Airport Advisory – Operated within 10 statute miles for specific high activity airports with no operational control tower. • Remote Airport Information Service – Used for short-term special events.
MTRs	MTRs are for use by the military for training, specifically low level combat tactics where low altitudes and high speed are needed.
TFRs	TFRs are established to: • Protect people and property from a hazard; • Provide safety for disaster relief aircraft during operations; • Avoid unsafe aircraft congestion associated with an incident or public interest event; • Protect the U.S. President, Vice President, and other public figures; • Provide safety for space operations; and • Protect in the State of Hawaii declared national disasters for humanitarian reasons. Only those TFRs annotated with an ending date and time of "permanent" are included in this Draft PEIS, since it indicates a longer, standing condition of the airspace. Other TFRs are typically a shorter duration of for a one-time specific event.
Parachute Jump Aircraft Operations	Parachute jump area procedures are in 14 CFR Part 105, while the U.S. parachute jump areas are contained in the regional Airport/Facility Directory.
Published VFRs and IRs	These are established routes for moving around and through complex airspace, like Class B airspace. VFRs are procedures used to conduct flights under visual conditions. IFRs are procedures used to conduct flights with instruments and meteorological conditions.
Terminal Radar Service Areas	Airspace areas that are not one of the established U.S. airspace classes. These areas provide additional radar services to pilots.

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

5.1.7.7 Aerial System Considerations

Unmanned Aerial Systems

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

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

Balloons

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

5.1.7.8 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 aboveground 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, 2015e).

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.

5.1.7.9 Indiana Airspace

The Indiana Office of Aviation is a division within the Indiana Department of Transportation (INDOT) Multimodal division. The Indiana Office of Aviation serves the aviation community by actively engaging in federal programs and policies and assessing changes as it pertains to state airport and air transportation facilities. The INDOT's Aviation division's mission is "to encourage, foster, and assist in the development of aeronautics" and "to encourage the establishment of airports, landing fields, and other navigation facilities" (INDOT, 2016a). Some of the Office of Aviation responsibilities include the following:

- "Airport Inspection and Certification
- Aviation Engineering Assistance
- Aviation Planning Assistance
- Airport Development
- Aviation Awareness
- Regulation of Tall Structures
- FAA Airport Safety Data Program
- Continuous Indiana State Aviation System Planning" (INDOT, 2016b).

There is one FAA FSDO for Indiana in Indianapolis (FAA, 2015d).

Indiana 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 assets associated with their airports. (National Association of State Aviation Officials (NASAO), 2015) Figure 5.1.7-5 presents the different aviation airports/facilities residing in Indiana, while Figure 5.1.7-6 and Figure 5.1.7-7 present the breakout by public and private airports/facilities. There are approximately 565 airports within Indiana as presented in Table 5.1.7-7 and Figure 5.1.7-5 through Figure 5.1.7-7 (DOT, 2015).

Table 5.1.7-7: Type and Number of Indiana Airports/Facilities

Type of Airport or Facility	Public	Private
Airport	99	307
Heliport	3	127
Seaplane	14	3
Ultralight	0	12
Balloonport	0	0
Gliderport	0	0
Total	**116**	**449**

Source: (DOT, 2015)

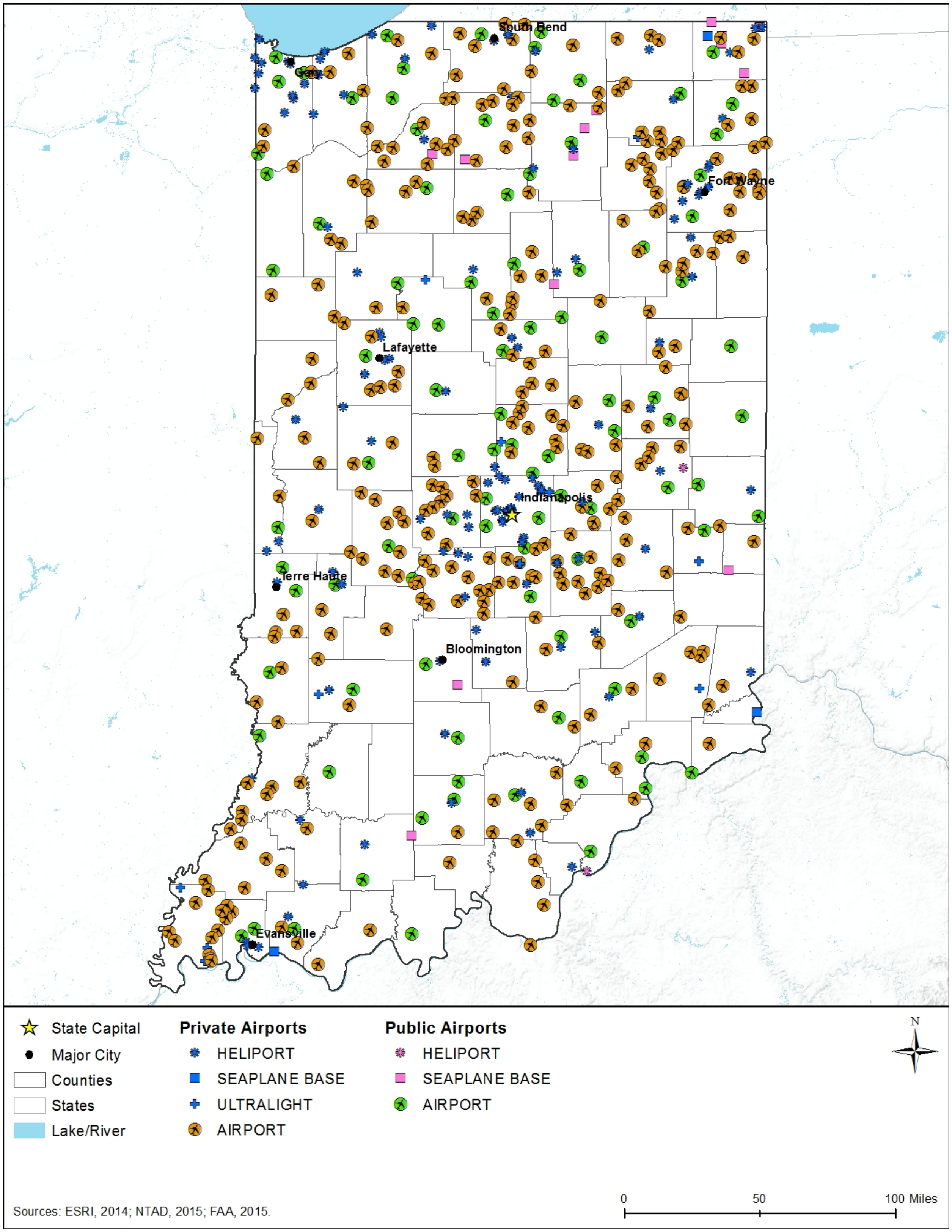


Figure 5.1.7-5: Composite of Indiana Airports/Facilities

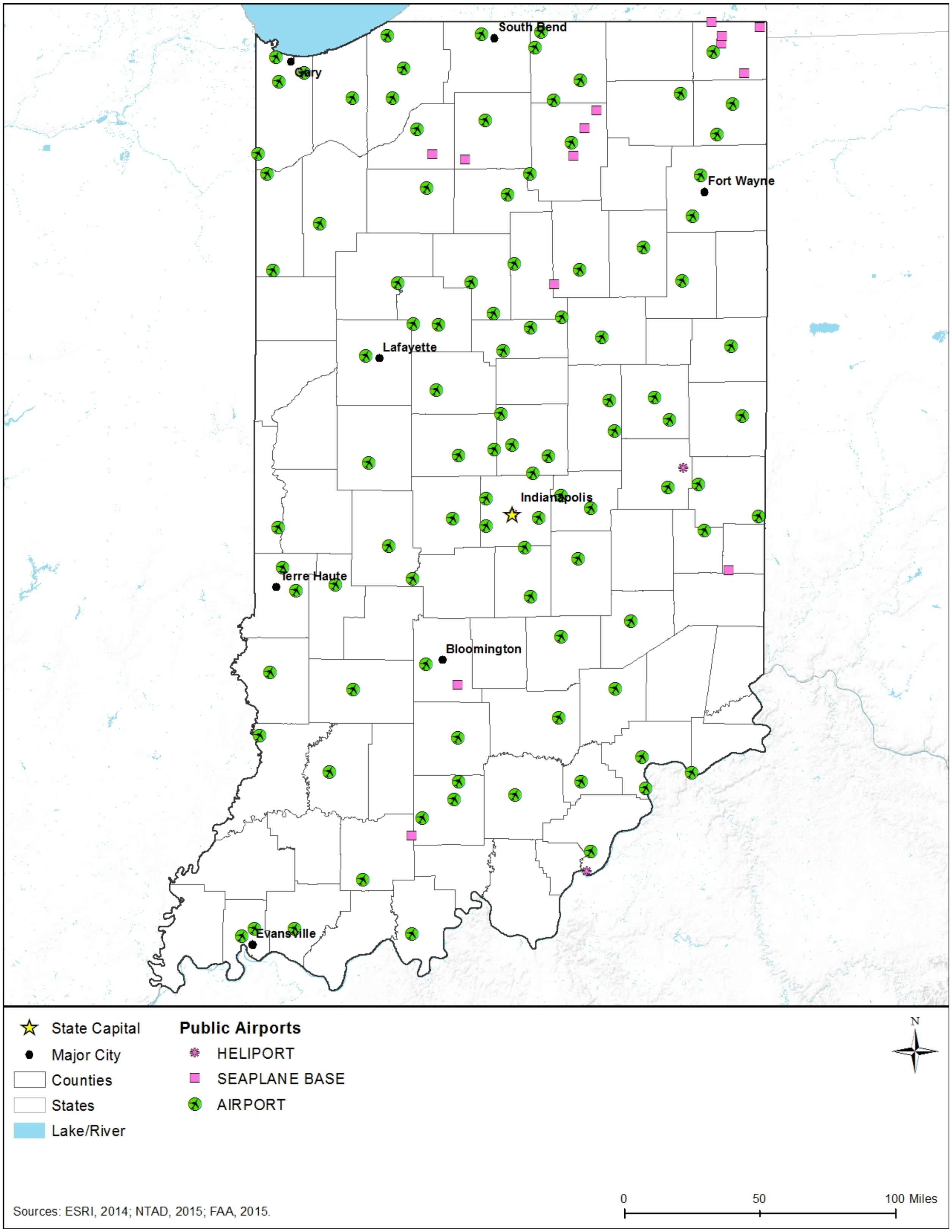


Figure 5.1.7-6: Public Indiana Airports/Facilities

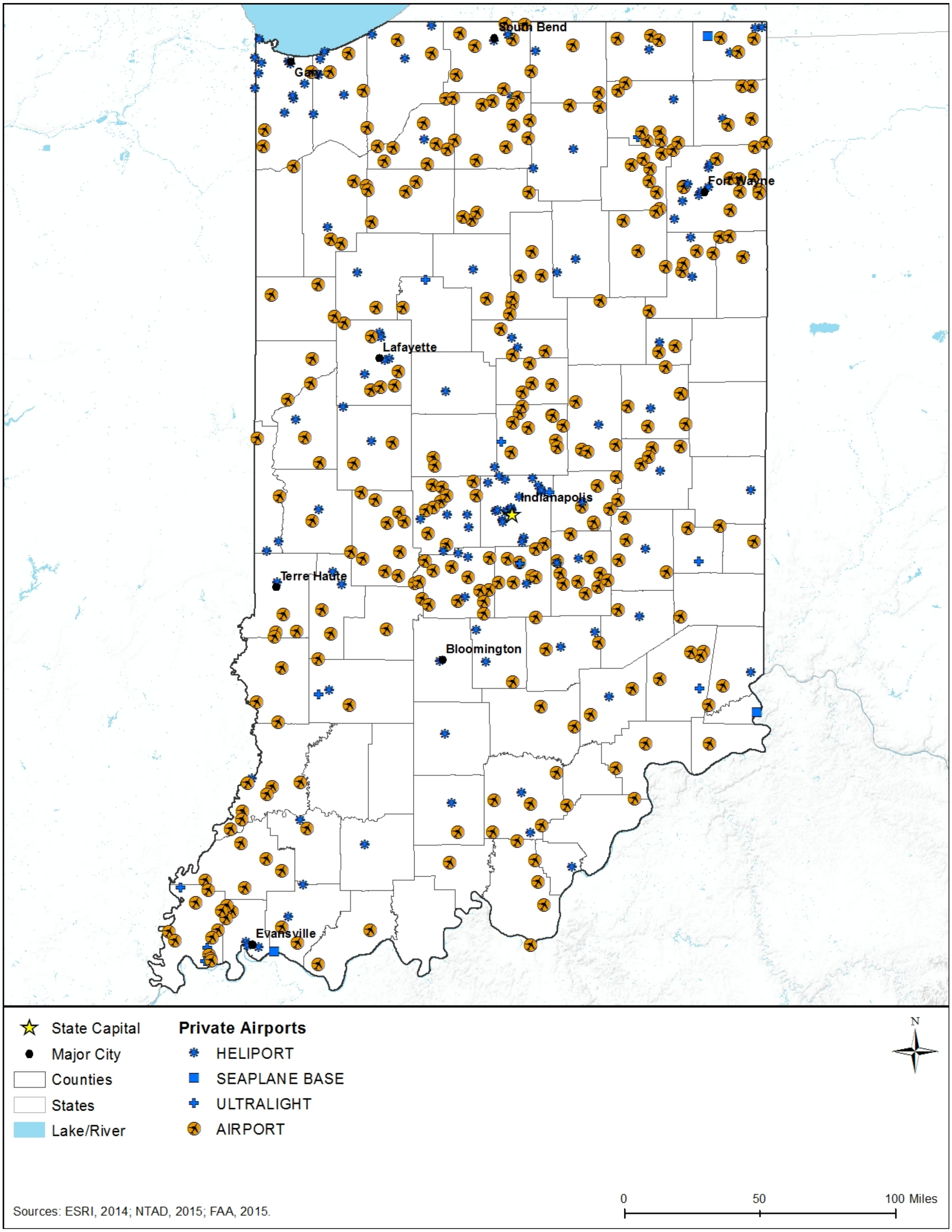


Figure 5.1.7-7: Private Indiana Airports/Facilities

There are no Class B in Indiana. Class C and D controlled airports for Indiana are as follows:

- Four Class D –
  - Evansville Regional
  - Fort Wayne International
  - Indianapolis International
  - South Bend, Michiana Regional Airport, South Bend
- Nine Class D –
  - Anderson Municipal
  - Monroe County Airport, Bloomington
  - Columbus Municipal
  - Elkhart Municipal
  - Gary Regional
  - Grissom Army Reserve Base, Peru
  - Purdue University Airport, Lafayette
  - Delaware County-Johnson Field, Muncie
  - Terre Haute International-Hulman Field Airport, Terre Haute. (FAA, 2016b)

SUAs (i.e., 6 restricted areas and 12 MOAs) located in Indiana are as follows:

- Atterbury Reserve Forces Training Area (Restricted)
  - R-3401A – Surface to 40,000 feet MSL
  - R-3401B – 1,200 feet AGL to and including 14,000 feet MSL
- Jefferson Proving Ground (JPG) (Restricted)
  - R-3403A – Surface to 43,000 feet MSL
  - R-3403B – 1,200 feet AGL to FL 180
- Crane (Restricted) –
  - R-3404 – Surface to and including 4,100 feet MSL
- Sullivan (Restricted) –
  - R-3405 – Surface up to and including 1,600 feet MSL. (FAA, 2016a)

The 12 MOAs located in Indiana are as follows:

- Hill Top – 10,000 feet MSL to, but not including, FL 180
- JPG –
  - A – 500 feet AGL up to, but not including, 6,000 feet MSL; excluding the airspace from the surface to, but not including, 4,000 feet MSL beginning at 38°39'00”N lat., 85°56'00”W long.; to 38°39'00”N lat., 86°05'13”W long.; to 38°46'00”N lat., 86° 13'00”W long.; to 38°50'34”N lat., 86°00'53”W long.; to 38°53'57”N lat., 85°51'51”W long.; thence south, southeast along the Louisville and Indiana railroad tracks; to 38°42'38”N lat., 85°46'51”W long.; to 38°40'17”N lat., 85°52'43”W long.; to point of beginning
  - B – 6,000 feet MSL up to, but not including, FL 180
  - C – 6,000 feet MSL up to, but not including, FL 180
  - D – 500 feet AGL up to, but not including, 4,000’ MSL
- Racer –
  - A – 500 feet AGL up to, but not including, 4,000 feet MSL
  - B – 4,000 feet MSL up to 8,000 feet MSL
  - C – 500 feet AGL up to, but not including, FL 180

  - D – 14,000 feet MSL up to, but not including, FL 180
- Red Hills – 6,000 feet MSL to, but not including, FL 180
- Twelve Mile –
  - East – 500 feet AGL up to, but not including, 10,000 MSL
  - West – 500 feet AGL up to, but not including, 6,000 feet MSL. (DOT, 2015)

The SUAs for Indiana are presented in Figure 5.1.7-8. There is one TFR (41895) (see Figure 5.1.7-8). There is also a National Security Area (NSA 0010)[107] located above Terre Haute (see Figure 5.1.7-8). The restrictions associated with this TFR and NSA, when active, may impact the airspace in the area. MTRs in Indiana, presented in Figure 5.1.7-9, consist of 1 Instrument Route and 11 Visual Routes.

UAS Considerations

The NPS signed a policy memorandum on June 20, 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). There are three NPA areas in Indiana that have to comply with this agency directive (NPS, 2015a).

Obstructions to Airspace Considerations

Several references in the Indiana Code address airspace hazards. As defined by the Indiana Code, an airport hazard "…means any structure, object of natural growth, or use of land, which obstructs the air space required for the flight of aircraft in landing or taking off at any airport or landing field or is otherwise hazardous to such landing or taking off (Indiana General Assembly, 2015c).

Indiana Code 8-21-12-13 (Zoning and Restrictions) regulates structures, as it obtains to potential impacts to navigable airspace. This chapter provides in part (a) "To provide free air space for the safe descent and ascent of aircraft and for the proper and safe use of an airport or landing field acquired or maintained under this chapter, the authority may establish by resolution or resolutions a restricted zone or zones of a distance in any direction from the boundaries of the district so that no building or other structure is erected high enough to interfere with the descent of an aircraft at an approach angle necessary for safety for the usual type of operation that is conducted at the airport or landing field." and the authority to " (b) …acquire by condemnation or purchase, upon the payment of due compensation, the right to prevent the erection of, and to

[107] National Security Area (NSA) consists of defined vertical and lateral dimensions in the airspace where there is increased security of ground facilities. Pilots are expected to voluntarily avoid flying through the NSA. Additional security levels may result in further restrictions of the NSA, which FAA Headquarters would issue and disseminate with a NOTAM. (FHWA, 2014b)

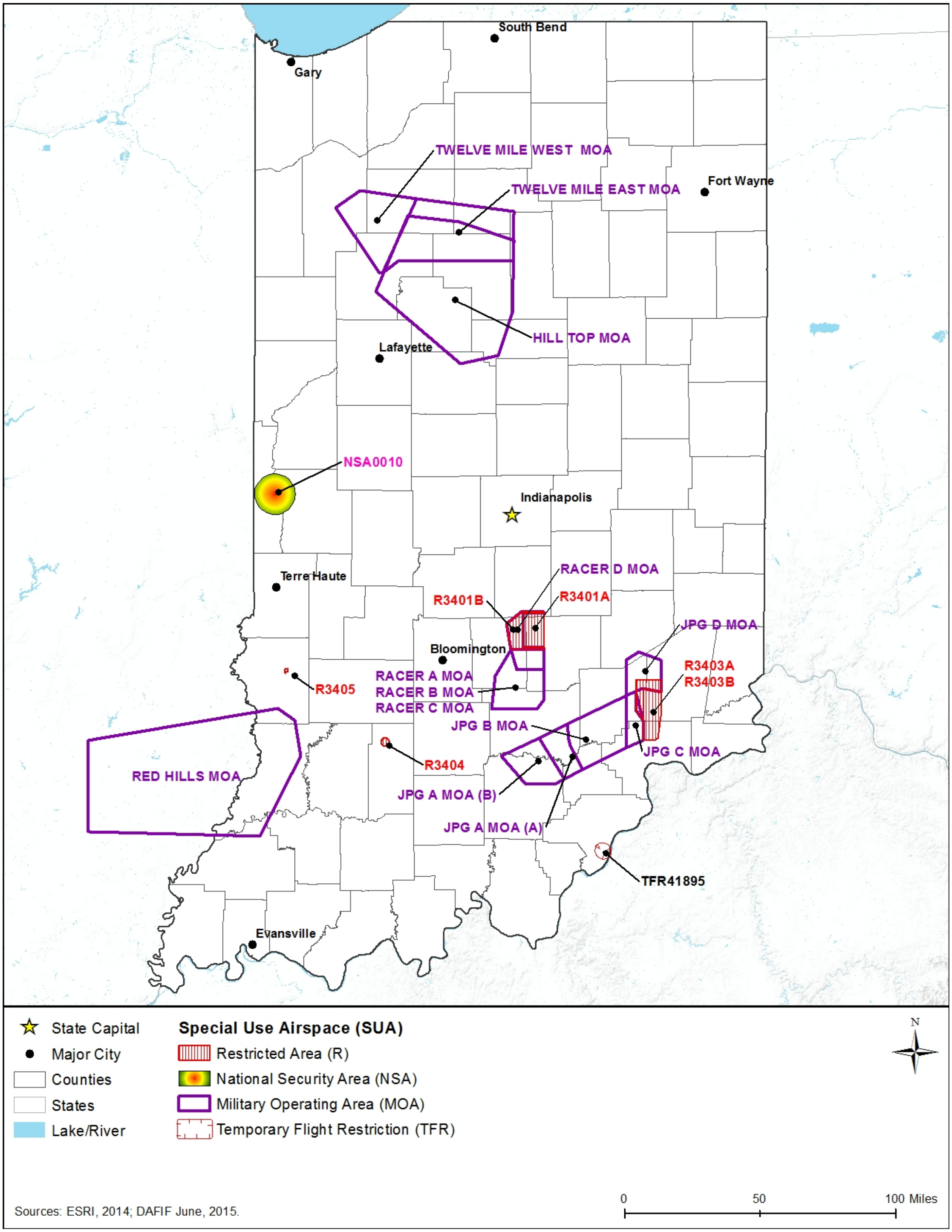


Figure 5.1.7-8: SUAs in Indiana

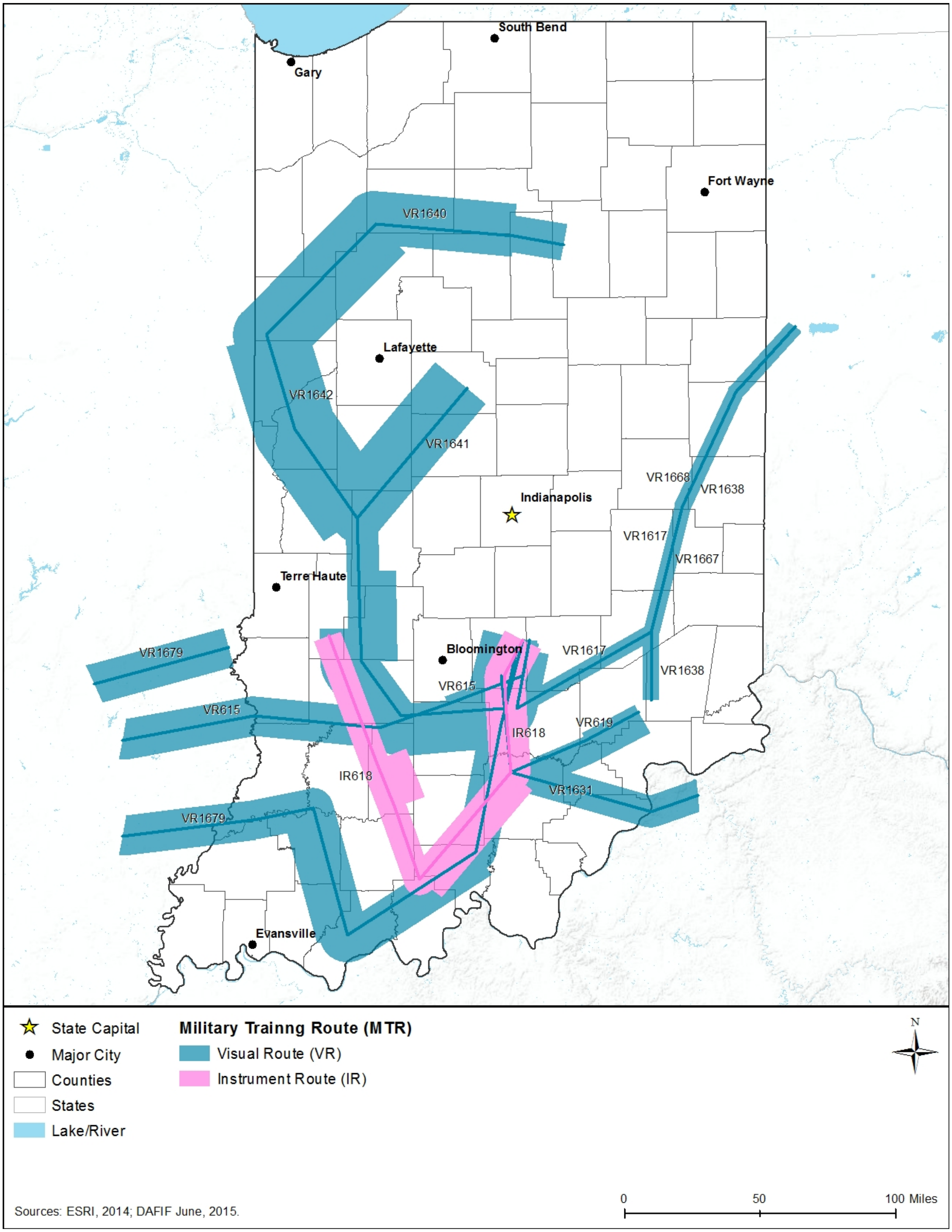


Figure 5.1.7-9: MTRs in Indiana

require the removal of, all buildings, towers, poles, wires, cables, other structures, and trees within the zone that interfere with the gliding angle or as much of any structure or trees that interfere with the gliding angles" (Indiana General Assembly, 2015f). Restrictions on the construction, alteration, addition to any structure are addressed in Indiana Code 8-21-10-3, Permit Requirements (Indiana General Assembly, 2015g).

5.1.8. Visual Resources

5.1.8.1 Definition of the Resource

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

5.1.8.2 Specific Regulatory Considerations

Table 5.1.8-1 presents state and local laws and regulations that relate to visual resources.

Table 5.1.8-1: Relevant Indiana Visual Resources Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Indiana Code 13-11-2-149.6 – Outstanding state resource water	Various state agencies	"Waters that may be considered for designation as outstanding state resource waters include water bodies that have unique or special ecological, recreational, or aesthetic significance."
Indiana Code 14-18-10-1 – Utility Easements	Various state agencies	"A person may not erect or construct a utility, telephone, or telegraph line upon or across…land acquired by the state and set aside for use by the public as a scenic or historic place…that part of a public highway right-of-way that passes through a state park, a state forest, a state game preserve, or land acquired by the state and set aside for us by the public as a scenic or historic place…unless that person has a permit from the director…"

In addition to the state laws and regulations, local zoning laws may apply related to visual resources. Viewsheds and scenic vistas are increasingly important to the state's towns, cities, and villages as they look at the future planning of their municipalities. Where counties, cities, towns, or villages have planning documents that address scenery, character, or visual resources, the placement of towers or temporary transmission structures may be required to comply with the management of those documents or provide mitigation measures to meet compliance.

5.1.8.3 Character and Visual Quality of the Existing Landscape

Indiana has a wide range of visual resources. The majority of the state is characterized as agricultural, developed, or forested (Figure 5.1.7-1 in Section 5.1.7, Land Use, Recreation, and Airspace). Lake Michigan is on the north border of the state and the Ohio River delineates the entire southern border. The Wabash River bisects the entire length of the state from the northeast to the southwest.

Agricultural lands are the most dominant landscape in the state. These areas generally have some abrupt lines and colors between crops and pastures, few tall structures (aside from grain silos and some trees), and no urban development. Lakes, rivers, wetlands, and waterfront lands in Indiana vary from vegetated riparian areas (areas located on the bank of a watercourse, lake, or tidewater) to wide, open lakeside vistas. The consistency, continuity, and lack of view obstructions from major constructed features characterizes the visual attributes of these areas. Developed areas are the second largest landscape within the state. These are comprised of the large metropolis of Indianapolis, Terre Haute, and Bloomington in the center; suburbs of Chicago, South Bend, Elkhart, and Fort Wayne in the north; and Louisville and Evansville to the south. Forested areas are the third most prevalent visual resource within the state. Visual resources within forested areas are generally comprised of continuous, natural looking cover with gradual transitions of line and color. They are typically characterized by the lack of disturbance or disruption of the landscape.

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.

5.1.8.4 Visually Important Historic Properties and Cultural Resources

Visual and aesthetic qualities of historic properties can contribute to the overall importance of a particular site. Such qualities relate to the integrity of the appearance and setting of these properties or resources. Viewsheds (the natural and manmade environment visible from one or more viewing points) can also contribute to the significance of historic properties or cultural resources (NASA, 2013). Viewsheds containing historic properties and cultural resources may be considered important because of their presence in the landscape. Figure 5.1.8-1 shows areas that are included in the National Register of Historic Places (NRHP) that may be considered visually sensitive. In Indiana, there are 1,838 NRHP listed sites, which include, 40 National Historic Landmarks, one National Historical Park (George Rogers Clark), and one National Memorial (Lincoln Boyhood). 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.

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

National Historic Landmarks

National Historic Landmarks (NHLs) are defined as "nationally significant historic places designated by the U.S. Secretary of the Interior because they possess exceptional value or quality in illustrating or interpreting the heritage of the United States" (NPS, 2016b). NHLs may include "historic buildings, sites, structures, objects, and districts" (NPS, 2016b). Other types of historic properties include battlefields and canals. The importance of NHL-designated properties can be attributed to scenic or aesthetic qualities, among other attributes, that may be considered visual resources or visually sensitive at these sites. In Indiana, there are 40 NHLs, including sites such as the Indianapolis Motor Speedway, the Lincoln Boyhood Home, and the Tippecanoe Battlefield (Figure 5.1.8-1) (NPS, 2012a). By comparison, there are over 2,500 NHLs in the United States (NPS 2015b). Figure 5.1.8-1 provides a representative sample of some historic and cultural resources that may be visually sensitive

5.1.8.5 Parks and Recreation Areas

Parks and recreation areas include state parks, National Recreation Areas, National 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 5.1.7-1 identifies parks and recreational resources in Indiana. Figure 5.1.8-3 displays natural areas that may be visually sensitive, including park and recreation areas.[108]

State Parks

State parks contain natural, historic, cultural, and/or recreational resources of significance to Indiana residents and visitors. There are 34 state parks and lakes throughout Indiana (Figure 5.1.8-2), most of which contain scenic or aesthetic areas considered to be visual resources or visually sensitive (IDNR, 2015q).

Table 5.1.8-2 contains a sampling of state parks and their associated visual attributes.

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

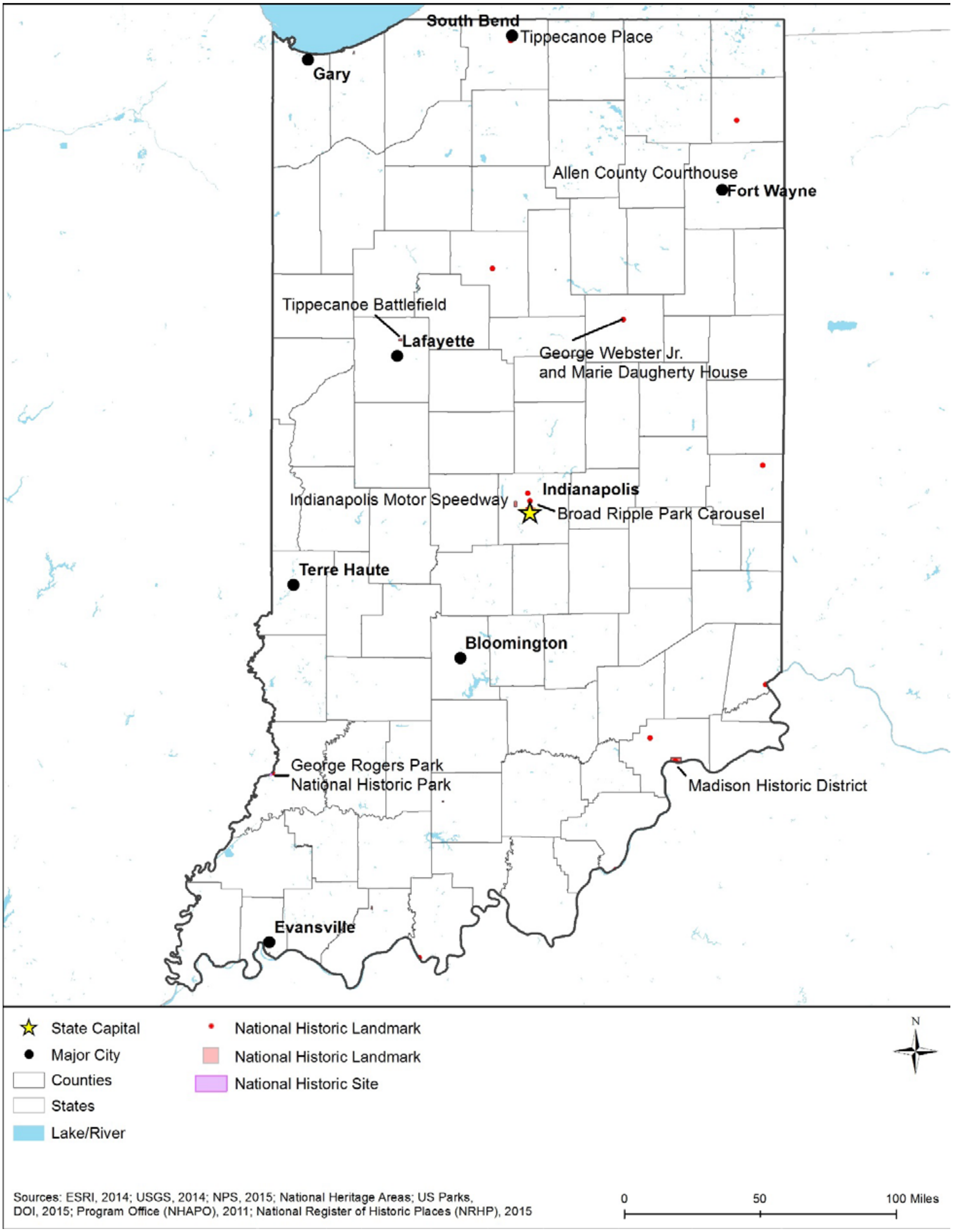


Figure 5.1.8-1: Representative Sample of Some Historic and Cultural Areas that May be Visually Sensitive

Table 5.1.8-2: Indiana State Parks and Associated Visual Attributes

State Park	Visual Attributes
Brookville Lake	Lake, American Indian mounds, beaches, wildlife, woodlands
Mounds State Parks	American Indian mounds, wildlife, pool
Salamonie Lake	Lake, woodlands, forests
Versailles State Park	Rolling hills, fossils, lake, scenic overlook, dam, aquatic wildlife

Source: (IDNR, 2016b) (IDNR, 2016c) (IDNR, 2016d) (IDNR, 2016e)

Source: (IDNR, 2016f)

Figure 5.1.8-2: Clifty Falls State Park

National Park Service

The NPS manages natural, historic, cultural, visual, ecological, and recreational resources of significance to the nation. Owned by the U.S. government, these areas are maintained for the public's use. In Indiana, there is one National Memorial (Lincoln Boyhood), one National Historical Park (George Rogers Clark), and one National Lakeshore (Indiana Dunes) (see Figure 5.1.8-4). For additional information regarding parks and recreation areas, see Section 5.1.7, Land Use, Recreation, and Airspace.

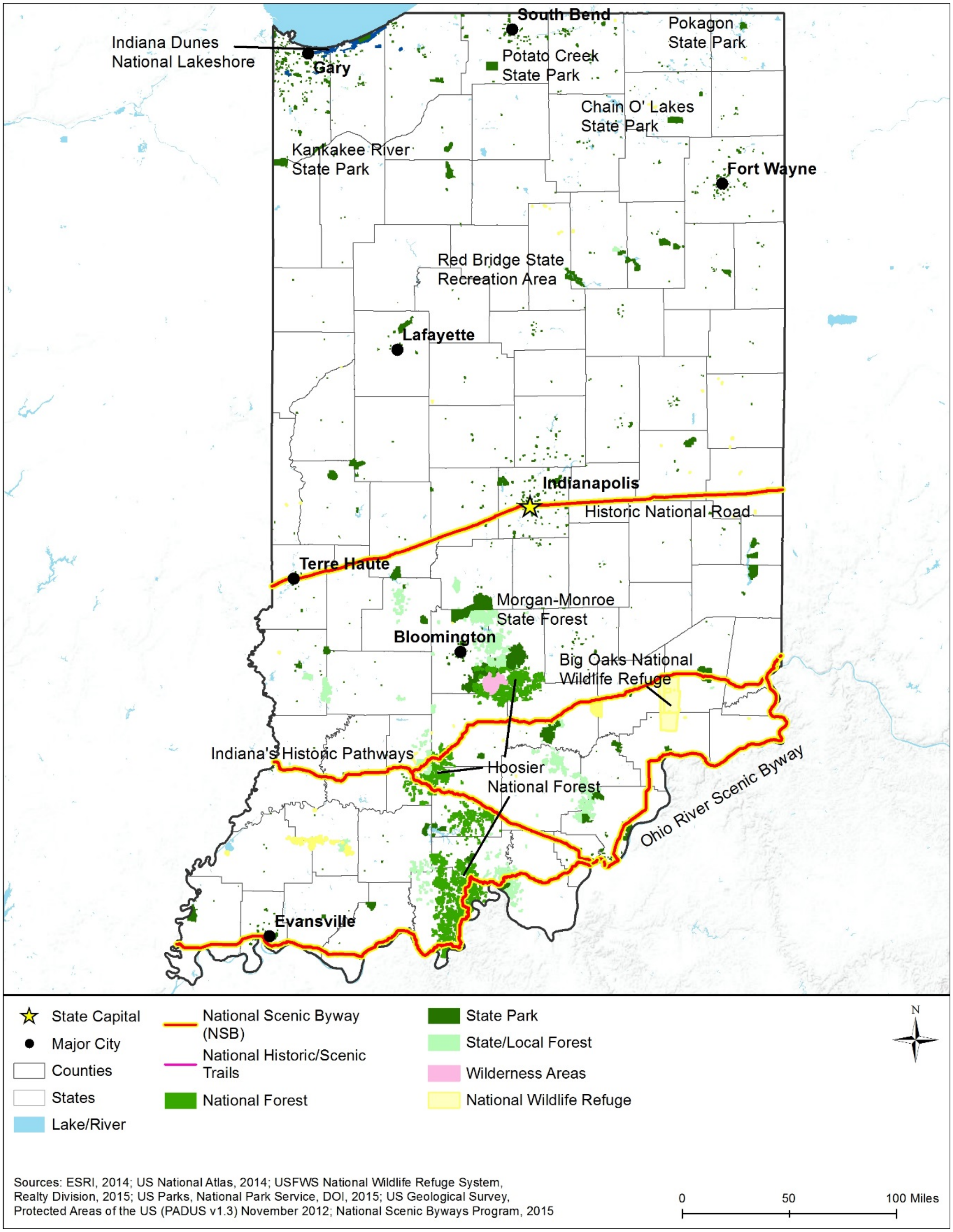


Figure 5.1.8-3: Natural Areas that May be Visually Sensitive

Source: (NPS, 2016a)

Figure 5.1.8-4: Indiana Dunes National Lakeshore

State and Federal Trails

State-designated trails contain visual resources such as historic views, forest and woodland views, and scenic vistas of valleys and gorges. There are over 300 state designated trails covering more than 3,500 miles in Indiana (Indiana Trails, 2015).

Designated under Section 5 of the National Trails System Act (16 U.S.C. 1241-1251, as amended), National Scenic Trails (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 no National Scenic Trails within Indiana (NPS, 2014c).

The National Trails System Act authorized the designation of National Recreational Trails near urban areas (American Trails, 2015). There are over 1,100 National Recreation Trails across the nation administered by the U.S. Forest Service, U.S. Army Corps of Engineers, USFWS, local or state governments, and non-profit organizations (National Recreation Trails, 2015).

5.1.8.6 Natural Areas

National Wilderness Areas

In 1964, Congress enacted the Wilderness Act of 1964 as "an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. A designation as a National Wilderness Area is the highest level of conservation protection given by Congress to federal lands. This Act defined wilderness as land untouched by man and primarily affected only by the "forces of nature" and as that which "may also contain ecological, geological, or other features of scientific, education, scenic, or historical value." Over 106 million acres of federal public lands have been designated as wilderness areas. These designated wilderness areas are managed by the U.S. Forest Service (USFS), BLM, USFWS, and NPS. (NPS, 2015c). Indiana is home to one federally managed Wilderness Area, the Charles C. Deam Wilderness, consisting of 12,472 acres (Figure 5.1.8-3) (NPS, 2015c). The area is characterized by forests, woodlands, streams, and abundance of wildlife.

State Forests

The IDNR manages 12 state forest units mostly located in the southern half of Indiana (Table 5.1.8-3). These lands are state-owned property managed "under the policy of multiple use in order to obtain benefits from recreation, timber production, and watershed protection." (IDNR, 2015s).

Table 5.1.8-3: Indiana State Forests

State Forest Name	Acres
Clark State Forest	24,000
Ferdinand State Forest	900
Greene-Sullivan State Forest	9,000
Harrison-Crawford State Forest	24,000
Jackson-Washington State Forest	18,000
Martin State Forest	7,863
Morgan-Monroe State Forest	24,000
Owen-Putman State Forest	Scattered Parcels
Pike State Forest	4,444
Salamonie River State Forest	850
Selmier State Forest	No data
Yellowwood State Forest	2,000

Source: (IDNR, 2015s)

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. There are no designated Wild and Scenic Rivers in Indian (National Wild and Scenic Rivers System, 2015b).

National Wildlife Refuges and State Wildlife Management Areas

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

- Muscatatuck NWR
- Big Oaks NWR (Figure 5.1.8-5)
- Patoka River NWR. (USFWS, 2015ak).

Visual resources within the NWRs include views and sites of the coast, beaches, wildlife, and naturally vegetated areas. State Wildlife Management Areas (WMAs) are lands owned by Indiana and are managed by the Department of Natural Resources, Division of Fish and Game. There are 26 WMAs scattered throughout the state (Table 5.1.8-4). Visual resources within these areas include wetland and waterfront vistas, forested hills and valleys, secluded streams, and majestic ridges. For additional information on wildlife refuges and management areas, see Section 5.1.6.4., Terrestrial Wildlife.

Source: (USFWS, 2016)

Figure 5.1.8-5: Big Oaks National Wildlife Refuge

Table 5.1.8-4: Indiana State Wildlife Management Areas

State Wildlife Area	Acres
Atterbury	4,905
Blue Grass	2,532
Chinook	2,141
Crosley	4,228
Deer Creek	1,962
Fairbanks Landing	No data
Glendale	8,060
Goose Pond	8,064
Hillenbrand	3,400
Hovey Lake	7,404
Jasper-Pulaski	8,142
J.E. Roush Lake	7,347
Kankakee	4,095
Kingsbury	7,280
LaSalle	3,797
Minnehaha	3,500
Pigeon River	11,794
Pisgah Marsh Area	445
Reynolds Creek Game Bird	1,250
Splinter Ridge	2,607
Sugar Ridge	8,100
Tri-County	3,546

State Wildlife Area	Acres
Wabashiki	2,600
Wilbur Wright	1,070
Willow Slough	9,956
Winamac	4,880

Source: (Indiana Division of Fish and Game, 2015)

National Natural Landmarks

National Natural Landmarks (NNLs) are sites designated by the U.S. Secretary of the Interior that "contain outstanding biological and/or geological resources, regardless of land ownership, and are selected for their outstanding condition, illustrative value, rarity, diversity, and value to science and education" (NPS, 2014d). These landmarks may be considered visual resources or visually sensitive. In Indiana, there are a total of 30 NNLs (Table 5.1.8-5). Ranging in size from two to over 1,000 acres, they contain many natural features such as bogs, fens, marshes, dunes, fossil reefs, canyons, springs, and caves. (NPS, 2012b). A prime example of a NNL within Indiana is the Dunes Nature Preserve NNL located within Indiana Dunes State Park (Figure 5.1.8-6. This NNL is considered the "best remaining example of undeveloped and relatively unspoiled dune landscape along the southern shore of Lake Michigan" (NPS, 2012a).

Source: (NPS, 2012a)

Figure 5.1.8-6: Dunes Nature Preserve NNL

Table 5.1.8-5: Indiana National Natural Landmarks

NNL Name	
Big Walnut Creek	Cabin Creek Raised Bog
Calvert and Porter Woods	Cowles Bog
Davis-Purdue Agriculture Center Forest	Donaldson Cave System and Woods
Dunes Nature Preserve	Fern Cliff Nature Preserve
Hanging Rock and Wabash Reef	Harrison Spring
Hemmer Woods	Hoosier Prairie
Hoot Woods	Kramer Woods
Marengo Cave	Meltzer Woods
Officer's Woods	Ohio Coral Reef
Pine Hills Natural Area	Pinhook Bog
Pioneer Mothers Memorial Forest	Portland Arch Nature Preserve
Rise at Orangeville	Rocky Hollow Falls Canyon Nature Preserve
Shrader-Weaver Woods	Tamarack Bog
Tolliver Swallowhole	Wesley Chapel Gulf
Wesselman Woods Nature Preserve	Wyandotte Caves

Source: (NPS, 2012b)

5.1.8.7 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. Indiana has three designated National Scenic Byways: the Ohio River Scenic Byway that meanders along the banks of the Ohio River, Indiana's Historic Pathways, and Historic National Road (see Figure 5.1.7-1 in Section 5.1.3 Transportation) (FHWA, 2015c). The National Scenic Byways Program is managed by the U.S. Department of Transportation, Federal Highway Administration.

Similar to National Scenic Byways, Indiana Scenic Byways are transportation corridors that are of particular statewide interest. There are five State Scenic Byways (Figure 5.1.7-1 in Section 5.1.7 Land Use and Recreation), including:

- River Road Scenic Byway
- Whitewater Canal Scenic Byway
- Whitewater Canal Scenic Byway Loop Routes
- Historic Michigan Road Byway
- Lincoln Highway Scenic Byway

5.1.9. Socioeconomics

5.1.9.1 Definition of the Resource

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

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

The financial arrangements for deployment and operation of the FirstNet network may have socioeconomic implications. Section 1.1 frames some of the public expenditure and public revenue considerations specific to FirstNet; however this is not intended to be either descriptive or prescriptive of FirstNet's financial model or anticipated total expenditures and revenues associated with the deployment of the 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 EO 12898. This PEIS addresses environmental justice in a separate section (Section 5.1.10). This PEIS also addresses the following topics, sometimes included within socioeconomics, in separate sections: land use, recreation, and airspace (Section 5.1.7), infrastructure (Section 5.1.1), and aesthetic considerations (Section 5.1.8).

Wherever possible, this section draws on nationwide datasets from federal sources such as the U.S. Census Bureau (Census Bureau)[109] and U.S. Bureau of Labor Statistics (BLS). This ensures

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[109] For U.S. Census Bureau sources, a URL (see references section) that begins with "http://factfinder.census.gov" indicates that the American FactFinder (AFF) interactive tool can be used to retrieve the original source data via the following procedure. If the reference's URL begins with "http://dataferrett.census.gov," significant socioeconomic expertise is required to navigate this interactive tool to the specific data. However, the data can usually be found using AFF. As of May 24, 2016, the AFF procedure is as follows: 1) Go to http://factfinder.census.gov. 2) Select "Advanced Search," then "Show Me All." 3) Select from "Topics" choices, select "Dataset," then select the dataset indicated in the reference; e.g., "American Community Survey, 2013 1-Year Estimates" or "2012 Census of Governments." Click "Close." Note: ACS is the abbreviation in the AFF for the American Community Survey. SF is the abbreviation used with the 2000 and 2010 "Summary Files." For references to the "2009-2013 5-Year Summary File," choose "2013 ACS 5-year estimates" in the AFF. 4) Click the "Geographies" box. Under "Select a geographic type," choose the appropriate type; e.g., "United States – 010" or "State – 040" or "..... County – 050" then select the desired area or areas of interest. Click "Add to Your Selections," then "Close." For Population Concentration data, select "Urban Area - 400" as the geographic type, then select 2010 under "Select a version" and then choose the desired area or areas. Alternatively, do not choose a version, and select "All Urban Areas within United States." Regional values cannot be viewed in the AFF because the regions for this PEIS do not match Census Bureau regions. All regional values were developed by downloading state data and using the most mathematically appropriate calculations (e.g., sums of state values, weighted averages, etc.) for the specific data. 5) In "Refine your search results," type the table number indicated in the reference; e.g., "DP04" or "LGF001." The dialogue box should auto-populate with the name of the table(s) to allow the user to select the table number/name. Click "Go." 6) In the resulting window, click the desired table under "Table, File, or Document Title" to view the results. If multiple geographies were selected, it is often easiest to view the data by clicking the "Download" button above the on-screen data table. Choose the desired comma-delimited format or presentation-ready format (includes a Microsoft

consistency of data and analyses across the states examined in this PEIS. In all cases, this section uses the most recent data available for each geography at the time of writing. At the county, state, region, and United States levels, the data are typically for 2013 or 2014. For smaller geographic areas, this section uses data from the Census Bureau's American Community Survey (ACS). The ACS is the Census Bureau's flagship demographic estimates program for years other than the decennial census years. This PEIS uses the 2009-2013 ACS, which is based on surveys (population samples) taken across that five-year period; thus, it is not appropriate to attribute its data values to a specific year. It is a valuable source because it provides the most accurate and consistent socioeconomic data across the nation at the sub-county level (U.S. Census Bureau, 2016).

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.

5.1.9.2 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.

5.1.9.3 Communities and Populations

This section discusses the population and major communities of Indiana and includes the following topics:

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

Statewide Population and Population Growth

Table 5.1.9-1 presents the 2014 estimated population and population density of Indiana in comparison to the Central region[110] and the nation. The estimated population of Indiana in 2014 was 6,596,855. The population density was 184 persons per square mile (sq. mi.), which is considerably higher (more than double) than the population density of both the region (66 persons/sq. mi.) and the nation (90 persons/sq. mi.). In 2014, Indiana was the 16th largest state by estimated population among the 50 states and the District of Columbia, 38th largest by land

Excel option). In some cases, the structure of the resulting file may be easier to work with under one format or another. Note that in most cases, the on-screen or downloaded data contains additional parameters besides those used in the FirstNet PEIS report table. Readers must locate the FirstNet PEIS-specific data within the Census Bureau tables. Additionally, the data contained in the FirstNet tables may incorporate data from multiple sources and may not be readily available in one table on the Census site.

[110] The Central region is comprised of the states of Colorado, Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Utah, Wisconsin, and Wyoming. Throughout the socioeconomics section, figures for the Central region represent the sum of the values for all states in the region, or an average for the region based on summing the component parameters. For instance, the population density of the Central region is the sum of the populations of all its states, divided by the sum of the land areas of all its states.

area, and had the 17th greatest population density (U.S. Census Bureau, 2015a; U.S. Census Bureau, 2015b).

Table 5.1.9-1: Land Area, Estimated Population, and Population Density of Indiana

Geography	Land Area (sq. mi.)	Estimated Population 2014	Population Density 2014 (persons/sq. mi.)
Indiana	35,826	6,596,855	184
Central Region	1,178,973	77,651,608	66
United States	3,531,905	318,857,056	90

Sources: (U.S. Census Bureau, 2015a; U.S. Census Bureau, 2015b)

Population growth is an important aspect for this PEIS, given FirstNet's mission. Table 5.1.9-2 presents the population growth trends of Indiana from 2000 to 2014 in comparison to the Central region and the nation. The state's annual growth decreased, from 0.64 percent to 0.43 percent, in the 2010 to 2014 period compared to 2000 to 2010. The growth rate of Indiana nearly matched the rate of the region (0.45 percent) and was considerably lower than the nation's rate (0.81 percent).

Table 5.1.9-2: Recent Population Growth of Indiana

Geography	Population			Numerical Estimated Population Change		Rate of Estimated Population Change (AARC)	
	2000	2010	2014 (estimated)	2000 to 2010	2010 to 2014	2000 to 2010	2010 to 2014
Indiana	6,080,485	6,483,802	6,596,855	403,317	113,053	0.64%	0.43%
Central Region	72,323,183	76,273,123	77,651,608	3,949,940	1,378,485	0.53%	0.45%
United States	281,421,906	308,745,538	318,857,056	27,323,632	10,111,518	0.93%	0.81%

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

Demographers prepare future estimated population projections using various population growth modeling methodologies. For this nationwide PEIS, it is important to use estimated population projections that apply the same methodology across the nation. It is also useful to consider projections that use different methodologies, since no methodology is a perfect predictor of the future. The Census Bureau does not prepare population projections for the states. Therefore, Table 5.1.9-3 presents projections of the 2030 population from two sources that are national in scope and use different methodologies: the University of Virginia's Weldon Cooper Center for Public Service and ProximityOne, a private sector demographic and economic data and analysis service (ProximityOne, 2015) (University of Virginia Weldon Cooper Center, 2015). The table provides figures for numerical change, percentage change, and annual growth rate based on averaging the projections from the two sources. The average projection indicates Indiana's estimated population will increase by approximately 671,000 people, or 10.2 percent, from 2014 to 2030. This reflects an average annual projected growth rate of 0.61 percent, which is higher than the historical growth rate from 2010 to 2014 of 0.43 percent. The projected growth rate of the state is similar to that of the region (0.60 percent) and lower than the projected growth rate of the nation (0.80 percent).

Table 5.1.9-3: Projected Estimated Population Growth of Indiana

Geography	Population 2014 (estimated)	Projected 2030 Estimated 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
Indiana	6,596,855	7,095,730	7,440,376	7,268,053	671,198	10.2%	0.61%
Central Region	77,651,608	83,545,838	87,372,952	85,459,395	7,807,787	10.1%	0.60%
United States	318,857,056	360,978,449	363,686,916	362,332,683	43,475,627	13.6%	0.80%

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

Population Distribution and Communities

Table 5.1.9-1 presents the distribution and relative density of the estimated population of Indiana. 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, 2015d). This map also presents the 10 largest population concentrations in the state, outlined in purple. These population concentrations reflect contiguous, densely developed areas as defined by the Census Bureau based on the 2010 census (U.S. Census Bureau, 2012; U.S. Census Bureau, 2015e). 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. Additional areas representing the state's top 10 population concentrations are distributed through the state, as are many smaller population concentrations.

Table 5.1.9-4 provides the populations of the 10 largest population concentrations in Indiana, based on the 2010 census. It also shows the changes in population for these areas between the 2000 and 2010 censuses.[111] In 2010, the largest population concentration was the Indianapolis area, which had approximately 1.5 million people. The second largest population was the Indiana portion of the Chicago area with 589,492 people. The state had no other population concentrations over 500,000. The smallest of these 10 population concentrations was the Terre Haute area, with a 2010 population of 92,742 people. The fastest growing area, by average

[111] 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.

annual rate of change from 2000 to 2010, was the Indianapolis area, with an annual growth rate of 2.01 percent. The South Bend area (Indiana portion) experienced a slight population decline during this period.

Table 5.1.9-4 also shows that the top 10 population concentrations in Indiana accounted for 53.4 percent of the state's population in 2010. Further, population growth in the 10 areas from 2000 to 2010 amounted to 105.6 percent of the entire state's growth. This figure of over 100 percent indicates that the population of the remainder of the state, as a whole, declined from 2000 to 2010.

Table 5.1.9-4: Population of the 10 Largest Population Concentrations in Indiana

Area	Population				Population Change 2000 to 2010	
	2000	2010	2009–2013	Rank in 2010	Numerical Change	Rate (AARC)
Bloomington	92,456	108,657	109,976	9	16,201	1.63%
Chicago (IL/IN) (IN Portion)	553,380	589,492	588,155	2	36,112	0.63%
Elkhart (IN/MI) (IN Portion)	130,866	142,692	143,226	7	11,826	0.87%
Evansville (IN/KY) (IN Portion)	185,396	200,768	201,623	5	15,372	0.80%
Fort Wayne	287,759	313,492	316,022	3	25,733	0.86%
Indianapolis	1,218,919	1,487,483	1,511,366	1	268,564	2.01%
Lafayette	125,738	147,725	148,695	6	21,987	1.62%
Louisville/Jefferson County (KY/IN) (IN Portion)	122,947	140,180	141,573	8	17,233	1.32%
South Bend (IN/MI) (IN Portion)	242,297	241,870	242,111	4	(427)	-0.02%
Terre Haute	79,376	92,742	91,508	10	13,366	1.57%
Total for Top 10 Population Concentrations	**3,039,134**	**3,465,101**	**3,494,255**	**NA**	**425,967**	**1.32%**
Indiana (statewide)	**6,080,485**	**6,483,802**	**6,514,861**	**NA**	**403,317**	**0.64%**
Top 10 Total as Percentage of State	**50.0%**	**53.4%**	**53.6%**	**NA**	**105.6%**	**NA**

Sources: (U.S. Census Bureau, 2012; U.S. Census Bureau, 2015f; U.S. Census Bureau, 2015g)
AARC = Average Annual Rate of Change (compound growth rate)

5.1.9.4 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.

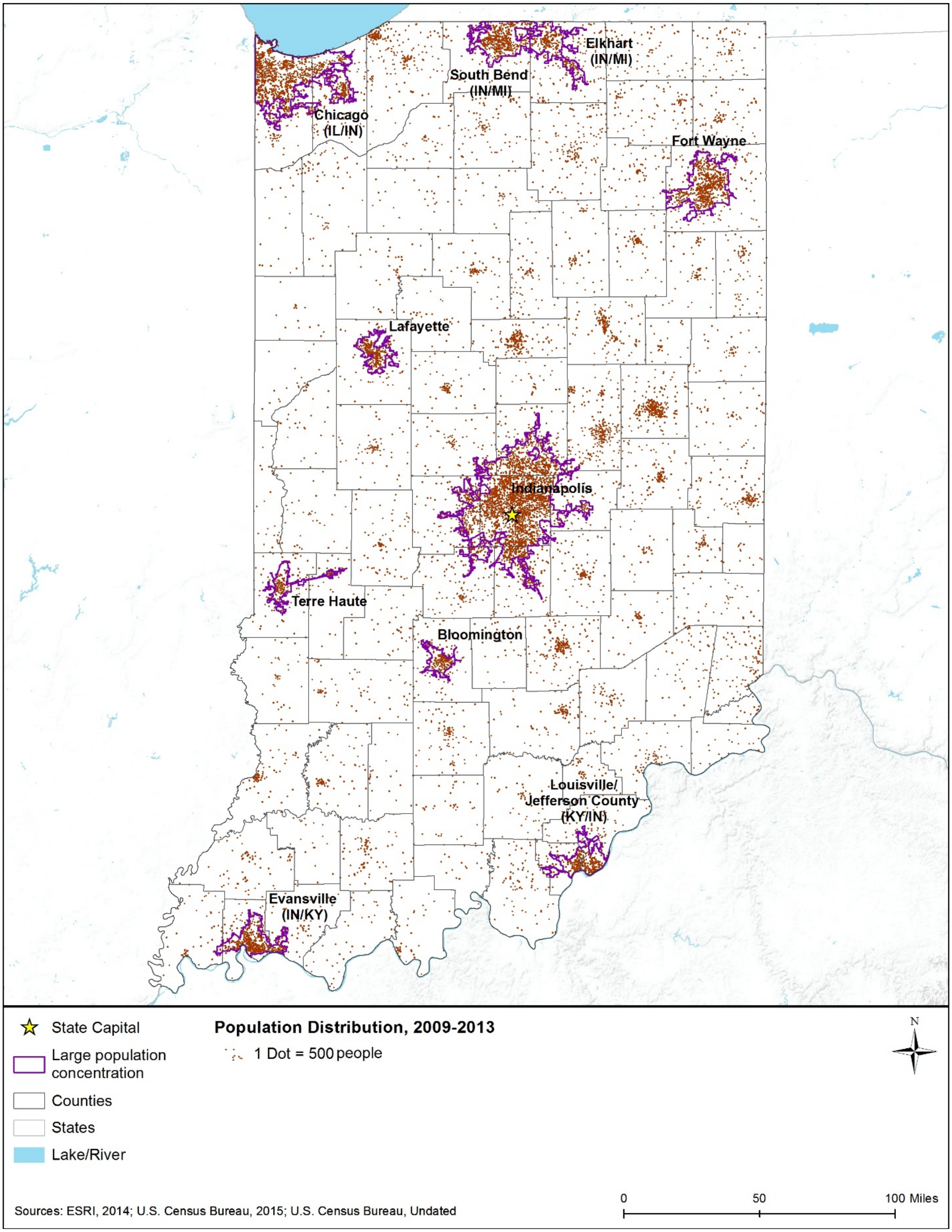

Figure 5.1.9-1: Estimated Population Distribution in Indiana, 2009–2013

Social institutions – educational, family, political, public service, military, and religious – are present throughout the state. The institutions most relevant to FirstNet Proposed Actions are public services such as medical and emergency medical services and facilities. This PEIS addresses public services in Section 5.1.1, Infrastructure. Project-level NEPA analyses may need to examine other institutions, depending on specific locations and specific types of actions.

Economic Activity

Table 5.1.9-5 compares several economic indicators for Indiana to the Central region and the nation. The table presents two indicators of income[112] – 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 5.1.9-5, the per capita income in Indiana in 2013 ($24,796) was $2,732 lower than that of the region ($27,528), and $3,388 lower than that of the nation ($28,184). (U.S. Census Bureau, 2015k; U.S. Census Bureau, 2015l; BLS, 2015f; U.S. Census Bureau, 2015i)

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 5.1.9-5 shows that in 2013, the MHI in Indiana ($47,508) was $4,537 lower than that of the region ($52,045), and $4,742 lower that of the nation ($52,250). (U.S. Census Bureau, 2015k; U.S. Census Bureau, 2015l; BLS, 2015f; U.S. Census Bureau, 2015i)

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 5.1.9-5 compares the unemployment rate in Indiana to the Central region and the nation. In 2014, Indiana's statewide unemployment rate of 6.0 percent was slightly higher than the rate for the region (5.7 percent) and slightly lower than the rate for the nation (6.2 percent).[113] (U.S. Census Bureau, 2015k; U.S. Census Bureau, 2015l; BLS, 2015f; U.S. Census Bureau, 2015i)

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[112] 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, 2015h)

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

Table 5.1.9-5: Selected Economic Indicators for Indiana

Geography	Per Capita Income 2013	Median Household Income 2013	Average Annual Unemployment Rate 2014
Indiana	$24,796	$47,508	6.0%
Central Region	$27,528	$52,045	5.7%
United States	$28,184	$52,250	6.2%

Sources: (BLS, 2015f; U.S. Census Bureau, 2015i; U.S. Census Bureau, 2015l; U.S. Census Bureau, 2015k)

Figure 5.1.9-2 and Figure 5.1.9-1 show how MHI in 2013 (U.S. Census Bureau, 2015i) and unemployment in 2014 (BLS, 2015f) varied by county across the state. These maps also incorporate the same population concentration data as Figure 5.1.9-1 (U.S. Census Bureau, 2012; U.S. Census Bureau, 2015e). Following these two maps, Table 5.1.9-6 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 Indiana.

Figure 5.1.9-2shows that, in general, at the county level, MHI in 2013 had a variable distribution across the state, with high and low MHI levels occurring throughout the state. Many of the counties in the southern third of the state had MHI levels below the national average. Most of the counties surrounding Indianapolis had MHI levels above the national average. Table 5.1.9-6 shows that MHI in three of the 10 population concentrations (the Indianapolis area and the Indiana portions of the Chicago and Louisville/Jefferson County areas) was above the state average ($48,248). MHI was lowest in the Bloomington area at $35,145, and highest in the Indianapolis area ($52,338).

Figure 5.1.9-3 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 distributed throughout most of the state, generally around the top 10 population concentrations, with a few exceptions. The highest unemployment rates were generally in the counties around the Terra Haute area and the Indiana portion of the Chicago area. Table 5.1.9-6 shows that 2009–2013 unemployment rates varied across the 10 areas, ranging from 7.3 percent in the Indiana portion of the Evansville area to 11.7 percent in the Indiana portion of the Elkhart area. The state average was 9.6 percent.

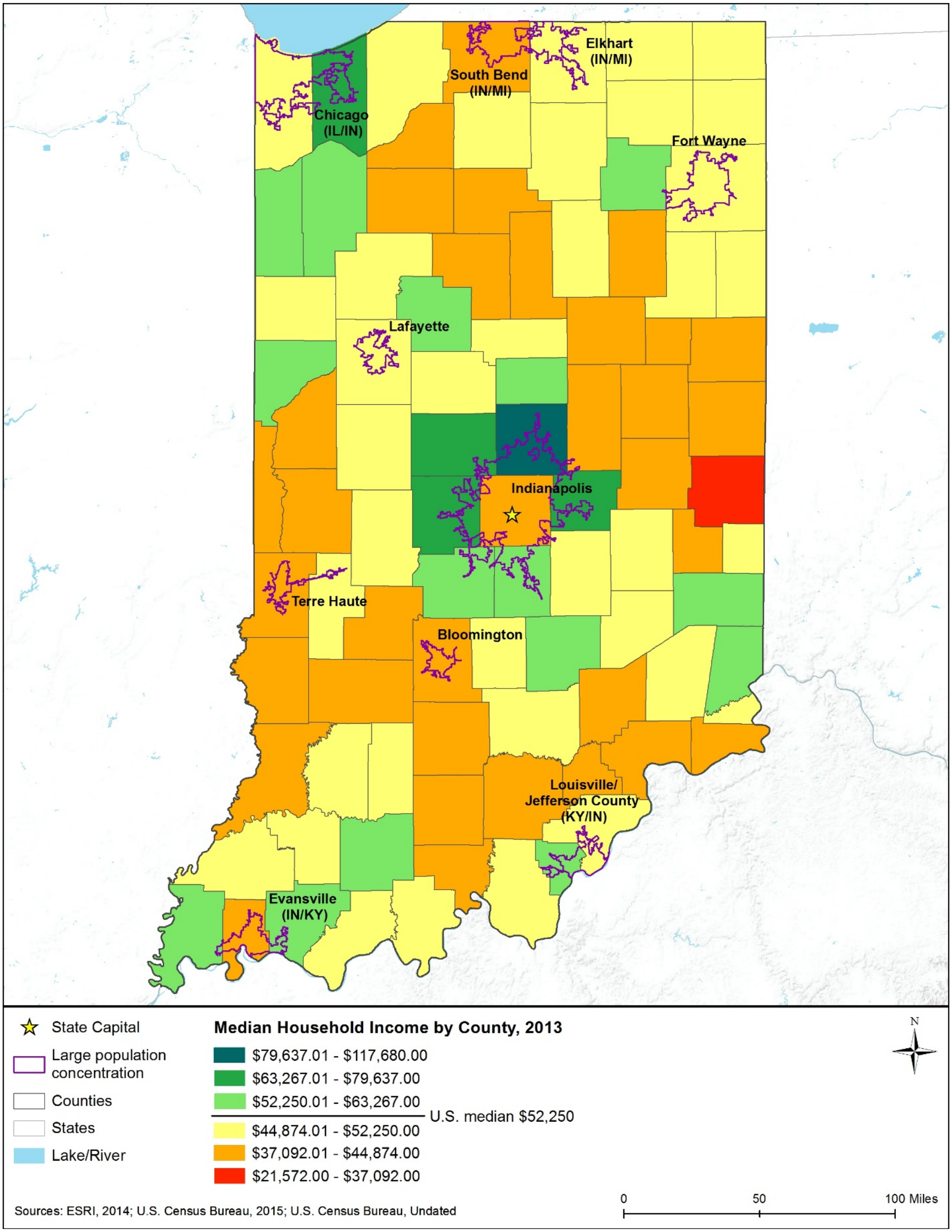

Figure 5.1.9-2: Median Household Income in Indiana, by County, 2013

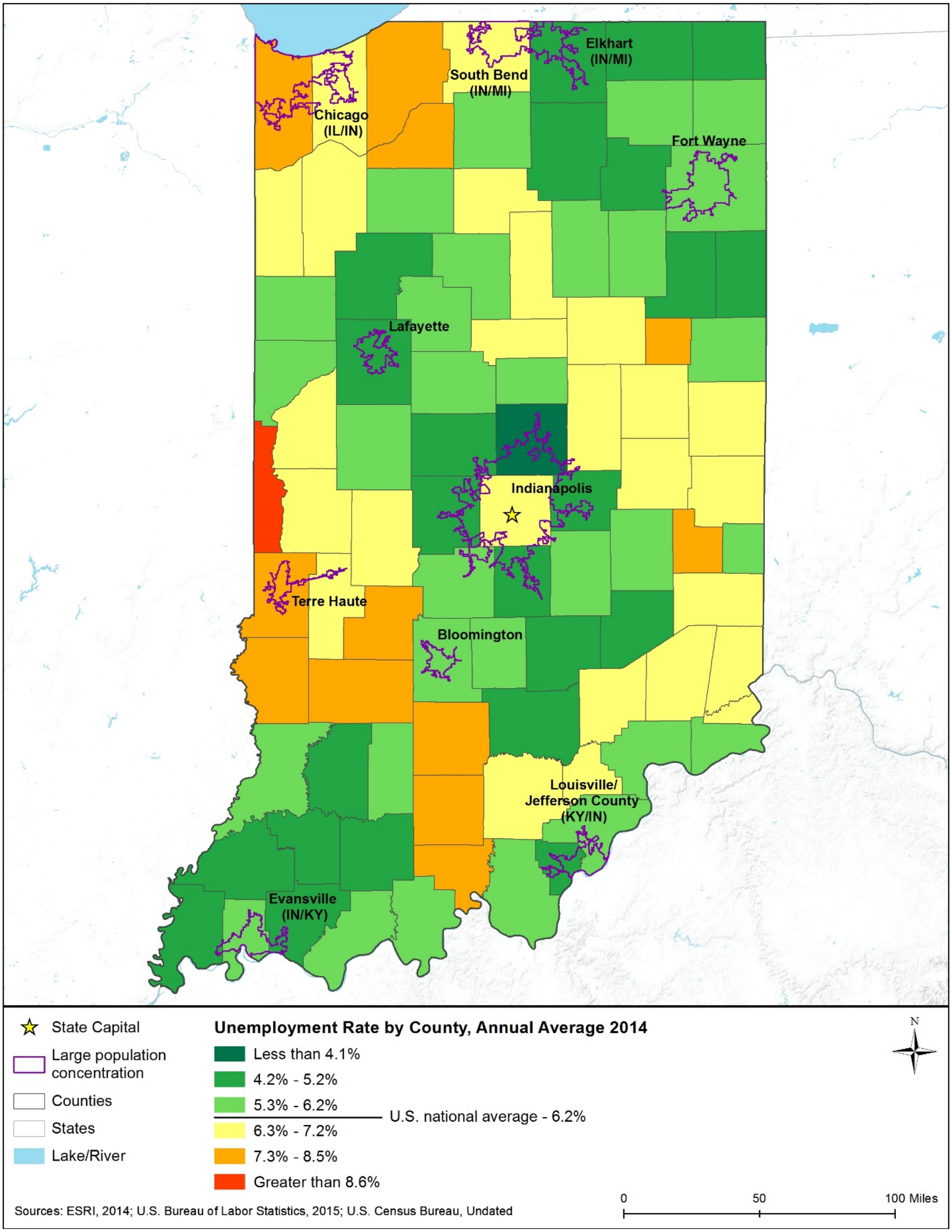

Figure 5.1.9-3: Unemployment Rates in Indiana, by County, 2014

Table 5.1.9-6: Selected Economic Indicators for the 10 Largest Population Concentrations in Indiana, 2009–2013

Area	Median Household Income	Average Annual Unemployment Rate
Bloomington	$35,145	8.0%
Chicago (IL/IN) (IN Portion)	$49,928	11.1%
Elkhart (IN/MI) (IN Portion)	$41,802	11.7%
Evansville (IN/KY) (IN Portion)	$45,067	7.3%
Fort Wayne	$47,394	10.2%
Indianapolis	$52,338	9.5%
Lafayette	$39,991	8.7%
Louisville/Jefferson County (KY/IN) (IN Portion)	$49,730	8.5%
South Bend (IN/MI) (IN Portion)	$43,555	11.2%
Terre Haute	$35,439	9.9%
Indiana (statewide)	$48,248	9.6%

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

Detailed employment data provides useful insights into the nature of a local, state, or national economy. Table 5.1.9-7 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 Indiana than in the Central region and the nation. The percentage of government workers and self-employed workers was slightly lower in the state than in the region and nation.

By industry, Indiana has a mixed economic base and some notable figures in the table are as follows. Indiana in 2013 had a considerably higher percentage of persons working in "manufacturing" than did the region or the nation. It had a considerably lower percentage of workers in "professional, scientific, management, administrative, and waste management services" than the nation and a somewhat lower percentage than the region. It also had a slightly lower percentage of workers in "finance and insurance, and real estate and rental and leasing" than both the region and the nation. The percentages for the remaining industries were within one percentage point of the regional and national value.

Table 5.1.9-7: Employment by Class of Worker and by Industry, 2013

Class of Worker and Industry	Indiana	Central Region	United States
Civilian Employed Population 16 Years and Over	3,025,786	36,789,905	145,128,676
Percentage by Class of Worker			
Private wage and salary workers	83.8%	81.7%	79.7%
Government workers	11.5%	12.8%	14.1%
Self-employed in own not incorporated business workers	4.6%	5.3%	6.0%
Unpaid family workers	0.2%	0.2%	0.2%

Class of Worker and Industry	Indiana	Central Region	United States
Percentage by Industry			
Agriculture, forestry, fishing and hunting, and mining	1.4%	2.2%	2.0%
Construction	5.7%	5.6%	6.2%
Manufacturing	18.7%	14.0%	10.5%
Wholesale trade	2.5%	2.7%	2.7%
Retail trade	11.3%	11.5%	11.6%
Transportation and warehousing, and utilities	5.3%	4.9%	4.9%
Information	1.5%	1.9%	2.1%
Finance and insurance, and real estate and rental and leasing	5.0%	6.5%	6.6%
Professional, scientific, management, administrative, and waste management services	8.0%	9.7%	11.1%
Educational services, and health care and social assistance	23.2%	23.4%	23.0%
Arts, entertainment, and recreation, and accommodation and food services	8.9%	9.1%	9.7%
Other services, except public administration	4.7%	4.6%	5.0%
Public administration	3.9%	3.9%	4.7%

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

Table 5.1.9-8 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 5.1.9-6 for 2013.

Table 5.1.9-8: Employment by Selected Industries for the 10 Largest Population Concentrations in Indiana, 2009–2013

Area	Construction	Transportation and Warehousing, and Utilities	Information	Professional, Scientific, Management, Administrative and Waste Management Services
Bloomington	3.2%	2.1%	2.5%	6.3%
Chicago (IL/IN) (IN Portion)	6.0%	6.5%	1.6%	7.9%
Elkhart (IN/MI) (IN Portion)	3.8%	4.2%	1.1%	5.6%
Evansville (IN/KY) (IN Portion)	5.9%	4.6%	2.2%	7.9%
Fort Wayne	4.6%	4.6%	2.2%	8.3%
Indianapolis	5.2%	5.7%	2.0%	11.4%
Lafayette	3.5%	2.6%	1.1%	7.0%
Louisville/Jefferson County (KY/IN) (IN Portion)	4.7%	6.4%	1.6%	8.9%

Area	Construction	Transportation and Warehousing, and Utilities	Information	Professional, Scientific, Management, Administrative and Waste Management Services
South Bend (IN/MI) (IN Portion)	4.1%	3.9%	1.5%	7.8%
Terre Haute	5.6%	3.8%	1.4%	7.0%
Indiana (statewide)	5.8%	5.2%	1.6%	7.7%

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

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 5.1.9-9 compares Indiana to the Central region and nation on several common housing indicators.

As shown in Table 5.1.9-9, in 2013, Indiana had a slightly higher percentage of housing units that were occupied (88.9 percent) than the region (88.4 percent) or nation (87.6 percent). Of the occupied units, Indiana also had a higher percentage of owner-occupied units (68.5 percent) than the region (67.6 percent), and the nation (63.5 percent). This is reflected in the higher percentage of detached single-unit housing (also known as single-family homes) in Indiana in 2013 (72.4 percent) compared to the region (67.7 percent) and nation (61.5 percent). The homeowner vacancy rate in Indiana (2.0 percent) was somewhat higher than the rate for the region (1.8 percent) and the nation (1.9 percent). This rate reflects “vacant units that are ‘for sale only’” (U.S. Census Bureau, 2015h). The vacancy rate among rental units was slightly higher in Indiana (7.0 percent) than in the region (6.0 percent) and the nation (6.5 percent).

Table 5.1.9-9: Selected Housing Indicators for Indiana, 2013

Geography	Total Housing Units	Housing Occupancy & Tenure				Units in Structure
		Occupied Housing	Owner-Occupied	Homeowner Vacancy Rate	Rental Vacancy Rate	1-Unit, Detached
Indiana	2,809,640	88.9%	68.5%	2.0%	7.0%	72.4%
Central Region	33,580,411	88.4%	67.6%	1.8%	6.0%	67.7%
United States	132,808,137	87.6%	63.5%	1.9%	6.5%	61.5%

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

Table 5.1.9-10 provides housing indicators for the largest population concentrations in the state. The table reflects survey data taken from 2009 to 2013. Thus, its figures are not directly comparable to the more recent data in the previous table. However, it does present variation in these indicators for population concentrations across the state and compared to the state average for the 2009 to 2013 period. Table 5.1.9-10 shows that during this period, the percentage of occupied housing units ranged from 88.0 to 92.7 percent across these population concentrations.

Table 5.1.9-10: Selected Housing Indicators for the 10 Largest Population Concentrations in Indiana, 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
Bloomington	45,795	91.7%	45.2%	1.4%	3.8%	46.7%
Chicago (IL/IN) (IN Portion)	248,253	88.0%	69.6%	1.9%	6.5%	69.6%
Elkhart (IN/MI) (IN Portion)	58,347	89.3%	66.6%	2.0%	11.1%	68.3%
Evansville (IN/KY) (IN Portion)	90,939	89.6%	64.6%	1.9%	6.0%	69.4%
Fort Wayne	136,684	90.2%	67.5%	2.2%	11.4%	71.5%
Indianapolis	650,065	88.9%	64.0%	2.1%	8.9%	65.6%
Lafayette	61,238	92.7%	48.7%	1.6%	4.7%	55.4%
Louisville/Jefferson County (KY/IN) (IN Portion)	61,894	89.4%	67.9%	2.4%	8.9%	70.8%
South Bend (IN/MI) (IN Portion)	104,516	88.2%	67.9%	3.0%	11.8%	74.1%
Terre Haute	39,943	85.7%	58.3%	3.1%	6.8%	68.8%
Indiana (statewide)	2,800,895	88.6%	70.0%	2.3%	8.4%	72.7%

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

Property Values

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

Table 5.1.9-11 provides indicators of residential property values for Indiana and compares these values to values for the Central 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 Indiana in 2013 ($122,200) was lower than the corresponding values for the Central region ($151,200) and the nation ($173,900).

Table 5.1.9-11: Residential Property Values in Indiana, 2013

Geography	Median Value of Owner-Occupied Units
Indiana	$122,200
Central Region	$151,200
United States	$173,900

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

Table 5.1.9-12 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. The median property value for these 10 communities ranged from $80,100 in the Terre Haute area to $154,100 in the Bloomington area, bracketing the state value ($122,800). Both the lowest and highest property values were in the two areas – Terra Haute and Bloomington, respectively – that had the lowest median household incomes (Table 5.1.9-6).

Table 5.1.9-12: Residential Property Values for the 10 Largest Population Concentrations in Indiana, 2009–2013

Area	Median Value of Owner-Occupied Units
Bloomington	$154,100
Chicago (IL/IN) (IN Portion)	$139,000
Elkhart (IN/MI) (IN Portion)	$112,000
Evansville (IN/KY) (IN Portion)	$120,100
Fort Wayne	$107,300
Indianapolis	$142,800
Lafayette	$122,900
Louisville/Jefferson County (KY/IN) (IN Portion)	$131,600
South Bend (IN/MI) (IN Portion)	$111,300
Terre Haute	$80,100
Indiana (statewide)	$122,800

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

Government Revenues

State and local governments obtain revenues from many sources. FirstNet Proposed Action's 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 5.1.9-13 presents total and selected state and local government revenue sources as reported by the Census Bureau's 2012 Census of Governments. It provides both total dollar figures (in millions of dollars) and figures per capita (in dollars), based on total population for each geography. The per capita figures were particularly useful in comparing the importance of certain revenue sources in the state relative to other states in the region and the nation. State and local governments may obtain some additional revenues related to telecommunications infrastructure. General and selective sales taxes may change, reflecting expenditures during system development and maintenance.

Table 5.1.9-13 shows that the state government in Indiana received less total revenue in 2012 on a per capita basis than its counterpart governments in the region and nation, while local governments in Indiana obtained more total revenue per capita than counterparts in the region and less than counterparts in the nation. Indiana state and local governments had lower levels per capita of intergovernmental revenue[114] from the federal government. The state government in Indiana obtained minimal revenue from property taxes. Local governments in Indiana obtained higher levels of property taxes, per capita, than local governments in the region, and lower levels than their counterparts in the nation. The Indiana state government reported lower revenue from general sales taxes than its counterparts in the region and nation. Local governments in Indiana reported higher revenue from general sales taxes than its counterparts in the region and nation. Local governments in Indiana reported no revenue from general tax sales. State and local governments in Indiana reported similar revenue per capita from selective sales taxes, and public utilities taxes specifically, than to counterparts in the region and nation. The state government in Indiana reported lower levels of individual income taxes, and similar levels of corporate income tax revenue, on a per capita basis than counterpart governments in the region and nation. Indiana's local governments reported higher per capita individual income tax revenue than counterparts in the region and nation. Local governments in Indiana reported no revenue from corporate income taxes.

Table 5.1.9-13: State and Local Government Revenues, Selected Sources, 2012

Type of Revenue	Indiana		Region		United States	
	State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount
Total Revenue ($M)	$35,910	$27,753	$463,192	$231,980	$1,907,027	$1,615,194
Per capita	$5,493	$4,245	$6,020	$3,015	$6,075	$5,145
Intergovernmental from Federal ($M)	$10,441	$673	$125,394	$9,383	$514,139	$70,360
Per capita	$1,597	$103	$1,630	$122	$1,638	$224
Intergovernmental from State ($M)	$0	$9,939	$0	$76,288	$0	$469,147
Per capita	$0	$1,520	$0	$992	$0	$1,495
Intergovernmental from Local ($M)	$74	$0	$2,721	$0	$19,518	$0
Per capita	$11	$0	$35	$0	$62	$0

[114] Intergovernmental revenues are those revenues received by one level of government from another level of government, such as shared taxes, grants, or loans and advances (U.S. Census Bureau, 2006).

Type of Revenue		Indiana		Region		United States	
		State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount
Property Taxes	($M)	$6	$6,482	$3,626	$61,015	$13,111	$432,989
Per capita		$1	$992	$47	$793	$42	$1,379
General Sales Taxes	($M)	$6,622	$0	$58,236	$6,920	$245,446	$69,350
Per capita		$1,013	$0	$757	$90	$782	$221
Selective Sales Taxes	($M)	$3,259	$217	$33,313	$2,191	$133,098	$28,553
Per capita		$499	$33	$433	$28	$424	$91
Public Utilities Taxes	($M)	$216	$85	$3,627	$1,153	$14,564	$14,105
Per capita		$33	$13	$47	$15	$46	$45
Individual Income Taxes	($M)	$4,766	$1,332	$72,545	$5,148	$280,693	$26,642
Per capita		$729	$204	$943	$67	$894	$85
Corporate Income Taxes	($M)	$795	$0	$9,649	$310	$41,821	$7,210
Per capita		$122	$0	$125	$4	$133	$23

Sources: (U.S. Census Bureau, 2015p; U.S. Census Bureau, 2015q)
Note: This table does not include all sources of government revenue. Summation of the specific source rows does not equal total revenue.

5.1.10. Environmental Justice

5.1.10.1 Definition of the Resource

Executive Order (EO) 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, issued in 1994, sets out principles of environmental justice and requirements that federal agencies should follow to comply with the EO (see Section 5.8.11). The fundamental principle of environmental justice is, “fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies” (USEPA, 2016e). Under the EO, each federal agency must “make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations” (Executive Office of the President, 1994). In response to the EO, the Department of Commerce developed an Environmental Justice Strategy in 1995, and published an updated strategy in 2013 (U.S. Department of Commerce, 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 EO (CEQ, 1997). Additionally, the USEPA’s Office of Environmental Justice (USEPA, 2015i) offers guidance on Environmental Justice issues and provides an “environmental justice screening and mapping tool,” EJSCREEN (USEPA, 2015n).

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).

5.1.10.2 Specific Regulatory Considerations

The IDEM uses the USEPA's fundamental principle of environmental justice noted above as its definition of environmental justice (IDEM, 2015q). IDEM issued a state environmental justice policy in 2006, affirming the importance of having a program dedicated to environmental justice matters. Through the issuance of this policy, IDEM established procedures to "ensure that the Agency and Agency staff treat all members of the public equally and fairly in the conduct of activities and decision-making processes within the Agency's jurisdiction (IDEM, 2008)." IDEM has since rescinded the policy and is in the process of drafting a new policy (Wiley, 2016).

5.1.10.3 Environmental Setting: Minority and Low-Income Populations

Table 5.1.10-1 presents 2013 data on the composition of Indiana's estimated population by race and by Hispanic origin. The state's estimated population had similar percentages of individuals who identify as Black / African American (9.2 percent) or Some Other Race (1.9 percent) when compared to the estimated population of the Central region, and lower percentages when compared to the nation's figures. Those percentages are, for Black / African American, 9.3 percent for the Central region and 12.6 percent for the nation; and for Some Other Race, 2.4 percent and 4.7 percent respectively. The state's population of people identifying as Asian (1.8 percent) was lower than that of the region (2.8 percent) and nation (5.1 percent). The state's estimated population of persons identifying as White (85.6 percent) was larger than that of the Central region (82.2 percent) and the nation (73.7 percent).

The percentage of the estimated population in Indiana that identifies as Hispanic (6.4 percent) is lower than in the Central region (8.5 percent), and considerably lower than in 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. Indiana's All Minorities estimated population percentage (19.4 percent) is lower than that of the Central region (23.3 percent) or the nation (37.6 percent).

Table 5.1.10-1: Estimated 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		
Indiana	6,570,902	84.2%	9.2%	0.2%	1.8%	0.0%	2.5%	2.2%	6.4%	19.4%
Central Region	77,314,952	82.2%	9.3%	0.7%	2.8%	0.1%	2.4%	2.5%	8.5%	23.3%
United States	316,128,839	73.7%	12.6%	0.8%	5.1%	0.2%	4.7%	3.0%	17.1%	37.6%

Source: (U.S. Census Bureau, 2015r)
"All Minorities" is defined as all persons who considered themselves Hispanic or of any race other than White. Because some Hispaincs identify as both Hispanic and of a not-White race, "All Minorities" is less than the sum of Hispanics and non-White races.

Table 5.1.10-2 presents the percentage of the estimated population living in poverty in 2013, for the state, region, and nation. The figure for Indiana (15.9 percent) is slightly higher than that for the Central region (14.7 percent) and nearly matches the nation's (15.8 percent).

Table 5.1.10-2: Percentage of Estimated Population (Individuals) in Poverty, 2013

Geography	Percent Below Poverty Level
Indiana	15.9%
Central Region	14.7%
United States	15.8%

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

5.1.10.4 Environmental Justice Screening Results

Analysis of environmental justice in a NEPA document typically begins by identifying potential environmental justice populations in the Proposed Action 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.

Table 5.1.10-1 visually portrays the results of the environmental justice population screening analysis for Indiana. The analysis used block group data from the Census Bureau's American Community Survey 2009-2013 5-Year Estimates (U.S. Census Bureau, 2015d; U.S. Census Bureau, 2015t; U.S. Census Bureau, 2015u; U.S. Census Bureau, 2015v) and Census Bureau urban classification data (U.S. Census Bureau, 2012; U.S. Census Bureau, 2015e)

Table 5.1.10-1 shows that Indiana has many areas with high and moderate potential for environmental justice populations. The distribution of these high and moderate potential areas is fairly even across the state, and occurs both within and outside of the 10 largest population concentrations.

It is important to understand how the data behind Table 5.1.10-1 affect the visual impact of this map. Block groups have similar populations (hundreds to a few thousand individuals) regardless of population density. In sparsely populated areas, a single block group may cover tens or even hundreds of square miles, while in densely populated areas, block groups each cover much less than a single square mile. Thus, while large portions of the state outside the areas defined as large population concentrations show moderate or high potential for environmental justice populations, these low density areas reflect modest numbers of minority or low-income individuals compared to the potential environmental justice populations within densely populated areas. The overall effect of this relative density phenomenon is that the map visually shows large areas of the state having environmental justice potential, but this over-represents the presence of environmental justice populations.

It is also very important to note that Table 5.1.10-1 does not definitively identify environmental justice populations. It indicates *degrees of likelihood of the presence* of populations of potential concern from an environmental justice perspective. Two caveats are important. First, environmental justice communities are often highly localized. Block group data may under- or over-represent the presence of these localized communities. For instance, in the large block groups in sparsely populated regions of the state, the data may represent dispersed individuals of minority or low-income status rather than discrete, place-based communities. Second, the definition of the moderate potential category draws a wide net for potential environmental justice populations. As discussed in Appendix D, the definition includes some commonly used thresholds for environmental justice screening that tend to over-identify environmental justice potential. Before FirstNet deploys Proposed Actions, additional site-specific analyses to identify specific, localized environmental justice populations may be warranted. Such analyses could tier-off the methodology of this PEIS.

This map also does not indicate whether FirstNet Proposed Actions would have actual impacts on environmental justice populations. An environmental justice effect on minority or low-income populations only occurs if the effect is harmful, significant (according to 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 5.2) addresses the potential for disproportionately high and adverse environmental or human health impacts on environmental justice populations.

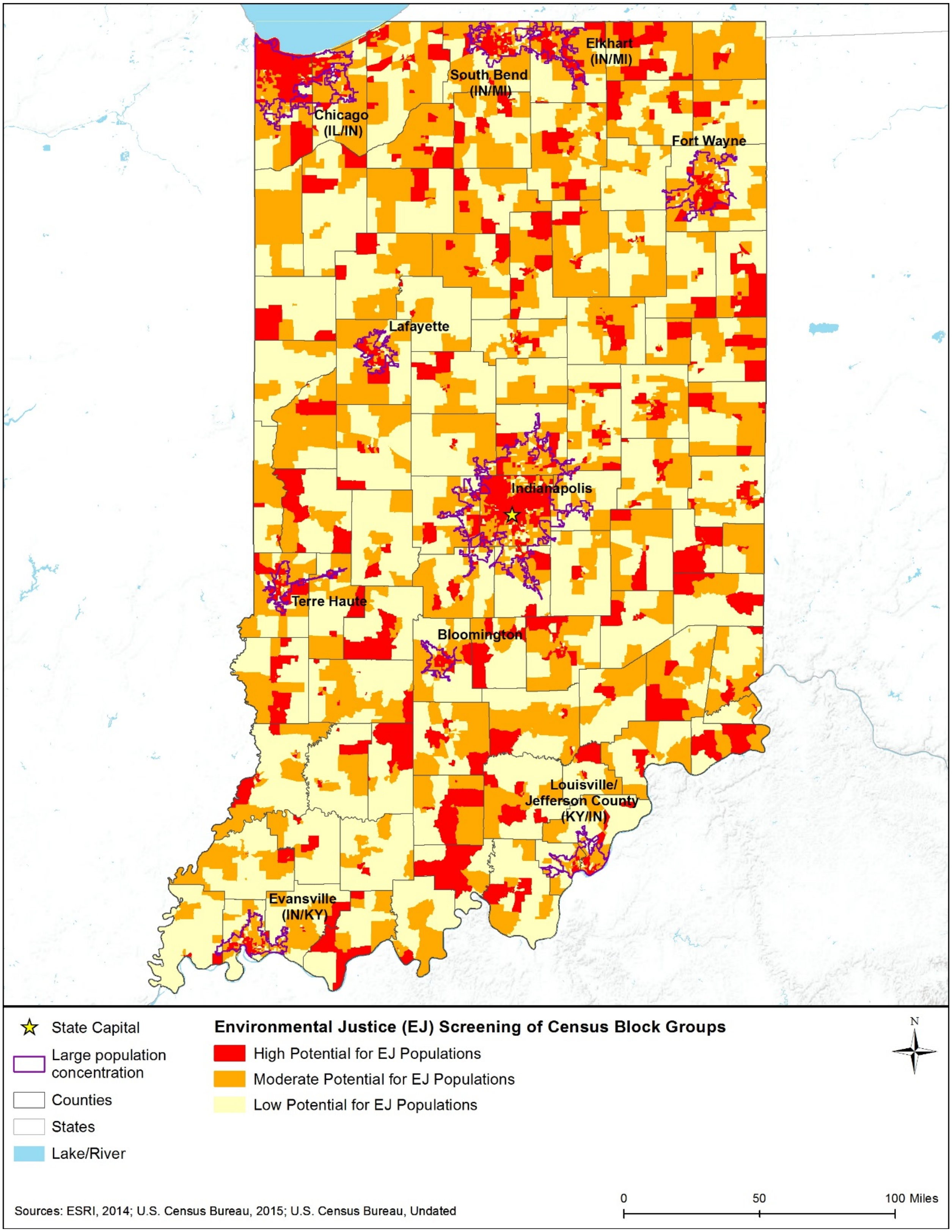

Figure 5.1.10-1: Potential for Environmental Justice Populations in Indiana, 2009–2013

5.1.11. Cultural Resources

5.1.11.1 Definition of Resource

For the purposes of this PEIS, Cultural Resources are defined as:

> Natural or manmade structures, objects, features, locations with scientific, historic, and cultural value, including those with traditional religious or cultural importance and any prehistoric or historic district, site, or building included in, or eligible for inclusion in, the National Register of Historic Places (NRHP).

This definition is consistent with the how cultural resources are defined in the:

- Statutory language and implementing regulations for Section 106 of the NHPA, formerly 16 U.S.C. 470a(d)(6)(A) (now 54 U.S.C. 306131(b)) and 36 CFR 800.16(l)(1);
- Statutory language and Implementing regulations for the Archaeological Resources Protection Act of 1979 (ARPA), 16 U.S.C. 470cc(c) and 43 CFR 7.3(a);
- Statutory language and implementing regulations for the Native American Graves Protection and Repatriation Act (NAGPRA), 25 U.S.C. 3001(3)(D) and 43 CFR 10.2(d);
- NPS's program support of public and private efforts to identify, evaluate, and protect America's historic and archeological resources (NPS, 2015e); and the
- Advisory Council on Historic Preservation's (ACHP) guidance for protection and preservation of sites and artifacts with traditional religious and cultural importance to Indian tribes or Native Hawaiian organizations (Advisory Council on Historic Preservation, 2004).

5.1.11.2 Specific Regulatory Considerations

The Proposed Action must meet the requirements of NEPA and other applicable laws and regulations. Applicable federal laws and regulations that apply to Cultural Resources include the NHPA (detailed in Section 5.1.11), the American Indian Religious Freedom Act (AIRFA), ARPA, and NAGPRA. Appendix C, Environmental Laws and Regulations, summarizes these pertinent federal laws.

Indiana has state statutes that are similar to the NHPA (refer to Table 5.1.11-1). However, federal statutes supersede these laws. 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 5.1.11-1: Relevant Indiana Cultural Resources Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Indiana State Law Historic Preservation Reviews (Sections 14, 16, and 18 of Indiana Code 14-21-1.)	Indiana State Historic Preservation Office (SHPO)	These laws mirror the NHPA for actions involving state-owned property, requiring agencies to consult with SHPO regarding potential impacts to historic properties.

5.1.11.3 Cultural and Natural Setting

Human beings have inhabited the Indiana region for more than 12,000 years (Jones & Johnson, 2012). The majority of evidence of Indiana's early human habitation comes from the study of archeological sites of pre-European contact and historic populations. In addition to the hundreds of archaeological sites listed in the state's inventory, there are 56 archaeological sites listed on the NRHP: 18 historic; 33 prehistoric; 4 of historical and prehistoric provenance; and 1 shipwreck (NPS, 2014e).

Archaeologists typically divide large study areas into regions. As shown in Figure 5.1.3-1, Indiana occupies a single physiographic region referred to as the Interior Plains. The Interior Plains are comprised the Central Lowland and Interior Low Plateaus Physiographic Provinces.

5.1.11.4 Prehistoric Setting

Archaeologists divide Indiana's prehistoric past into four periods: Paleoindian Period (10000 - 8000 B.C.), Archaic Period (8000 - 700 B.C.), Woodland Period (700 B.C. - A.D. 1200), and Mississippian Period (A.D. 1200 - 1650) (Jones & Johnson, 2012). Figure 5.1.11-1 shows a timeline representing these periods of early human habitation of present day Indiana. It is important to note that there is potential for undiscovered archaeological remains representing every prehistoric period throughout the state. Evidence of human occupation is prevalent in each of Indiana's physiographic regions. Due to advancements in techniques and associating artifacts discovered with similar ones previously assigned to a particular range of the archaeological record, the periods associated with a particular time in North American human development continue to become increasingly accurate (Pauketat, 2012; Haynes, Donahue, Jull, & Zabel, 1984; Haynes, Johnson, & Stafford, 1999).

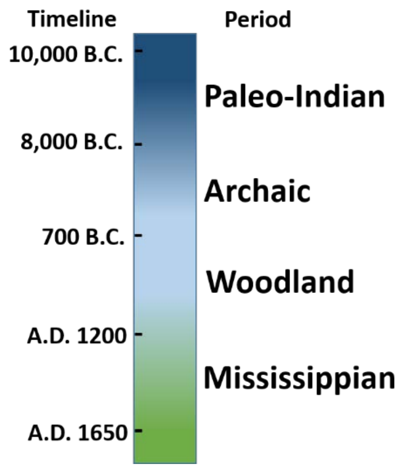

Figure 5.1.11-1: Timeline of Prehistoric Human Occupation

Sources: (Institute of Maritime History, 2015; Jones & Johnson, 2012)

Paleoindian Period (10000 - 8000 B.C.)

The Paleoindian Period represents the earliest human habitation of the Indiana region. It is hypothesized that the settlers were descendants of people who migrated to North America via a land bridge at the Bering Strait during the latter part of the last ice age (Late Pleistocene epoch) (Jones & Johnson, 2012). These early people lived in small groups of nomadic hunters and gatherers that used chipped-stone tools, including the "fluted javelin head" arrow and spear points (referred to as the Clovis fluted point). Studies show that such technology was prevalent in northeastern Asia, the Arabian Peninsula, and Spain prior to human arrival into North America (Charpentier, Inizan, & Feblot-Augustins, 2002).

Paleoindian people ranged across Indiana in small bands that followed migratory large game, such as caribou and other species that are now extinct. In nearly every county in Indiana, there is evidence of Paleoindian people using Clovis fluted point technology to hunt large animals, and the stone scrapers and long blades used to butcher them. They also constructed temporary hunting and fishing camps near streams or large water sources, and more permanent camps were near lithic materials (like chert), which were mined for tool manufacturing. (Jones & Johnson, 2012)

The Magnet Site (12PE17) is on a terrace of the Ohio River in Perry County and has yielded 80 projectile points that date to the Paleoindian Period. The tools include one Early Paleoindian Clovis fluted point, one unclassified fluted point midsection, many Late Paleoindian points, and various other stone tools. This large tool-manufacturing site was occupied for centuries during the Paleoindian Period (Smith, 1995). Other similar sites have been found in northeastern Indiana where the Great Lakes, Ohio, and the Upper Mississippi watershed meet, indicating that the region provided a long-term supply of resources for hunter-gatherer groups (White, 2006).

Archaic Period (8000 - 700 B.C.)

During the Archaic Period, the last ice age was ending and the climate was becoming warmer and dryer. The changing environment was less hospitable to large game, and the Archaic Period people diversified their diet with plants and small game. These changes coincided with a shift in the economy of the culture, and gradual development of settlement sites (Jones & Johnson, 2012).

Early Archaic sites are found throughout Indiana. The range and number of these sites indicate a considerable increase in human populations of the region, and that people were successfully adapting to the changing environment. Like their Paleoindian predecessors, Early Archaic people were nomadic hunter-gatherers, who took advantage of the seasonal variations of game and edible plants (Jones & Johnson, 2012).

Tool manufacturing became more diverse during the Early Archaic. The invention of the atlatl (spear throwing tool) occurred at this time. Spears, knives and other sophisticated tools for the processing of flora and fauna became common during this period. Grinding or "pitted" stones, milling implements, and axes provide evidence that the people were processing various types of plants (Jones & Johnson, 2012; Thies & Witty, 1992). Burned rock masses form this period are assumed to be earthen ovens for cooking (Thies & Witty, 1992).

The Middle Archaic Period of Indiana is not well understood, but there is evidence that people began to experiment with the manufacturing of pottery during this time (Jones & Johnson, 2012; Thies & Witty, 1992). The climate continued to warm and stone tools were modified and specialized for different food processing techniques. Ground stone tools, axes, and spear throwing weights are associated with the Middle Archaic Period in Indiana. Lifestyles gradually became less nomadic and more sedentary, with increasing longer occupation of settlement sites (Jones & Johnson, 2012). In the Indiana region, people of the Middle Archaic tended to occupy sites near major rivers and basin outlets, as opposed to the upper reaches of divides and basins, which were preferred during the Early Archaic Period.

Late Archaic people of Indiana continued to situate themselves near major rivers and basin outlets (Stafford, 1994). Distinct ethnic groups may have begun to be associated with particular river valleys. There is evidence that people continued to expand on their knowledge of the environment. Small points (arrowheads) associated with the advent of the bow and arrow are assigned to the Late Archaic Period. It appears that the materials used for tool making were being quarried from local sources and were of low quality. Tools from the Late Archaic include manos, mortars, grinding slabs, nutting stone, and bone and antler tools such as fishhooks, awls, and pins. They were also producing ornaments such as beads made from shell, pearls, copper pendants, gorgets, and hairpins (Jones & Johnson, 2012).

The people of the Late Archaic were living in small fishing sites or semi-permanent villages. The first ritualistic treatment of burial mounds in Indiana are associated with the Late Archaic period. (Thies & Witty, 1992; Jones & Johnson, 2012). More sophisticated pottery vessels for collecting and storing edible plants began to appear in the archaeological record during this period (Thies & Witty, 1992). The use of weedy plants such as goosefoot and lambsquarters is well documented from the Indiana archaeological record (Jones & Johnson, 2012).

The Terminal Archaic Period culture in Indiana produced increasingly sophisticated tools, such as the barbed projectile point, and which is a diagnostic for dating archeological sites from this period. Because of their ability to adapt to a lifestyle dependent on major river sources, Terminal Archaic people became to be known as the Riverton culture (Jones & Johnson, 2012).

Evidence of mortuary practices include red ochre used in rituals, and copper beads and various other implements present within burial mounds. The Riverton site (12D563) in Dearborn County has “yielded large numbers of features, Riverton and other earlier Late Archaic points, and some apparently ceremonial burials were present” (Jones & Johnson, 2012).

Woodland Period (700 B.C. - A.D. 1200)

The increased use of pottery and ceramics are the diagnostics that archaeologists use to differentiate the Woodland Period from earlier cultural periods in Indiana. Burial ceremonies continue to become more elaborate during the Early Woodland Period, and mounds with log tombs and red ochre are present. Evidence of horticultural practices are present and the people were cultivating such plants as gorges and sunflowers (Jones & Johnson, 2012).

The population of Indiana continued to grow during the Middle Woodland Period and the Hopewellian culture, known for their increase in social activities, began. Mound, earthwork complexes, and ceremonial and mortuary sites indicate that people were developing a more sophisticated culture, with a hierarchal social structure taking hold (i.e., tribal groups) (Jones & Johnson, 2012).

Tools such as blades, blade cores, figurines, panpipes, and platform pipes were manufactured during this period. Long-distance trading networks are evident by the exchanging of materials such as galena, copper, mica, shell, and obsidian that originate from outside the state. Ceremonial mounds became more elaborate, and “some of the sites have astronomical alignments within and between mound complexes” (Jones & Johnson, 2012). Horticulture continues to be a major part of subsistence during the Middle Woodland, and goosefoot, marshelder, and sunflowers were being harvested for their nutritional value (Jones & Johnson, 2012). Artifacts from the Mann site in southwestern Indiana include complicated-stamped ceramic sherds, blades, copper, cut mica, obsidian, quartz crystals, and clay human figurines. The Mann site is also one of the best examples of an elaborate earthworks village complex in the United States (Jones & Johnson, 2012).

The bow and arrow became an important component of subsistence strategy during the Late Woodland Period in Indiana. Small, triangular chipped stone (commonly referred to as arrowheads) are diagnostic markers for this period. Knives for cutting plants and hoes for intensive agriculture practices are identified for this period. Maize, beans, and squash became an important part of the diet and allow for a more sedentary lifestyle (Jones & Johnson, 2012).

Pottery became more elaborate during the Late Woodland Period. Excavation of the Bellinger site in northwestern Indiana revealed pottery dating from the Early to Late Woodland Periods. Also found at the Bellinger site were lithic tools and new pottery types (Schurr, 1997). Before the Catlin site burial mound (mound 2) in Vermillion County was destroyed for the construction of a highway in 1966, archaeologists were able to collect materials from the central pit area. Materials such as human bone and shale slabs, cord-marked sherds, and a notable steatite[115] platform pipe were retrieved. This is important because steatite is an exotic material and is an indication of trade within and among groups (Seeman, 1981).

Mississippian Period (A.D. 1200 - 1650)

The Mississippian Period is sometimes referred to as the transitional period from the Woodland culture. Pottery remains as an important marker for identifying the sites from the Mississippian Period. The pots have a distinct cord-impressed design, and the rims are thicker than those of the Woodland Period.

Mounds built during the Mississippian were constructed in a platform (truncated) style. This building style is more elaborate than structures from previous periods, with plazas, nearby villages, palisade settlements and cemeteries. Maize, beans, and squash agriculture becomes more intensified and hierarchal chiefdoms are established (Jones & Johnson, 2012).

The best example of Mississippian Period construction comes from the Angel Site in southwestern Indiana. Mound A of the Angel site is the largest of the platform mounds previously mentioned. The upper platform of Mound A is a full eight meters in height (Monaghan & Peebles, 2010). The mounds are on the banks of the Ohio River and were built between A.D. 1050 and 1400. At the height of their use, there were approximately 1,000 people

[115] Commonly known as soapstone.

living there. There are 11 elevated platform earthen mounds associated with the Angel site, and the total area is approximately 103 acres within a 75-mile radius. Religious, political and trade practices were conducted at these ceremonial centers (Indiana State Museum, 2015).

5.1.11.5 Federally Recognized Tribes of Indiana

There are no federally recognized tribes in Indiana.

5.1.11.6 Significant Archaeological Sites of Indiana

As previously mentioned in Section 5.1.11.3 there are 56 archaeological sites in Indiana listed on the NRHP. Table 5.1.11-2 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. The number of archaeological sites may increase with the discovery of new sites. A current list of NRHP sites are listed on the NPS NRHP website (http://www.nps.gov/nr/) (NPS, 2014f).

Indiana State Cultural Resources Database and Tools

The Indiana Division of Historic Preservation and Archaeology (DHPA)

The Indiana Division of Historic Preservation and Archaeology acts as the State Historic Preservation Office (SHPO) for Indiana. The goals of the division are to promote public awareness of cultural resources and foster conservation efforts through financial programs. Public resources hosted on the DHPA website (http://www.in.gov/dnr/historic/) include publications, educational resources, and lists of subject matter experts. The DHPA website also directs interested users to the Indiana State Historic Architectural and Archaeological Research Database (SHAARD), which is a free digital inventory of cultural resources in in the state. The SHAARD User Guide and related information are available at (http://www.in.gov/dnr/historic/4505.htm) (Indiana Historical Bureau, 2015).

Indiana Historical Society (IHS)

The Indiana Historical Society is a private, non-profit organization with the goal of preserving and promoting state history. The society publishes relevant literature and maintains a large collection of archival material and artifacts at the Marilyn Glick Indiana History Center in Indianapolis, ID. Additionally, IHS provides resources online through its website (http://www.indianahistory.org/), including access to IHS' continually expanding digital collections (IDNR, 2015h).

Table 5.1.11-2: Archaeological Sites on the National Register of Historic Places in Indiana

Closest City	Site Name	Type of Site
Anderson	Mounds State Park	Prehistoric
Bloomfield	Osborn Site	Prehistoric
Bloomington	Epsilon II Archeological Site (12MO133)	Prehistoric
Bloomington	Kappa V Archeological Site (12MO301)	Prehistoric
Bono	Bono Archaeological Site (12 Lr 194)	Prehistoric
Bushrod	Beehunter Archeological Site (12-Gr-315)	Historic
Charlestown	Work, John, House and Mill Site	Historic
Clarksville	Old Clarksville Site	Historic, Military
Corydon	Corydon Battle Site	Military
Delphi	Delphi Lime Kilns	Historic
Delphi	Lock No. 33 Lock Keeper's House, and Wabash and Erie Canal Lock No. 33	Historic
Delphi	Sunset Point	Historic
Derby	Rockhouse Cliffs Rock Shelters (12PE98; 12PE100)	Prehistoric
Ellettsville	Ennis Archaeological Site (12 OW 229)	Prehistoric
Evansville	Angel Mounds	Prehistoric
Fort Wayne	de Richardville, Chief Jean-Baptiste, House	Historic - Aboriginal
Graysville	Daugherty-Monroe Archaeological Site (12SU13)	Prehistoric
Hovey Lake	Ashworth Archaeological Site (12 Po 7)	Prehistoric
Hovey Lake	Hovey Lake Archaeological District	Historic, Prehistoric
Hudsonville	Glendale River Archaeological Site (12 Da 86)	Prehistoric
Huntington	Chief Richardville House and Miami Treaty Grounds	Historic - Aboriginal
Indianapolis	Archeological Sites 12Ma648 and 12Ma649	Historic
Jeffersonville	Smith--Sutton Site	Prehistoric
Kouts	Collier Lodge Site	Historic, Historic - Aboriginal, Prehistoric
Lafayette	Fort Ouiatenon	Historic, Historic - Aboriginal, Military
Lafayette	Tippecanoe Battlefield	Military
Lawrenceburg	Jennison Guard Site	Prehistoric
Marshall	Lusk Home and Mill Site	Historic
Merom	Merom Site and Fort Azatlan	Prehistoric
Michigan City	MUSKEGON Shipwreck Site	Shipwreck
Mount Vernon	Mount Vernon Site	Prehistoric
Mount Vernon	Murphy Archeological Site	Historic - Aboriginal, Prehistoric
Mt. Vernon	Mann Site	Prehistoric
New Amsterdam	Swan's Landing Archeological Site (12HR304)	Prehistoric
New Castle	Chrysler Enclosure	Prehistoric
New Castle	New Castle Archeological Site	Prehistoric
Newburgh	Ellerbusch Archeological Site (12W56)	Prehistoric
Noblesville	Castor Farm Site	Prehistoric

Closest City	Site Name	Type of Site
Noblesville	Strawtown Enclosure	Prehistoric
Noblesville	Taylor Ten	Prehistoric
North Terre Haute	Markle House and Mill Site	Historic
Oakland City	Patoka Bridges Historic District	Historic
Parker City	Windsor Mound	Prehistoric
Seymour	Low Spur Archeological Site (12J87)	Prehistoric
Seymour	Sand Hill Archeological Site 12J62	Prehistoric
Skelton	Mussel Knoll Archeological Site (12GI11)	Prehistoric
Skelton	Weber Village Archaeological Site (12 Gi 13)	Prehistoric
St. Croix	Potts Creek Rockshelter Archeological Site (12CR110)	Prehistoric
Utica	Howes', Mitchell P., Lime Kiln and Quarry	Historic
Utica	Starkweather's, Samuel, Lime Kiln and Quarry	Historic
Utica	Tyler, Moses H., Company Lime Kiln and Quarry No. 1	Historic
Vincennes	Fort Knox II Site	Historic, Military
Vincennes	Pyramid Mound (12k14)	Prehistoric
Washington	Prairie Creek Site	Prehistoric
Winchester	Fudge Site	Prehistoric
Yankeetown	Yankeetown Archeological Site	Prehistoric

Source: (NPS, 2014f)

5.1.11.7 Historic Context

In the 1670s, Rene Robert Cavelier, Sieur de La Salle, a French fur trader and explorer, became the first European to explore parts of Indiana as he traveled down the Ohio River from Canada. By the mid-18th century, French pioneers had settled in the area, with Vincennes in southern Indiana being one of their early settlements. "Named in honor of a local military commander, Vincennes was one of a chain of French fortresses that extended from Quebec to New Orleans" (Indiana Historical Society, 2010a).

Control of present day Indiana transitioned from France to England following the French and Indian War (1754 to 1764), and to the United States following the American Revolution. Indiana was a part of the Northwest Territory from 1787 to 1800, at which point it became the Indiana Territory. Settlers in Indiana "…ventured into the interior of the territory and made their homes in the central region of the territory. Indiana's northern region was settled last (during the 1830s and 1840s) by New Englanders who made this region their new home" (Indiana Historical Society, 2015a). On December 11, 1816, Indiana became the 19th state to join the Union (Indiana Historical Society, 2015b).

Industrial development, economic growth, and immigration were aided during the early-to-mid 19th century by road improvement, canal construction, and eventually railroad construction. "On October 1, 1847, the last rail was laid on the Madison and Indianapolis rail line that linked Indiana's capital with the Ohio River eighty-six miles away," allowing for more efficient trade and transportation between Indiana and the eastern states (Indiana Historical Society, 2010b).

Farming drew settlers to the state, as did textile mills like the Cannelton Cotton Mill (1848), which has been designated as a National Historic Landmark (Indiana Historical Society, 2010c). During the Civil War, Indiana provided the second largest number of soldiers of any northern state for the Union army (Indiana Historical Society, 2015c).

During the late 19th century, and lasting into the 20th century, industry developed throughout Indiana, particularly in the northern part of the state near Lake Michigan, with immigration spiking both from domestic sources and from abroad (Indiana Historical Society, 2010d). Indiana industry was supported by the state's coal and natural gas resources (Indiana Historical Society, 2015d). During World War I (WWI), many immigrants, particularly those of German heritage, were treated poorly due to the fear that immigrants might be spies for their countries of origin. More than 130,000 soldiers from Indiana served abroad in the U.S. Armed Forces during WWI (Indiana Historical Society, 2015e).

New Deal social and work relief programs mitigated some of the economic downturn of the Great Depression, until World War II (WWII) rejuvenated the state's economy with "military installations and ordinance plants [that] created thousands of new jobs and private industry shifted to wartime production" (Indiana Historical Society, 2015f). Following WWII, the economy of Indiana continued to boom, which led to both commercial and residential growth. Suburban areas grew around the state in the form of housing communities and industrial parks. This growth was fueled by the growth of the automobile, as well as continued immigration from Europe (Indiana Historical Society, 2015g).

Indiana has 1,828 NRHP listed sites, as well as 40 NHLs (NPS, 2015a). Indiana contains no National Heritage Areas (NPS, 2015d). Figure 5.1.11-2 shows the location of NRHP sites within Indiana.[116]

5.1.11.8 Architectural Context

Indiana architectural styles followed a similar development pattern as that of the rest of the United States, evolving as building methods and aesthetic changes occurred. "The earliest documented residential buildings in the state reveal traditional French building technology and log construction brought by Scots-Irish settlers moving north of the Ohio River from eastern Kentucky, West Virginia, and the Carolinas" (IDNR, 2012). As architecture evolved, house types included "I-house types, hall and parlor plans, double pens, and shotgun houses whose locations trace the pattern of early settlement in the state" (IDNR, 2012).

[116] See Section 5.1.8.4 for a more in-depth discussion of additional historic resources as they relate to recreational resources.

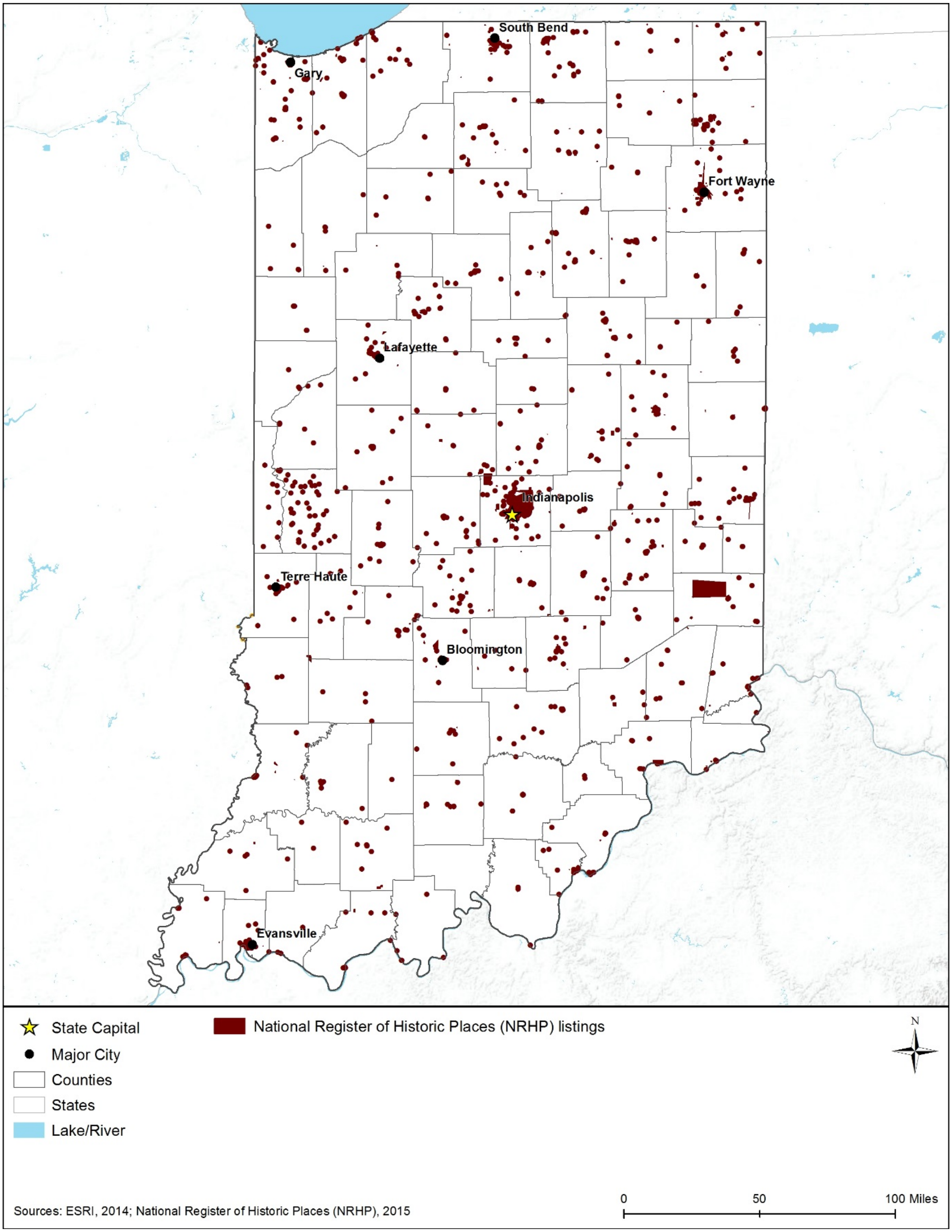

Figure 5.1.11-2: National Register of Historic Places (NRHP) Sites in Indiana

Building styles include the Federal style during the first half of the 19th century, most of which can be found in the southern part of the state in the area of usable waterways and early roads (IDNR, 2015o). The Levi Coffin House is an existing example of the Federal style. Greek Revival architecture followed, being built from about 1840 to 1860, and was implemented on various types of buildings, including civic buildings, farmhouses, and many others (IDNR, 2015i). Saint John's Episcopal Church in Crawfordsville demonstrates this type. During the second half of the 19th century, picturesque and romantic architecture gained popularity, with styles ranging from Gothic Revival, to Italianate, to Second Empire, to Queen Anne (IDNR, 2015k). Italianate architecture is extremely common, as the height of its popularity coincided with a period of rapid growth of the state's economy. The Louise Sturm Hardware Store in Jasper is one of many existing Italianate examples (IDNR, 2015d).

During the early 20th century, revival architecture became popular, including Colonial Revival and Neoclassical Revival. This was overlapped and followed by the Prairie style, Craftsman style, and bungalow and foursquare house types (IDNR, 2015k). "More recently, in the explosion of housing construction following World War II, whole residential neighborhoods were platted, many oriented more towards interstate highways and regional shopping malls than toward downtowns" (IDNR, 2012). The construction of these large suburban neighborhoods has resulted in the loss of many historic houses and traditionally rural farm areas (IDNR, 2012). Modern styles were built as well, such as Art Deco, Art Moderne, and International; the Leeson's Building in Elwood is an example of Art Deco architecture (IDNR, 2015k) (IDNR, 2015e).

"A number of Indiana's township schools have survived with some, like Howard School in Boone County, being interpreted" (IDNR, 2012). In addition, a variety of 20th century historic structures have been converted into housing and office space, with historic schools and factory buildings being examples. Indiana's collegiate campuses have also survived in a manner that is sympathetic to historic resources, which has resulted in historic buildings and campus layouts remaining intact. Historic churches vary from being small and vernacular to large high style structures. Mills were common along waterways that were used to power machinery, with the Cannelton Cotton Mill (1848), in Cannelton being a surviving example (IDNR, 2012).

Transportation improvements have been important to the history of the state. While canals that were built during the second quarter of the 19th century were surpassed by railroads in importance, "canal beds, tow paths, locks, and feeder dams" still exist today (IDNR, 2012). Bridges of varying styles have been built over the years, with existing historic bridges displaying the evolution of building technology and engineering methods (IDNR, 2015f). Early bridges were often covered wooden bridges; however, many have been replaced as road capacities increased. Historic roadways, such as the National Road, were remade into larger highways during the early 20th century, or the Interstate Highway System in the 1950s (IDNR, 2012).

Figure 5.1.11-4: Representative Architectural Styles of Indiana

- Top Left – Log Farm House (Brown County, IN) – (United States Resettlement Administration, 1935)
- Top Center – North Christian Church (Columbus, IN) – (Korab, 1959)
- Top Right – Indianapolis Courthouse (Indianapolis, IN) – (Detroit Publishing Company, 1904)
- Bottom Left – Indiana State House (Indianapolis, IN) – (Detroit Publishing Company, 1900)
- Bottom Right – Cannelton Mill (Cannelton, IN) – (Historic American Engineering Record, 1968)

5.1.12. Air Quality

5.1.12.1 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[117] 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)[118] or micrograms per cubic meter ($\mu g/m^3$) determined over various periods of time (averaging time).[119] This section discusses the existing air quality in Indiana. The USEPA designates areas within the United States as attainment,[120]

[117] Topography: The unique features and shapes of the land (e.g., valleys and mountains).
[118] Equivalent to 1 milligram per liter (mg/L).
[119] 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, 2015t).
[120] Attainment areas: Any area that meets the national primary or secondary ambient air quality standard for the pollutant (USEPA, 2015j).

nonattainment,[121] maintenance,[122] or unclassifiable[123] 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.

5.1.12.2 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[124] or secondary,[125] 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, 2016f). HAPs can have severe adverse impacts on human health and the environment, including increased risk of cancer, reproductive issues, or birth defects. HAPs are federally regulated under the CAA via the National Emission Standards for Hazardous Air Pollutants (NESHAPs). USEPA developed the NESHAPs for sources and source categories emitting HAPs that pose a risk to human health. Appendix E presents a list of federally regulated HAPs.

In conjunction with the federal NAAQS, Indiana maintains its own air quality standards, the Indiana Ambient Air Quality Standards (IN AAQS). Indiana Department of Environmental Management (IDEM) follows the NAAQS and have state requirements for Total Suspended Particulates (TSP) and 1-hour Ozone. Table 5.1.12-1 presents an overview of the IN AAQS as defined by Indiana Department of Environmental Management's (IDEM) Office of Air Quality (OQA).

[121] 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, 2015j).
[122] 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, 2015j).
[123] 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, 2015j).
[124] 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, 2014a).
[125] 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, 2014a).

Table 5.1.12-1: Indiana Ambient Air Quality Standards

Pollutant	Averaging Time	Primary Standard		Secondary Standard		Notes
		µg/m^3	ppm	µg/m^3	ppm	
CO	8-hour	10,000	9	-	-	Standard is not to be exceeded more than once per year
	1-hour	40,000	35	-	-	
Lead	3-month	0.15	-	Same as Primary		Arithmetic mean concentration over a three (3) month period
NO_2	1-hour	-	0.10	-	-	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	Annual	100	0.053	Same as Primary		Annual mean
PM_{10}	24-hour	150	-	Same as Primary		Maximum twenty-four (24) hour average concentration
$PM_{2.5}$	Annual	12	-	15	-	Annual arithmetic mean concentration
	24-hour	35	-	Same as Primary		Ninety-eighth percentile twenty-four (24) hour concentration
O_3	1-hour	235	0.12	Same as Primary		The expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is equal to or less than one (1) as determined by 40 CFR 50, Appendix H
	8-hour	-	0.075	Same as Primary		Annual fourth-highest daily maximum 8-hour 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	-	-	1,300	0.5	Not to be exceeded more than once per year
TSP	Annual	75	-	-	-	Annual geometric mean
	24-hour	260	-	150	-	Not to be exceeded more than one (1) day per year

Source: (IDEM, 2015a)

Title V Operating Permits/State Operating Permits

Indiana 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). IAC Title 326 Air Pollution Control Division - Article 2 Rule 7 (Part 70 Permit Program) describes the applicability of Title V operating permits. Indiana 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 5.1.12-2). The permit issued to a facility contains both state and federal portions and incorporates a reporting schedule (USEPA, 2014b).

Table 5.1.12-2: Major Air Pollutant Source Thresholds

Pollutant	TPY
Any Criteria Pollutant*	100
Single HAP	10
Total/Cumulative HAPs	25

*Sources in nonattainment areas will have lower thresholds for some criteria pollutants depending on the classification of the nonattainment area.
Source: (USEPA, 2014b).

Exempt Activities

IDEM Title 326 IAC 2-7-2 (Applicability to the Part 70 Permit) exempts the following sources from obtaining a Title V (Part 70 Permit):

- A source for which the commissioner has issued an operating agreement under 326 IAC 2-9 [Source Specific Operating Agreement Program].
- A source that is not subject to this rule because it meets the requirements of 326 IAC 2-10 [Permit by Rule] or 326 IAC 2-11 [Permit by Rule for Specific Source Categories]" (IDEM, 2015b)

Temporary Emissions Sources Permits

Under IAC Title 326 IAC 2-7-14 (temporary source permits) the IDEM commissioner can issue a temporary single Part 70 permit for a source that is not an affected source, works at multiple temporary locations, and moves at least once during the duration of the permit. New portable sources must be registered or permitted if they meet the requirements of Rule 5.1 (Construction of a New Source) or Rule 6.1 (Minor Source Operating Permit Program).

State Preconstruction Permits

Preconstruction registration and permits must be submitted prior to any work that qualifies for a major or minor source permit as defined in Rule 2-5.1 (Construction of New Sources), Rule 6.1 (Minor Source Operating Permit Program), Rule 2-7-8 (Permit Issuances, Renewal, and Revisions), and 2-7-10.5 (Part 70 Permits; Source Modification). For the State Minor Source and Synthetic Title V Permit the operating and construction permits are inclusive in one permit.

Additionally, IDEM details the exemptions for construction, modification, and permit of any emission unit, operation, or process under Title 326 IAC 2-1.1-3 (State Construction and Operating Permit Requirements-Exemptions). The following sources will be exempt from minor source permitting:

- New sources or modification to existing sources that have the potential to emit less than the potential to emit (PTE) thresholds in Table 5.1.12-3. PTE thresholds are based on a site aggregate.

Table 5.1.12-3: Minor Source Potential to Emit (PTE) Thresholds

Pollutant	TPY
PM, PM_{10}, or direct $PM_{2.5}$	5
SO_2, NO_x, and VOC	10
CO	25

Pollutant	TPY
Lead	0.2
Single HAP	1
Total/Cumulative HAPs	2.5
Hydrogen sulfide (H_2S), Total reduced sulfur (TRS), Reduced sulfur compounds, and Fluorides	5

Source*:* (IDEM, 2015b)

- New or modification to existing sources that consist of activities only associated with the following emergency generators:
  - Gasoline generators not exceeding 110 horsepower.
  - Diesel generators not exceeding 1,600 horsepower.
  - Natural gas turbines or reciprocating engines not exceeding 16,000 horsepower. (IDEM, 2015b)

General Conformity

Established under Section 176(c)(4) of the CAA, "the General Conformity Rule ensures that the actions taken by federal agencies in nonattainment and maintenance areas do not interfere with a state's plans to meet national standards for air quality" outlined in the 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 (USEPA, 2013a).

The estimated pollutant emissions are compared to *de minimis*[126] levels. These values are the minimum thresholds for which a conformity determination must be performed (Table 5.1.12-4). As a result, lower *de minimis* thresholds for VOCs and NO_X could apply depending on the attainment status of a county.

[126] USEPA states that "40 CFR 93 § 153 defines de minimis levels, that is, the minimum threshold for which a conformity determination must be performed, for various criteria pollutants in various areas" (USEPA, 2016b).

Table 5.1.12-4: *De Minimis* Levels

Pollutant	Area Type	TPY
Ozone (VOC or NO_X)	Serious Nonattainment	50
	Severe Nonattainment	25
	Extreme Nonattainment	10
	Other areas outside an OTR	100
Ozone (NO_X)	Maintenance	100
Ozone (VOC)	Maintenance outside an OTR	100
CO, SO_2, NO_2	All Nonattainment and Maintenance	100
PM_{10}	Serious Nonattainment	70
	Moderate Nonattainment and Maintenance	100
$PM_{2.5}$ (Direct Emissions) (SO_2) (NO_X (unless determined not to be a significant precursor)) (VOC or ammonia (if determined to be significant precursors))	All Nonattainment and Maintenance	100
Lead	All Nonattainment and Maintenance	25

Source: (U.S. Government Publishing Office, 2010)

If a Proposed Action does not result in an emissions increase above the *de minimis* levels in Table 5.1.12-4, 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 5.1.12-4, then the Proposed Action must undergo a conformity determination. The federal agency must first show that the Proposed Action would meet all SIP control requirements and that any new emissions would not cause a new violation of the NAAQS. To demonstrate conformity,[127] 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 Proposed Action;
- Show the emissions would be fully offset by implementing reductions from another source in the same area; and
- Conduct air quality modeling that demonstrates the emissions would not cause or contribute to new violations of the NAAQS, or increase the frequency or severity of any existing violations of the NAAQS (USEPA, 2010).

State Implementation Plan (SIP) Requirements

The Indiana SIP is composed of many related actions to ensure ambient air concentrations of the six criteria pollutants comply with the NAAQS. Indiana's SIP is a conglomeration of separate actions taken for each of the pollutants. All of Indiana's SIP actions are codified under 40 CFR

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

Part 52 Subpart P. A list of all SIP actions for all six criteria pollutants can be found on IDEM Office of Air Quality's (http://www.in.gov/idem/airquality/2335.htm).

5.1.12.3 Environmental Setting: Ambient Air Quality

Nonattainment Area

The USEPA classifies areas as attainment, nonattainment, maintenance, or unclassifiable for six criteria pollutants. When evaluating an area's air quality against regulatory thresholds (i.e., permitting and general conformity), maintenance areas are often combined with nonattainment, while unclassifiable areas are combined with attainment areas. Figure 5.1.12-1 and Table 5.1.12-5 present the current nonattainment areas in Indiana as of January 30, 2015. The years listed in the table for each pollutant indicate when USEPA promulgated the standard for that pollutant; note that, for $PM_{2.5}$, O_3, and SO_2, these standards listed are in effect. Table 5.1.12-5 contains a list of the counties and their respective current nonattainment status for each criteria pollutant. The year(s) listed in the table for each pollutant indicate when USEPA promulgated the AAS for that pollutant; note that, for CO, Lead, PM_{10}, $PM_{2.5}$, O_3, and SO_2, these standards listed are in effect. Unlike Table 5.1.12-5, Figure 5.1.12-1, does not differentiate between standards for the same pollutant. Additionally, given that particulate matter is the criteria pollutant of concern, PM_{10} and $PM_{2.5}$ merge in the figure to count as a single pollutant.

Table 5.1.12-5: Indiana Nonattainment and Maintenance Areas by Pollutant Standard and County

County	Pollutant and Year USEPA Implanted Standard										
	CO	Lead		NO_2	PM_{10}	$PM_{2.5}$		O_3		SO_2	
	1971	1978	2008	1971	1987	1997	2006	1997	2008	1971	2010
Allen								M			
Boone								M			
Clark						X-4		M			
Daviness											X-6
Dearborn						M		M	X-5		
Delaware			X-6					M			
Dubois						M					
Elkhart								M			
Floyd						X-4		M			
Gibson						M					
Green								M			
Hamilton						M		M			
Hancock								M			
Hendricks						M		M			
Jackson								M			
Jefferson						X-4					
Johnson						M		M			
La Porte								M		M	
Lake	M				M	M		M	X-5	M	
Madison								M			
Marion	M	M				M		M		M	X-6
Morgan						M		M			X-6
Pike						M					X-6

County	Pollutant and Year USEPA Implanted Standard										
	CO	Lead		NO_2	PM_{10}	$PM_{2.5}$		O_3		SO_2	
	1971	1978	2008	1971	1987	1997	2006	1997	2008	1971	2010
Porter						M		M	X-5		
Shelby								M			
Spencer						M					
St Joseph								M			
Vanderburgh						M		M			
Vermillion					M						
Vigo								M		M	X-6
Warrick						M		M			
Wayne										M	

Source: (USEPA, 2015o)
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, a The years under each pollutant represent the year that the specific national standard was implemented.

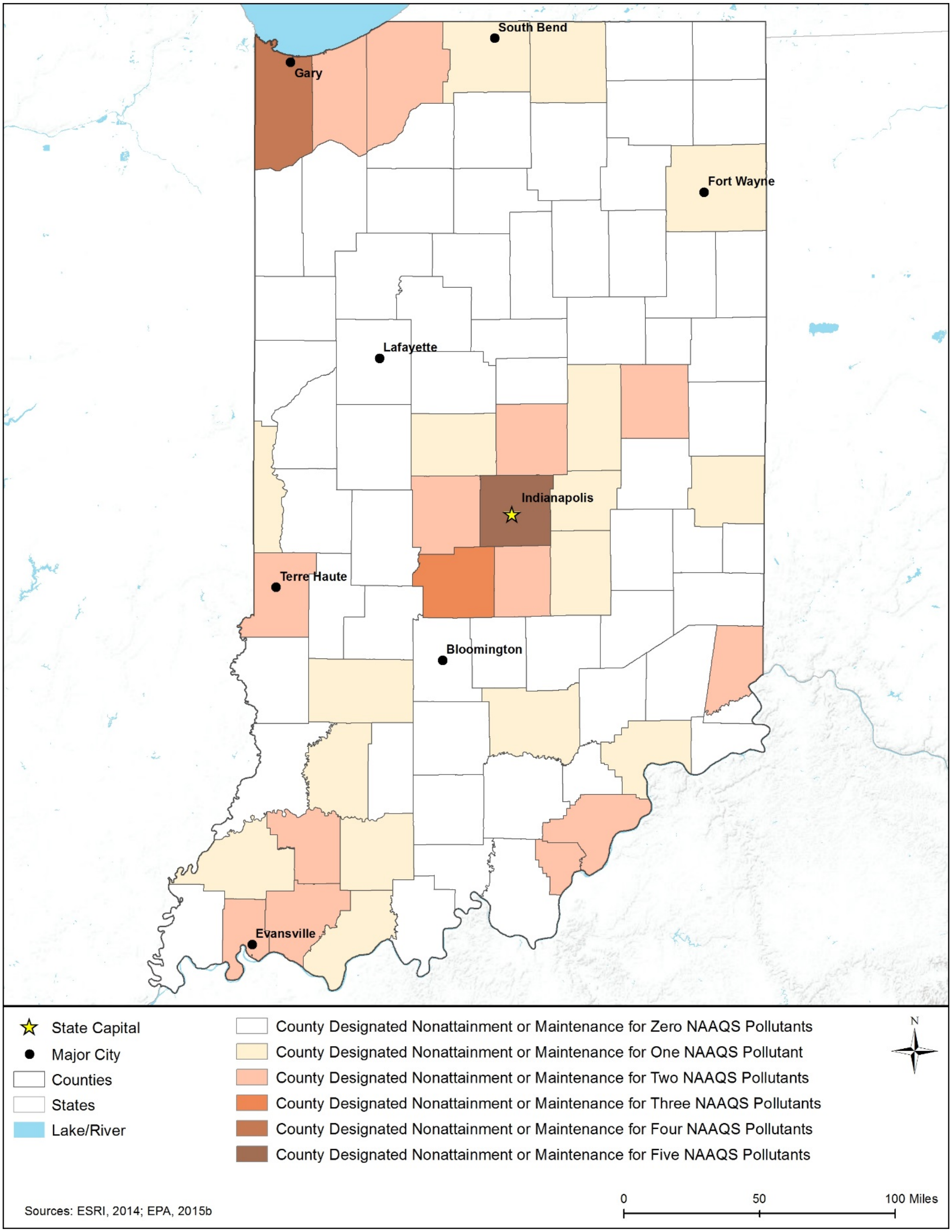

Figure 5.1.12-1: Nonattainment and Maintenance Counties in Indiana

Air Quality Monitoring and Reporting

IDEM measures air pollutants at 82 sites across the state as part of the National Air Monitoring Stations Network and the state and local Air Monitoring Stations Network. Annual Indiana State Ambient Air Quality Reports are prepared, containing pollutant data summarized by region. The IDEM reports real-time pollution levels for 62 sites for O_3 and $PM_{2.5}$ on their website (http://idem.tx.sutron.com/cgi-bin/airfacts.pl) to inform the public, as O_3 and $PM_{2.5}$ are the main pollutant of concern in Indiana (IDEM, 2015o).

Air Quality Control Regions

The USEPA classified all land in the United States as a Class I, Class II, or Class III Federal Air Quality Control Region (AQCR) (42 U.S.C. 7470). These are different from the air quality classification levels defined in Table 5.1.12-1 as part of the NYAAQS. 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 the USEPA developed the standards for a Class III AQCR, to date they have not actually classified any area as Class III. Therefore, any area that is not classified as a Class I area is, by default, automatically designated as a Class II AQCR (42 U.S.C. 7470).

In a 1979 USEPA memorandum, the Assistant Administrator for Air, Noise, and Radiation (USEPA, 1979) advised the 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[128] of a Class I area. "The EPA's policy is that FLMs should be notified by the Regional Office about any project that is within 100 kilometers of a Class I area. For sources having the capability to affect air quality at greater distances, notification should also be considered for Class I areas beyond 100 kilometers" (Page, 2012). The 2005 USEPA guidelines for air quality modeling do not provide a precise modeling range for Class I areas.

- PSD applies to new major sources or major modifications at existing sources for pollutants where the source is in an attainment or unclassifiable area. An air quality analysis is required for sources subject to PSD requirements and generally consists of using a dispersion model to evaluate emission impacts to the area. "Historically, the EPA guidance for modeling air quality impacts under the PSD program has tended to focus more on the requirements for a Class II modeling analysis. Such guidance has provided that applicants need not model beyond the point of significant impact or the source or 100 kilometers[129] (the normal useful range of EPA-approved Gaussian plume models" (USEPA, 1992).

Indiana does not contain any Federal Class I areas; all land within the state is classified as Class II (USEPA, 2012a). If an action is considered major source and consequently subject to PSD requirements, the air quality impact analysis need only to analyze the impacts to air quality within 100 kilometers from the source (Seitz, 1992). There is a Class I area where the 100-kilometer buffer intersects a few Indiana counties. Any PSD-applicable Proposed Action within

[128] The memorandum and associated guidance use kilometers. 100 kilometers is equal to about 62 miles.
[129] The memorandum and associated guidance use kilometers; 50 kilometers is equal to about 31 miles.

these counties would require FLMs notification from the appropriate Regional Office. Figure 5.1.12-2 provides a map of Indiana highlighting all relevant Class I areas and all areas within the 100-kilometer radiuses. The numbers next to each of the highlighted Class I areas in Figure 5.1.12-2 and correspond to the numbers and Class I areas listed in Table 5.1.12-6.

Table 5.1.12-6: Relevant Federal Class I Areas

#[a]	Area	Acreage	State
1	Mammoth Cave National Park	51,303	KY

Source: (USEPA, 2012a)
[a] The numbers correspond to the shaded regions in Figure 5.1.12-2.

Figure 5.1.12-2: Federal Class I Areas with Implications for Indiana

5.1.13. Noise

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

5.1.13.1 Definition of the Resource

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

The effects of noise can be classified into three categories:

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

Fundamentals of Noise

For environmental noise analyses, a noise metric refers to the unit that quantitatively measures the effect of noise on the environment. The unit used to describe the intensity of sound is the decibel (dB). Audible sounds range from 0 dB (“threshold of hearing”) to about 140 dB (“threshold of pain”) (OSHA, 2016b). The vibration frequency characteristics of the sound, measured as sound wave cycles per second [Hertz (Hz)], determines the pitch of the sound (Federal Transit Authority, 2006). 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 (OSHA, 2016b).

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

- The total sound energy radiated by a source, usually reported as a sound power level.
- The actual air pressure changes experienced at a particular location, usually measured as a sound pressure level (SPL) (the frequency characteristics and SPL combine to determine the loudness of a sound at a particular location).
- The duration of a sound.
- The changes in frequency characteristics or pressure levels through time.

Figure 5.1.13-1 presents the sound levels of typical events that occur on a daily basis in the environment. For example, conversational speech is measured at about 55 to 60 dBA, whereas a band playing loud music may be as high as 120 dBA.

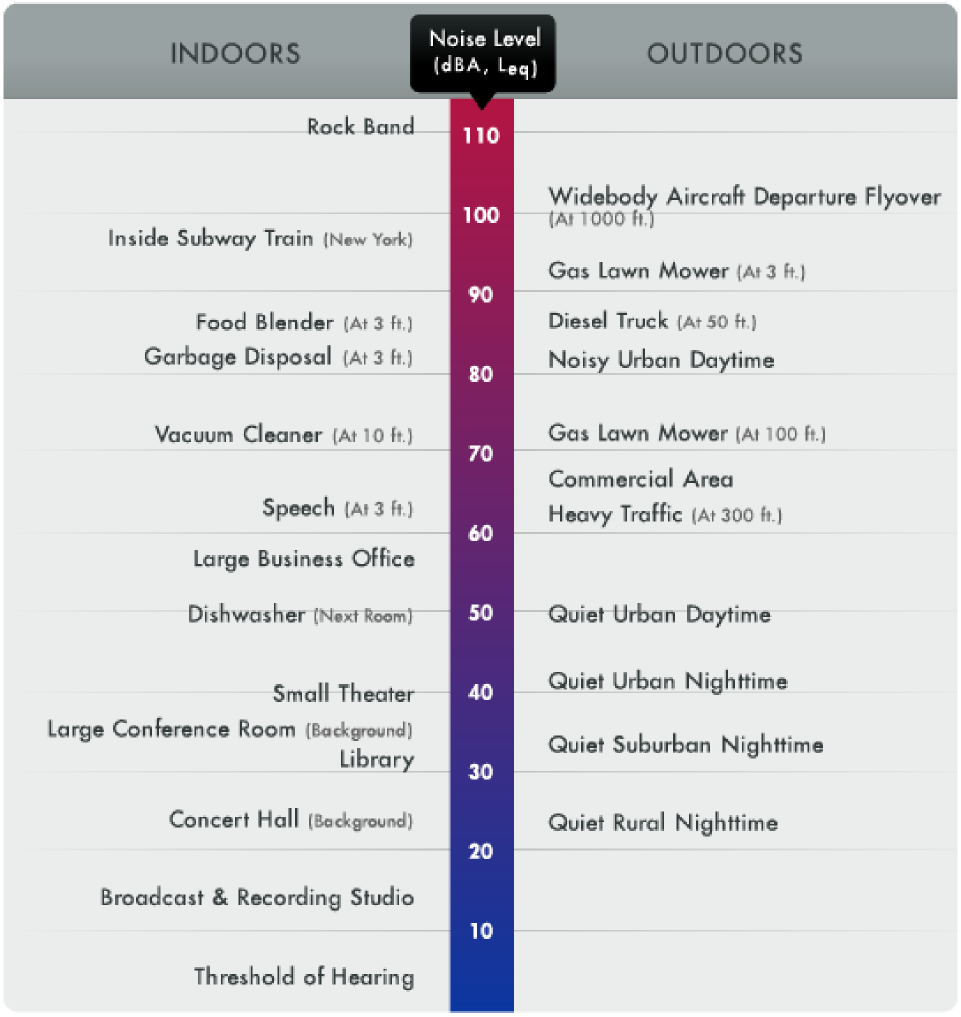

Figure 5.1.13-1: Sound Levels of Typical Sounds

Leq: Equivalent Continuous Sound Level
Source: (Sacramento County Airport System, 2015)
Prepared by: Booz Allen Hamilton

Because of the logarithmic unit of measurement, sound levels cannot be added or subtracted linearly. However, several methods of estimating sound levels can be useful in determining approximate sound levels. First, if two sounds of the same level are added, the sound level increases by approximately three dB (for example: 60 dB + 60 dB = 63 dB). Secondly, the sum of two sounds of a different level is slightly higher than the louder level (for example: 60 dB + 70 dB = 70.4 dB).

The changes in human response to changes in dB levels is categorized as follows (Federal Transit Authority, 2006):

- A 3-dB change in sound level is considered a barely noticeable difference;
- A 5-dB change in sound level will typically result in a noticeable community response; and

- A 10-dB change, which is generally considered a doubling of the sound level, almost certainly causes an adverse community response.

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

5.1.13.2 Specific Regulatory Considerations

As identified in Appendix C, Environmental Laws and Regulations, the Noise Control Act of 1972, along with its subsequent amendments (e.g., Quiet Communities Act of 1978 [42 U.S.C. Parts 4901−4918]), delegates authority to the states to regulate environmental noise and directs government agencies to comply with local community noise statutes and regulations. Although no federal noise regulations exist, the USEPA has promulgated noise guidelines (USEPA, 1974). Similarly, most states have no quantitative noise-limit regulations.

Indiana has several statewide noise regulations, which are compiled under the Indiana Code. They mainly apply to motor vehicle functions, such as engine horns and mufflers. Table 5.1.13-1 provides a brief summary of these regulations.

Table 5.1.13-1: Relevant Indiana Noise Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
IC9-19-8-3	The Indiana General Assembly	Requires vehicles to be equipped with a noise muffler. (Indiana General Assembly, 2015h)
IC9-19-14-3	The Indiana General Assembly	Regulates the use of sirens, whistles, and bells on emergency vehicles. (Indiana General Assembly, 2015h)

Many cities and towns may have additional, local noise ordinances to further manage community noise levels. The noise limits specified in such ordinances are typically applied to define noise sources and specify a maximum permissible noise level. Larger cities and towns, such as Indianapolis, Fort Wayne, and Evansville 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).

5.1.13.3 Environmental Setting: Ambient Noise

The range and level of ambient noise in Indiana varies widely based on the area and environment of the area. The population of Indiana can choose to live and interact in areas that are large cities, rural or suburban communities, small towns, and national and state parks. Figure 5.1.13-1 illustrates noise values for typical community settings and events that are representative of what the population of Indiana may experience on a day-to-day basis. These noise levels represent a wide range and are not specific to Indiana. As such, this section describes the areas where the population of Indiana 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 urban areas that are likely to have the highest ambient noise levels in the state are Indianapolis, Fort Wayne, and Evansville.
- **Airports:** Areas surrounding airports tend to have higher noise levels due to aircraft operations that occur throughout the day. A jet engine aircraft can produce between 130 to 160 dBA in its direct proximity (FAA, 2007). However, commercial aircraft are most likely to emit noise levels between 70 to 100 dBA depending of the type of aircraft and associated engine (FAA, 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 is in proximity to urban communities resulting in noise exposures from aircraft operations (arrivals/departures) to surrounding areas at higher levels and with the potential for increased noise levels during peak operation times (early morning and evenings), when there is an increase in air traffic. The noise levels in areas surrounding commercial airports can have significantly higher ambient noise levels than in other areas. In Indiana, Indianapolis International Airport (IND) and South Bend International Airport (SBN) have combined annual operations of more than 187,000 flights, with IND accounting for more than 151,000 of those flights (FAA, 2015c). These operations result in increased ambient noise levels in the surrounding communities. See Section 5.1.7, Land Use, Recreation, and Airspace, and Figure 5.1.7-4 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, 2015d). There are a number of major highways within the state that may contribute to higher ambient noise levels for residents living near those traffic corridors. The major highways in the state tend to have higher than average ambient noise levels on nearby receptors, ranging from 52 to 75 dBA (FHWA, 2015d). See Section 5.1.1, Infrastructure, and Figure 5.1.1-1 for more information about the major highways in the state.
- **Railways:** Like highways, railways tend to have higher than average ambient noise levels for residents living in close proximity (Federal Transit Authority, 2006). Railroad operations can produce noise ranging from 70 dBA for an idling locomotive to 115 dBA when the locomotive engineer rings the horn while approaching a crossing (FRA, 2015b). Indiana has multiple rail corridors with passenger rail traffic. For example, the Indiana section of the Cardinal route stops in Connersville, Indianapolis, Crawfordsville, Lafayette, Rensselaer, and Dyer. The Indiana section of the Capitol Limited and Lake Shore Limited routes stop in Waterloo, Elkhart, and South Bend (INDOT, 2011). See Section 5.1.1, Infrastructure, and Figure 5.1.1-1 for more information about rail corridors in the state.

- **National and State Parks:** The majority of national and state parks are likely to have lower than average ambient noise levels given their size and location in wilderness areas. National and state parks, historic areas, and monuments are protected areas to preserve these areas in their natural environment. These areas typically have lower noise levels, as low as 30 to 40 dBA (NPS, 2014g). Indiana has three NPS units and 30 National Natural Landmarks (NPS, 2015a). Visitors to these areas expect lower ambient noise conditions than the surrounding urban areas. See Section 5.1.8, Visual Resources, and Figure 5.1.8-3 for more information about national and state parks for Indiana.

5.1.13.4 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 Indiana have at least one school, church, or park, in addition to likely having other noise-sensitive receptors. There are most likely thousands of sensitive receptors throughout Indiana.

5.1.14. Climate Change

5.1.14.1 Definition of the Resource

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

Accelerated rates of climate change are linked to an increase in atmospheric concentrations of greenhouse gas (GHG) caused by emissions from human activities such as burning fossil fuels to generate electricity (USEPA, 2012b). The IPCC is now 95 percent certain that humans are the main cause of current global warming (IPCC, 2013). Human activities result in emissions of four main GHGs: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and halocarbons (a group of gases containing fluorine, chlorine, or bromine) (IPCC, 2007). The common unit of measurement for GHGs is metric tons of CO_2-equivalent[130] (MT CO_2e), which equalizes for the different global warming potential of each type of GHG. Where this document references emissions of CO_2 only, the units are in million metric tons (MMT) CO_2. Where the document references emissions of multiple GHGs, the units are in MMT CO_2e.

[130] CO_2e refers to Carbon Dioxide Equivalent, "A metric measure used to compare the emissions from various greenhouse gases based upon their global warming potential (GWP). Carbon dioxide equivalents are commonly expressed as million metric tons of carbon dioxide equivalents (MMT CO_2e). The carbon dioxide equivalent for a gas is derived by multiplying the tons of the gas by the associated GWP. MMT CO_2e = (million metric tons of a gas) * (GWP of the gas)." (USEPA, 2015r)

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 concentration 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 5.2, Environmental Consequences). Existing climate conditions in the Proposed Action 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 / drought; and 3) severe weather events.

5.1.14.2 Specific Regulatory Considerations

The pertinent federal laws relevant to the protection and management of climate change are summarized in Appendix C, Environmental Laws and Regulations. Indiana has not established goals and regulations to reduce GHG emissions to combat climate change.

5.1.14.3 Indiana Greenhouse Gas Emissions

Estimates of Indiana'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 methane (CH_4) and nitrous oxide (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, 2015k). Individual states have developed their own GHG inventories, which are updated with different frequencies and trace GHG in a variety of ways.

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

According to the EIA, Indiana emitted a total of 199.8 MMT of CO_2 in 2013. CO_2 emissions were dominated by the electric power sector (49 percent), followed by the industrial sector (23 percent) transportation sector (20 percent). The electric power sector is responsible for most of the coal emissions, at 93 MMT. The industrial sector consumes most of the natural gas, and the transportation sector consumes most of the petroleum products (Table 5.1.14-1) (EIA, 2015h). Annual emissions between 1980 and 2013 are represented in Figure 5.1.14-1. Indiana's CO_2 emissions initially declined between 1980 and 1982 before increasing to a high of 238.3 MMT in 2000 where they remained steady until 2007 when they began to decline to their current level, with a slight increase in 2013. Both increases and declines were driven by emissions from coal. In recent years emissions from natural gas have increased moderately. Indiana was ranked 7th in the U.S. for total CO_2 emissions in 2013, and 8th overall for per capita CO_2 emissions (EIA, 2015f).

The majority of Indiana's GHG emissions are CO_2. These emissions are the result of fossil fuel combustion for the purpose of producing energy, mostly petroleum products from electric power generating facilities and coal-fired power plants. Other major GHGs emitted in Indiana are CH_4, hydrofluorocarbons, NO_x, sulfur hexafluoride (SF_6) and perfluorocarbons (EIA, 2015g).

Indiana does not currently have an official state-level GHG emission inventory. Total U.S. GHG greenhouse were 6,673 million metric tons (14.7 trillion pounds) in 2013. In 2012, Indiana emitted 194.9 million metric tons of CO_2, or 2.9 percent of the total. Emissions came from energy related activities across all sectors such residential (19.6 percent) commercial (13.3 percent) industrial (45.7 percent) and, transportation (21.4 percent). Overall, the electric power sector is the largest single contributor to greenhouse gas emissions in Indiana in 2013 (EIA, 2015d).

The Whiney Refinery, located in Indiana, is the largest inland crude oil refinery in the United States. Indiana also has one smaller refinery in Mount Vernon and 14 ethanol facilities. Even though Indiana is a large consumer of motor gas, fuel and, diesel oils the majority of the state does not require reformulated gasoline to help reduce emissions (EIA, 2015g).

Natural gas was first discovered in Indiana in the 1870s however, the state did not start producing large quantities until the last two decades. The industrial and residential sectors rely heavily on natural gas and as a result, Indiana cannot keep up with the growing demand. The interstate pipeline from the U.S. Gulf Coast and Canada supply more than half of Indiana's natural gas needs (EIA, 2015g).

Indiana is a large supplier of bituminous coal used for the industrial sector, mainly for coke production and steel manufacturing. The state is one of the largest producers in the nation however, it does not meet the demands so "coal is shipped by rail from Illinois, Wyoming, West Virginia, Kentucky, Virginia, Alabama, and Pennsylvania, with small amounts from Colorado, Utah, and Ohio" Coal is Indiana's main source of electricity generation with natural gas and wind accounting for the remainder (EIA, 2015g) (EIA, 2015d).

Figure 5.1.14-1: Indiana CO_2 Emissions from Fossil Fuels by Fuel Type and Sector, 2013

Fuel Type (MMT)		**Source (MMT)**	
Coal	112.8	Residential	8.7
Petroleum Products	50.9	Commercial	5.4
Natural Gas	36.1	Industrial	46.4
		Transportation	40.9
		Electric Power	98.4
Total	**199.8**	**Total**	**199.8**

Source: (EIA, 2015h)

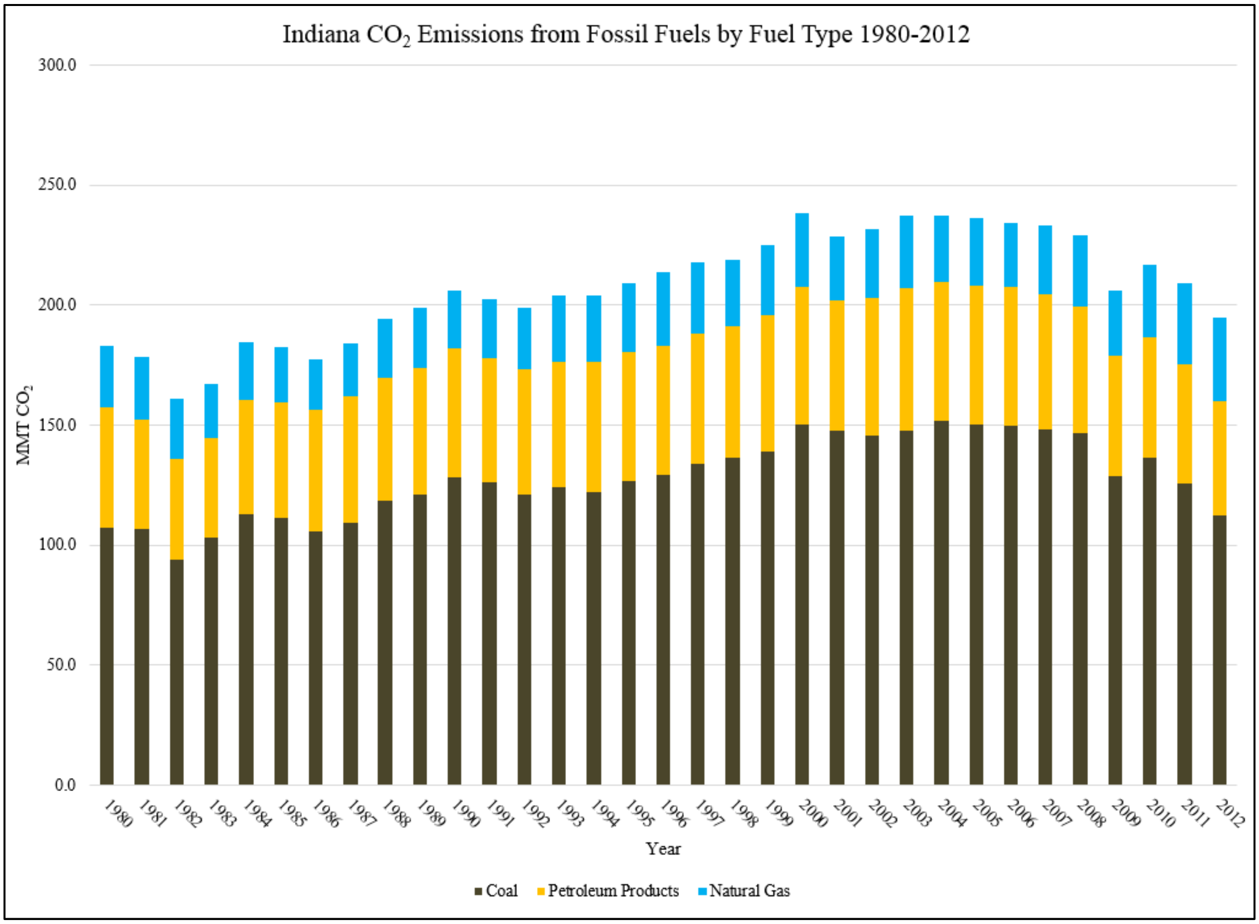

Figure 5.1.14-2: Indiana CO_2 Emissions from Fossil Fuels by Fuel Type 1980-2013

Source: (EIA, 2015d)

5.1.14.4 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, 2011a).

Across the United States, the five most common climate groups are (A), (B), (C), (D), and (E). Southern regions of Indiana are classified as climate group (C). Climates classified as (C) are generally warm, with humid summers and mild winters. During winter months, the mean climate feature is the mid-latitude cyclone (NWS, 2011a). Northern regions of Indiana are classified as climate group (D). 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) (NWS, 2011b). In addition, there are many thunderstorms during summer months. Indiana has two sub-climate categories, which are described in the following paragraphs.

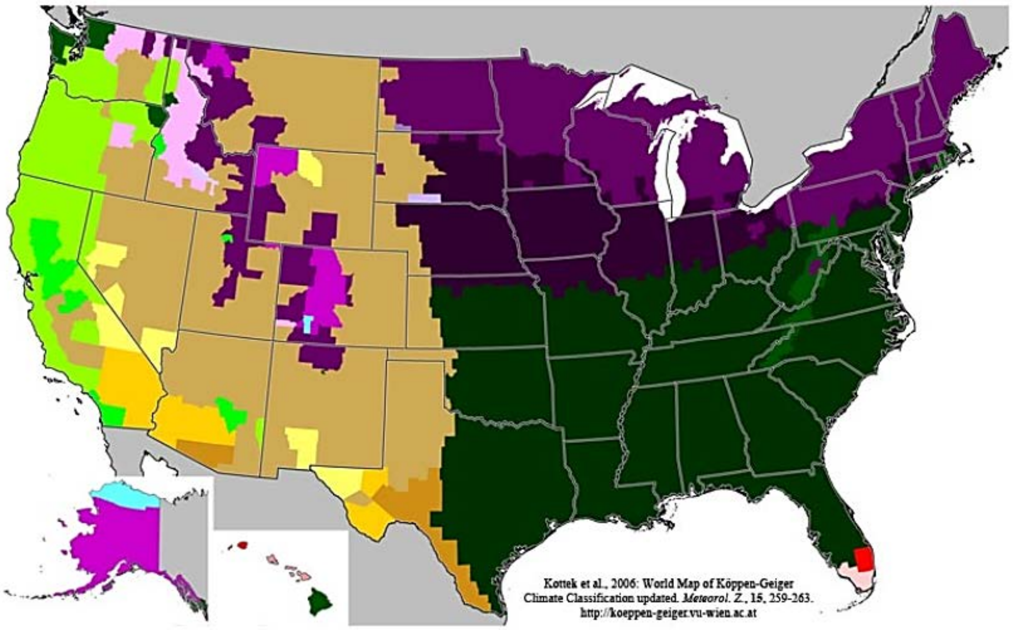

Figure 5.1.14-3: Köppen-Geiger Climate Classes for U.S. Counties

Source: (Kottek, 2006)

Cfa – The Köppen-Geiger climate classification system classifies areas of southern Indiana, such as Bloomington, as Cfa. Cfa climates are generally warm, with humid summers and mild winters. In this climate classification zone, the secondary classification indicates year-round rainfall, but it is highly variable; thunderstorms are dominant during summer months. In this climate classification zone, the tertiary classification indicates mild, hot summers with average temperature of warm months over 72° F. Average temperatures of the coldest months are under 64° F (NWS, 2011a) (NWS, 2011b).

Dfa – The Köppen-Geiger climate classification system classifies northern Indiana, such as Indianapolis and Fort Wayne, as Dfa. Climates classified as Dfa are characterized by warm and humid temperatures, with hot summers and precipitation occurring regularly throughout the year. In this climate classification zone, the secondary classification indicates substantial precipitation during all seasons. In this climate classification zone, the tertiary classification indicates hot summer months, with warmer temperatures averaging above 71.6° F (NWS, 2011a) (NWS, 2011b).

This section discusses the current state of Indiana's climate with regard to air temperature, precipitation, and extreme weather events (e.g., flooding, severe storms, blizzards, and thunderstorms) in the state's two climate regions, Cfa and Dfa.

Air Temperature

Winds from the Gulf of Mexico and Canada play a major role in Indiana's climate. From the south, winds from the Gulf of Mexico transport "warm, moist air into the state" (Scheeringa, 2015). This warm Gulf air "collides with continental polar are brought southward by the jet stream from Canada" (Scheeringa, 2015). This transition from "cold to hot weather can produce an active spring with thunderstorms and tornadoes" (Scheeringa, 2015). January is typically the coldest month in Indiana, while July is the warmest (Scheeringa, 2015). The average summer temperature ranges between 70 and 80° F. The average winter temperature ranges between 25 and 35° F (Indiana State Climate Office, 2015) (Scheeringa, 2015).

The highest temperature to occur in Indiana was on July 14, 1936 with a record of 116° F, in Saint Joseph County (SCEC, 2015). The lowest temperature to occur in Indiana was on January 19, 1994 with a record of negative 36° F, in New Whiteland (SCEC, 2015).

Cfa **–** Bloomingdale, located within southern Indiana, is within the climate classification zone Cfa. The average temperature in Bloomingdale is approximately 53.4° F; 31.3° F during winter months; 73.8° F during summer months; 52.8° F during spring months; and 55.5° F during autumn months (NOAA, 2015b).

Dfa **–** Fort Wayne, located in northern Indiana, is within the climate classification zone Dfa. The average temperature in Fort Wayne is approximately 50.5° F; 27.4° F during winter months; 71.7° F during summer months; 49.6° F during spring months; and 52.8° F during autumn months (NOAA, 2015b). Indianapolis is also located within the climate classification zone Dfa. The average temperature in Indianapolis is 53.2° F; 30.5° F during winter months; 73.9° F during summer months; 52.6° F during spring months; and 55.2° F during autumn months (NOAA, 2015b).

Precipitation

Annual precipitation in Indiana ranges from 37 inches in the north, to 47 inches in the south. May is typically the wettest month in Indiana, with an average of 4 to 5 inches of rainfall statewide. During summer months, average rainfall across the state decreases. During autumn months, rainfall averages approximately 3 inches. "Indiana winters are the driest time of the year with less than 3 inches of precipitation commonly received each month" (Scheeringa, 2015). February is typically the driest month of the year, with precipitation beginning to increase again March and April. "On average, precipitation occurs every third day in Indiana" (Scheeringa, 2015).

Lake Michigan also plays a significant role in Indiana's climate, particularly in northwest Indiana near the shore. "Air passing over the lake picks up moisture which is released over land" (Scheeringa, 2015). Heavy snowfall in Indian occurs as far east as Gary and as far inland as Elkhart. "Lake-related snowfall and cloudiness can extend to central Indiana in winter when driven by strong northwesterly winds" (Scheeringa, 2015). Average annual snowfall in Indiana ranges from 14 inches in the southwestern regions, to 76 inches in the north central area, near Lake Michigan. "Measurable snow typically begins in late November and ends by early April, although the season can begin as early as mid-October and end as late as early May" (Scheeringa, 2015).

The state 24-hour precipitation record occurred in Indiana on August 6, 1905 with a record of 10.5 inches, in Princeton (SCEC, 2015). The greatest 24-hour snowfall record to occur was on December 23, 2004 with a record of 33 inches, in Salem (SCEC, 2015).

Cfa – Bloomingdale, located within southern Indiana, is within the climate classification zone Cfa. The average annual precipitation in Bloomingdale is approximately 47.36 inches; 9.51 inches during winter months; 12.74 inches during summer months; 13.86 inches during spring months; and 11.25 inches during autumn months (NOAA, 2015b).

Dfa – Fort Wayne, located in northern Indiana, is within the climate classification zone Dfa. The average annual precipitation in Fort Wayne is approximately 38.34 inches; 7.07 inches during winter months; 12.04 inches during summer months; 10.50 inches during spring months; and 8.73 inches during autumn months (NOAA, 2015b). Indianapolis is also located within the climate classification zone Dfa. The average annual precipitation in Indianapolis is 42.44 inches; 8.15 inches during winter months; 11.93 inches during summer months; 12.42 inches during spring months; and 9.94 inches during autumn months (NOAA, 2015b).

Severe Weather Events

Indiana typically experiences an annual average of 23 tornadoes per year, with the majority of tornadoes occurring during March and April. Between 1950 and 2001, a recorded 1,024 tornadoes have occurred within the state. The largest tornado ever recorded was in 1925, with winds that reached 70 miles per hour (mph) and was one and a half miles wide. In 1974, more than 21 tornadoes occurred in the state, affecting 39 counties. On March 18, 1925 a tornado with winds between 60 and 73 mph traveled 219 miles through Indiana, Illinois, and Missouri, killing 695 people. "On June 2, 1990, 37 tornadoes ripped through Indiana, the most on any day in state history" (Scheeringa, 2015) (Indiana State Climate Office, 2015). "Property damage is greatest from flash flooding and high winds during thunderstorms, while hail occasionally causes crop losses over small areas during the summer" (Scheeringa, 2015).

Flooding in Indiana occurs in nearly every part of the state and has occurred during every month of the year. "The sandy soils of the northernmost and southwest counties are most prone to drought" (Scheeringa, 2015). Flooding is Indiana's most costly and destructive natural hazard, with excessive late-winter rainfall being the leading cause of widespread flooding throughout the state. During the Great Easter Flood of 1913, approximately 7 percent of Indiana's population was left homeless and 100 were killed. As a result, "most of the state's infrastructure was left in ruins including railroads, roads, telegraph, telephone, and power" (NWS, 2015a). For most of the state, this flood remains the most destructive. In June of 2008, severe flooding occurred throughout the state, isolating the city of Columbus for nearly 24-hours. This severe flooding affected approximately 25,000 people, claimed four lives, and caused an estimated one billion in monetary damages (NWS, 2015a).

5.1.15. Human Health and Safety

5.1.15.1 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 or vehicle traffic. Vehicle traffic and the transportation of hazardous materials and wastes are evaluated in Section 5.1.1, Infrastructure.

5.1.15.2 Specific Regulatory Considerations

Federal organizations, such as the U.S. Department of Labor, 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 Indiana, this resource area is regulated by the Indiana Department of Labor (IDOL), and the Indiana Department of Environmental Management (IDEM). Federal OSH regulations apply to workers through either OSHA, or stricter state-specific plans that must be approved by OSHA. The Indiana Occupational Safety and Health Administration (IOSHA) State Plan is an OSHA-approved “State Plan,” which has adopted all OSHA standards and regulations identically (OSHA, 2015a). Public and private sector occupational safety and health regulations are enforced at the state level by IOSHA and at the federal level by OSHA. Public health is regulated by the Indiana State Department of Health (ISDH).

Federal laws relevant to protecting occupational and public health and safety are summarized in Appendix C, Environmental Laws and Recommendations. Table 5.1.15-1 below summarizes the major Indiana laws relevant to the state’s occupational health and safety, hazardous materials, and hazardous waste management programs.

Table 5.1.15-1: Relevant Indiana Human Health and Safety Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Indiana Code: Title 10, Article 14	Indiana Department of Homeland Security	Establishes the Emergency Management and Disaster Law, which includes requirements for protecting public health and safety in the event of a natural or manmade disaster. Includes requirements for communications service engineers and technical personnel acting as first response communications service providers.
Indiana Code: Title 22, Article 8	Indiana Department of Labor	Establishes Indiana's OSHA program, including requirements for reporting occupational injuries and illnesses, including fatalities.

5.1.15.3 Environmental Setting: Existing Telecommunication Sites

There are many inherent health and safety hazards at telecommunication sites. Telecommunication site work is performed indoors, below ground level, on building roofs, over water bodies, and on communication towers. Tasks may also be performed at dangerous heights or confined spaces while operating heavy equipment, on energized equipment near underground and overhead utilities, and while using hazardous materials, such as flammable gases and liquids. Because telecommunication workers are often required to perform work outside, heat and cold exposure, precipitation, and lightning strikes also present hazard and risks depending on the task, occupational competency, and work-site monitoring (OSHA, 2016a). A summary description of the health and safety hazards present in the telecommunication occupational work environment is listed below.

Working from height, overhead work, and slips, trips, or falls – At tower and building-mount sites, workers regularly climb structures using fixed ladders or step bolts to heights up to 2,000 feet above the ground's surface (OSHA, 2015b). In addition to tower climbing hazards, telecommunication workers have restricted workspace on rooftops or work from bucket trucks parked on uneven ground. Cumulatively, these conditions present fall and injury hazards to telecommunication workers, and the general public who may be observing the work or transiting the area (International Finance Corporation, 2007).

Trenches and confined spaces – In rare cases, FirstNet deployment, operation, and maintenance activities may involve work in trenches or confined spaces. Installation and maintenance of underground utilities in urban areas or utility man-ways are examples of when trenching or confined space work could occur. 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. (OSHA, 2016a)

Heavy equipment and machinery – New and replacement facility deployment and maintenance can involve the use of heavy equipment and machinery. During the lifecycle of a telecommunication site, heavy equipment such as bulldozers, backhoes, dump trucks, cement trucks, and cranes are used to prepare the ground, transport materials and soil, and raise large sections of towers and antennas. Telecommunication workers may be exposed to the additional site traffic and often work near heavy equipment to direct the equipment drivers and to accomplish work objectives. Accessory machinery such as motorized pulley systems, hydraulic metal shears, and air driven tools present additional health and safety risks as telecommunication work sites. These pieces of machinery can potentially sever skin and bone, or cause other significant musculoskeletal injuries to the operator. (OSHA, 2016a)

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. (International Finance Corporation, 2007)

Optical fiber safety – Optical fiber cable installation and repair presents additional risks to telecommunications workers, including potential eye or tissue damage, through ingestion, inhalation, or other contact with glass fiber shards. The shards are generated during termination and splicing activities, and can penetrate exposed skin (International Finance Corporation, 2007). Additionally, fusion splicing (to join optical fibers) in confined spaces or other environments with the potential for flammable gas accumulation presents risk of fire or explosion (Fiber Optic Association, 2010).

Noise – Sources of excess noise at telecommunication sites include heavy equipment operation, electrical power generators and other small engine equipment, air compressors, electrical and pneumatic power tools, and road vehicles, such a diesel engine work trucks. The cumulative noise environment has the potential to exceed the OSHA acceptable level of 85 decibels (dB) per 8-hour time weighted average (TWA) (see Section 5.1.13, 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 (OSHA, 2016a).

Hazardous materials and hazardous waste – Work at telecommunication sites may require the storage and use of hazardous materials such as fuel sources for backup power generators and compressed gases used for welding and metal cutting (new towers only). In some cases, telecommunication sites require use of potentially hazardous products (e.g., herbicides). Secondary hazardous materials (e.g., exhaust fumes) may be a greater health risk than the primary hazardous material (e.g., diesel fuel). Furthermore, the use of hazardous materials creates down-stream potential to generate hazardous waste. While it is unlikely that any FirstNet Proposed Actions 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. (OSHA, 2016a)

Aquatic environments – Installation of telecommunication lines may include laying, burying, or boring lines under wetlands and waterways, including lakes, rivers, ponds, and streams. Workers responsible for these activities operate heavy equipment from soft shorelines, boats, barges, and other unstable surfaces. There is potential for equipment and personnel falls, as well as drowning in waterbodies. Wet work conditions also increase risks of electric shock and hypothermia. (OSHA, 2016a)

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. (OSHA, 2016a)

Telecommunication Worker Occupational Health and Safety

The U.S. Department of Labor, Bureau of Labor Statistics (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 both telecommunication equipment installers and repairers, except line installers (SOC code 49-2022), or telecommunication line installers and repairers (SOC code 49-9052). Both occupations are reported under the installation, maintenance and repair occupations (SOC code 49-0000).

As of May 2014, there were 3,290 telecommunication equipment installers and repairers, and 1,960 telecommunication line installers and repairers (Figure 5.1.15-1) working in Indiana (BLS, 2015a). Indiana has not reported incidence rates of nonfatal occupational injuries or illnesses in the telecommunications industry since 1996, when data are first available. Within the broader information industry (NAICS code 51), in 2013, Indiana had 1.8 cases of nonfatal occupational injuries or illnesses in the telecommunications industry per 100 full-time workers (BLS, 2015b). By comparison, there were 1.9 nonfatal occupational injury cases nationwide in both 2012 and 2013 per 100 full-time workers in the telecommunications industry (BLS, 2013a).

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, 2013b). This represents 45 percent of the broader information industry fatalities (40 total), and less than 1 percent of occupational fatalities (4,585 total). By comparison, Indiana had one occupational fatality in the telecommunications industry (NAICS code 517) in 2013 (BLS, 2015d).

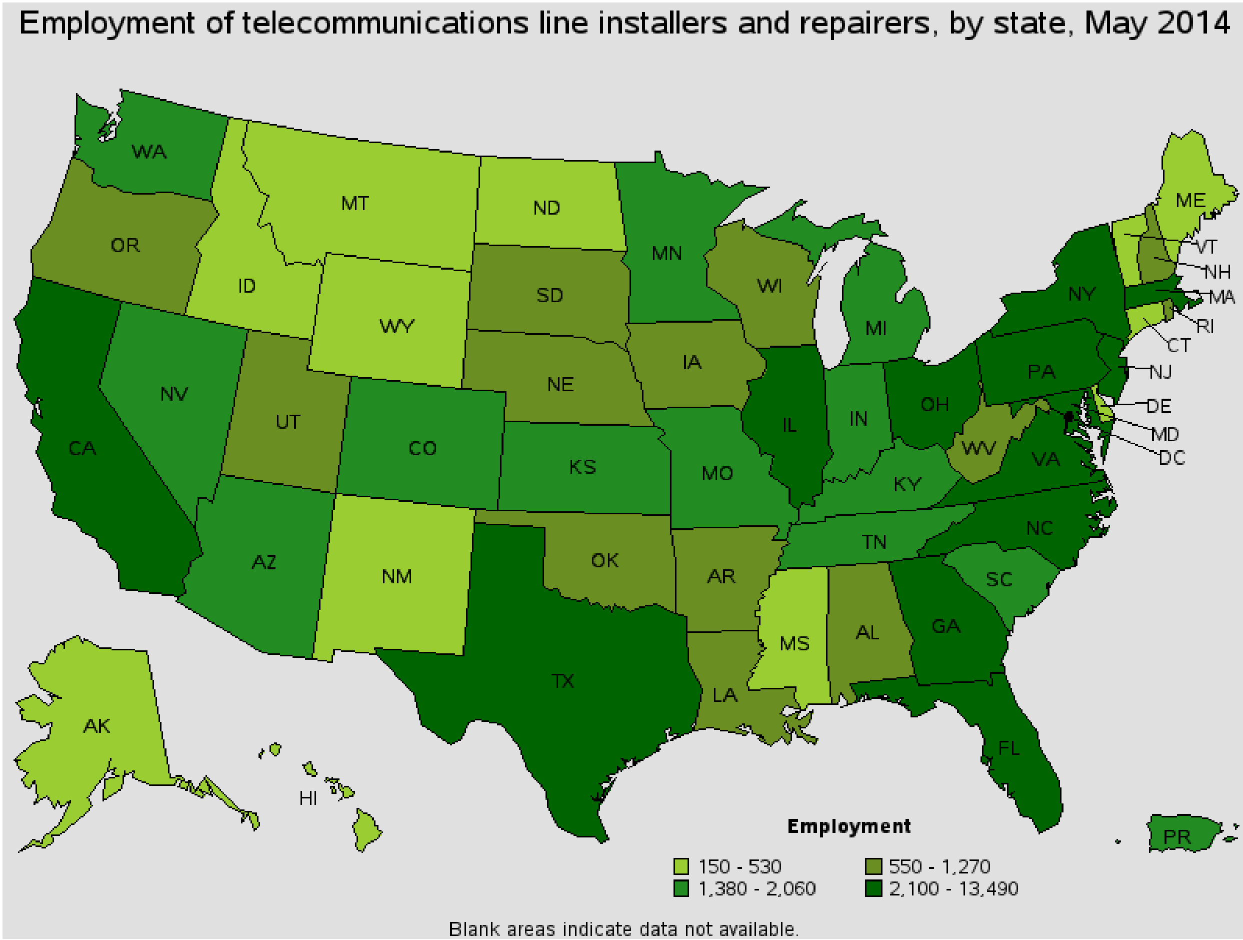

Figure 5.1.15-1: Number of Telecommunication Line Installers and Repairers Employed per State, May 2014

Source: (BLS, 2015c)

Public Health and Safety

The general public is unlikely to encounter occupational hazards at telecommunication sites due to limited access. ISDH collects injury surveillance and fatality data among the general public through the Epidemiology Resource Center and Division of Trauma and Injury Prevention (Indiana State Department of Health, 2014). The same data are reported with more specificity at the federal level through the Center for Disease Control and Prevention Wide-ranging Online Data for Epidemiologic Research (WONDER). While the WONDER database cannot be searched for cases specific to telecommunication sites, many available injury categories are consistent with risks present at telecommunication sites. For example, between 1999 and 2013, there were 236 fatalities due to a fall from, out of, or through a building or structure; 31 fatalities due to being caught, crushed, jammed or pinched in or between objects; and 32 fatalities due to exposure to electric transmission lines (Centers for Disease Control and Prevention, 2015a). Among the general public, trespassers entering telecommunication sites would be at the greatest risk for exposure to health and safety hazards.

5.1.15.4 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 the 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[131] or listed on the National Priorities List, 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.

Indiana's Office of Land Quality administers the Superfund Program, and is managed under IDEM (IDEM, 2012). As of November 2015, Indiana had 98 RCRA Corrective Action sites,[132] 698 brownfield sites, and 37 proposed or final Superfund/NPL sites (USEPA, 2015p). Based on a November 2015 search of USEPA Cleanups in My Community (CIMC) database, there are six Superfund sites (USEPA, 2015c) and one RCRA Corrective Action sites (USEPA, 2015c) in Indiana where contamination has been detected at an unsafe level, or a reasonable human exposure risk still exists.

Brownfield sites in Indiana may enroll in the Indiana Brownfields Program, managed by the Indiana Finance Authority (IDEM, 2015r). One example of a brownfield site is the Harrison Square development in Fort Wayne. The site was formerly used as a vehicle maintenance facility, tire store, bus station, and beverage facility. Contamination at the site included 5 petroleum tanks, 2 hydraulic fluid tanks, an oil-water separator, and 560 tons of contaminated soils. The City of Fort Wayne financed cleanup activities in part through $125,000 an Indiana Brownfields Program Petroleum Remediation Grant, transforming the site in 2009 into a mixed-use space that includes a hotel, residential units, retail space, and a baseball stadium (Indiana Finance Authority, 2008).

In addition to contaminated properties, certain industrial facilities are permitted to release toxic chemicals into the air, water, or land. One such program is the Toxics Release Inventory (TRI), administered by the USEPA under the Emergency Planning and Community Right to Know Act (EPCRA) of 1986. The Toxic Release Inventory database is a measure of the industrial nature of

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[131] The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) enacted in 1980, commonly referred to as the Superfund Program, governs abandoned hazardous waste sites, and collects a tax on chemical and petroleum industries. CERCLA was amended by the Superfund Amendments and Reauthorization Act (SARA) in 1986; see Appendix C, Environmental Laws and Regulations (USEPA, 2011).

[132] Data gathered using USEPA's CIMC search on November 12, 2015, for all sites in Indiana, where cleanup type equals 'RCRA Hazardous Waste – Corrective Action,' and excludes sites where cleanup phase equals 'Construction Complete' (i.e., no longer active) (USEPA, 2013b) .

an area and the over-all chemical use, and can be used to track trends in releases over time. The "releases" do not necessarily equate to chemical exposure by humans or necessarily constitute to quantifiable health risks because the releases include all wastes generated by a facility – the majority of which are disposed of via managed, regulated processes that minimize human exposure and related health risks (e.g., in properly permitted landfills or through recycling facilities). As of October 2015, Indiana had 922 TRI reporting facilities. The identification of a TRI facility does not necessarily indicate that the facility is actively releasing to the environment; the majority of TRI reports involve permitted disposal facilities. According to the USEPA, in 2013, the most recent data available, Indiana released 155.1M pounds of toxic chemicals through onsite and offsite disposal, transfer, or other releases, largely from petroleum and chemicals industries. This accounted for 3.78 percent of nationwide TRI releases, ranking Indiana 3 of 56 U.S. states and territories based on total releases per square mile. (USEPA, 2015e)

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. As of November 2, 2015, Indiana had 203 permitted major discharge facilities registered with the USEPA Integrated Compliance Information System (USEPA, 2015f). The National Institute of Health, U.S. National Library of Medicine, provides an online mapping tool called TOXMAP, which allows users to "visually explore data from the USEPA's TRI and Superfund Program" (NIH, 2015a). Figure 5.1.15-2 provides an overview of potentially hazardous sites in Indiana.

Telecommunication Worker Occupational Health and Safety

Telecommunications sites may be on or near contaminated land, industrial discharge facilities, or sites presenting additional hazards. Occupational exposure to contaminated environmental media can occur during activities like soil excavating, trenching, other earthwork, and working over water bodies. Indoor air quality may also be impacted from vapor intrusion infiltrating indoors from contaminated soil or groundwater that are present beneath a building's foundation. As of October 2015, there are 28 USEPA-regulated telecommunications sites in Indiana (USEPA, 2015g). These sites are regulated under one or more environmental programs including NPDES compliance, Superfund/NPL status, and TRI releases.

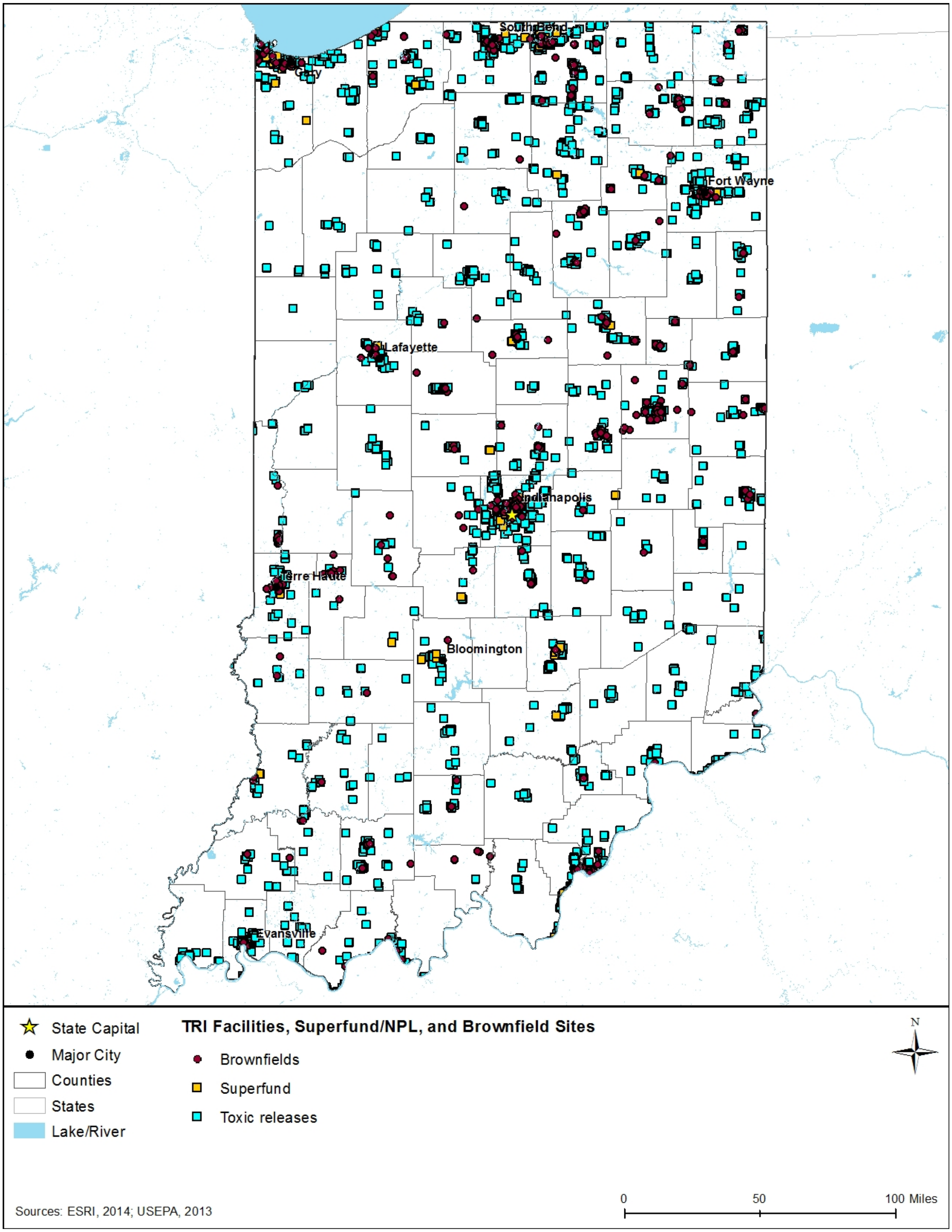

Figure 5.1.15-2: TOXMAP Superfund/NPL and TRI Facilities in Indiana (2013)

According to BLS data, Indiana had 12 occupational fatalities[133] since 2003 within the installation, maintenance, and repair occupations (SOC code 49-0000) from exposure to “harmful substances or environments,” although these were not specific to telecommunications (BLS, 2015d). By comparison, the BLS reported three fatalities in 2011 and three fatalities in 2014 nationwide within the telecommunications industry (NAICS code 517), due to exposure to harmful substances or environments (BLS, 2015e). In 2014, BLS also reported four 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, 2014).

Public Health and Safety

As described earlier, access to telecommunications sites is nearly always restricted to occupational workers. Although site access control is one of the major reasons telecommunications sites present an inherent low risk to non-occupational workers, the general public could be potentially exposed to contaminants and other hazards in a variety of ways. One example would be if occupational workers disturb contaminated soil while digging, causing hazardous chemicals to mix with an underlying groundwater drinking water sources. If a 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 ISDH Environmental Epidemiology Section partners with the Agency for Toxic Substances and Disease Registry (ATSDR) and local health departments to provide health assessments and consultations that identify and assess human exposure risks at contaminated sites. Public health assessments, consultations, and advisories for documented hazardous waste sites are publicly available through the ATSDR Public Health Assessments and Health Consultations website (Centers for Disease Control and Prevention, 2015c). At the federal level, the Center for Disease Control and Prevention, National Environmental Public Health Tracking Network, provides health, exposure, and hazard information, including known chemical contaminants, chronic diseases, and conditions based on geography. However, injury and fatality data for reported acute toxic substance releases is not available for Indiana (Centers for Disease Control and Prevention, 2015b).

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

Spotlight on Indiana Superfund Sites: U.S. Smelter and Lead Refinery, Inc. (USS Lead)

The USS Lead site encompasses 79 acres in East Chicago, IN (Lake County), including the former USS Lead facility and surrounding commercial, municipal, and residential areas. The site was used for copper and lead smelting, silver refining, and arsenic production between 1906 and 1985. Lead recovery from scrap metal and automobile batteries generated two waste streams, a blast furnace slag pile, and lead-containing flue dust stockpile. The blast furnace slag pile was dumped annually into a nearby wetland, and the 3- to 5-acre flue-dust pile was dispersed by wind and rain into the surrounding community until it was covered in 1982 and later removed in 1992. Figure 5.1.15-3: Population Density Surrounding USS Lead Site (East Chicago, IN) below shows the population density within a one-mile buffer (green) of the USS Lead site (red). (Centers for Disease Control and Prevention, 2011)

In 1992, following multiple NPDES permit violations for discharged furnace cooling water and stormwater runoff into the Grand Calumet River, USS Lead's parent company declared bankruptcy and the site was proposed to the NPL. USS Lead entered into a RCRA Administrative Order in 1993, demolishing and burying all structures and contaminated materials in an onsite capped landfill over the next six years. ATSDR conducted a Public Health Assessment in 1994 and Exposure Investigation in 1998, concluding contamination from the site presented a public health hazard, primarily to children ages 0 to 6. In 2009, the site was listed as final on the NPL. (Centers for Disease Control and Prevention, 2011).

Human health and safety risks at and near the site include lead and arsenic contamination in residential soils, and lead-contaminated sediment in nearby Lake Michigan, Wahala Beach, and other recreational areas. Exposure pathways include direct contact and inhalation of contaminated soils, as well as ingestion of contaminated garden produce. In 2014, USEPA and the state of Indiana reached an agreement with the current site owners, and divided the cleanup areas into three zones. USEPA is working to sample residential soils within each zone and will remove and replace soils where lead contamination exceeds 800 micrograms per kilogram (estimated 53 percent of properties) (USEPA, 2015h).

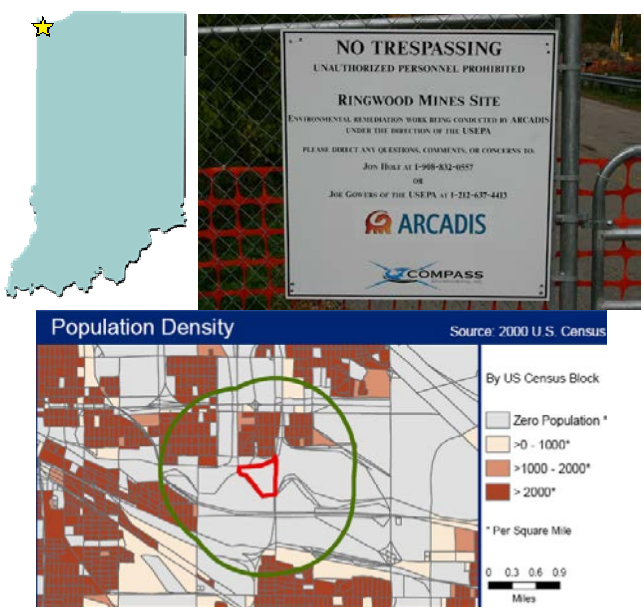

Figure 5.1.15-3: Population Density Surrounding USS Lead Site (East Chicago, IN)

Source: (Centers for Disease Control and Prevention, 2011)

5.1.15.5 Abandoned Mine Lands at or near Telecommunications Sites

Another health and safety hazard in Indiana includes surface and subterranean mines. In 2015, the Indiana mining industry ranked 28th for nonfuel minerals (primarily crushed stone, portland cement, lime, construction sand and gravel, and masonry cement), generating a value of $916M (USGS, 2014f). In 2013, the most recent data available, Indiana had 36 coal mining operations (12 underground and 24 surface) (EIA, 2013). Health and safety hazards 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).

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 IDNR, Bureau of Mine Reclamation, administers the Abandoned Mine Lands Program and is responsible for managing AML health and safety hazards at an estimated 1,200 pre-1977 coalmining sites using fees collected from active coalmine operators (IDNR, 2015n). Figure 5.1.15-4 shows the distribution of High Priority (Priority 1, 2 and adjacent Priority 3) AMLs in Indiana, where Priority 1 and 2 sites pose a significant risk to human health and safety, and Priority 3 sites pose a risk to the environment. As of November 2015, Indiana had 1,116 Priority 1 and 2 AMLs, with 135 unfunded problem areas (U.S. Department of the Interior, 2015b).

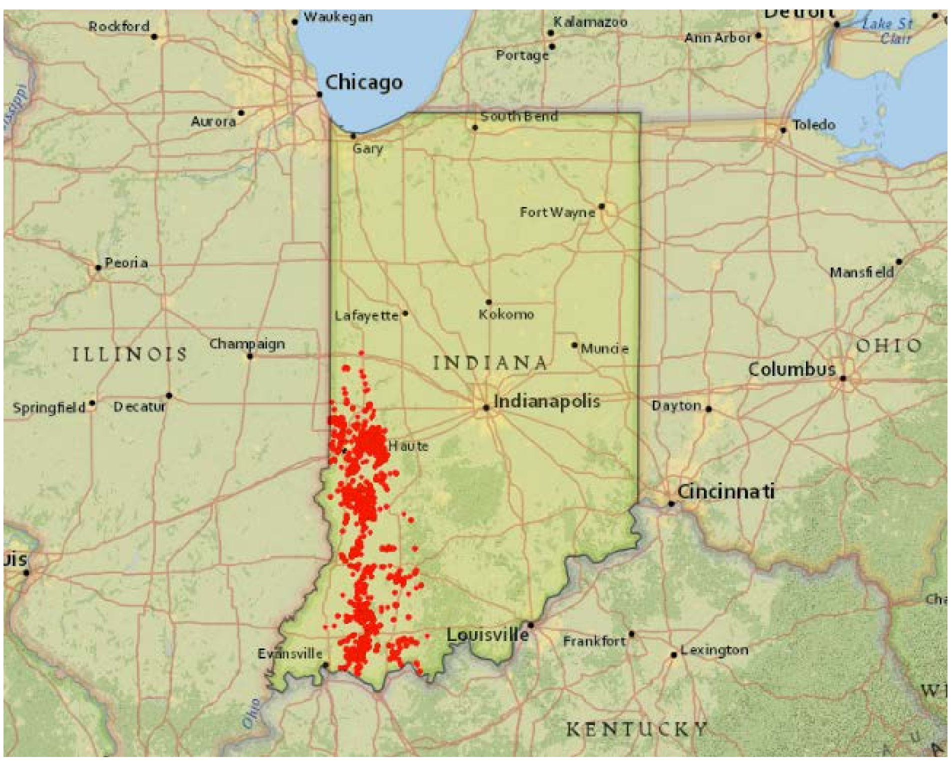

Figure 5.1.15-4: High Priority Abandoned Mine Lands in Indiana (2015)

Source: (Office of Surface Mining Reclamation and Enforcement, 2015)

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. Because the locations of many abandoned mines are unknown or hidden, these mines pose a risk to telecommunications workers because they may be encountered during deployment and maintenance operations.

Public Health and Safety

Subterranean coalmines present additional health and safety risks to the general public, by generating toxic combustible gases, which can penetrate the surface through ground fractures, potentially seeping into residential structures. Additionally, coalmine fires 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, 2015a).

5.1.15.6 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 public. Telecommunications, including public safety communications, can be unavailable (temporarily or permanently) during disaster events. Examples of manmade disasters are train derailments, refinery fires, or other incident involving the release of hazardous constituents. A common example of a natural disaster is flooding. Floodwaters damage transportation infrastructure (roads, railways, etc.) and utility lines (sewer, water, electric power, broadband, natural gas lines, etc.). Hazardous chemicals and sanitary wastes often contaminate floodwaters, which can cause headaches, skin rashes, dizziness, nausea, excitability, weakness, fatigue, and disease to exposed workers (OSHA, 2003).

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

Telecommunication Worker Occupational Health and Safety

Telecommunication workers are often called upon to provide support to natural and manmade disaster response efforts because of the critical need to restore and maintain telecommunication capabilities. The need to enter disaster areas as part of the recovery effort exposes telecommunication workers to elevated risks because chemical, biological, and physical hazards might not have not been fully identified or assessed. Transportation infrastructure and utilities in the affected areas are often compromised and present unknown chemical and biologic hazards. Correspondingly, if telecommunication workers are injured during response and repair operations, their rescue and treatment might over-extend first responder staff and medical facilities that are delivering care to victims of the initial incident.

Currently, IDOL and BLS do not report data specific to injuries or fatalities among telecommunication workers responding to natural or manmade disasters. However, the National Response Center (NRC), managed by the U.S. Coast Guard, compiles reports for oil spills, chemical releases, or other maritime security incidents and contains incident reports related to occupational health and safety. Of the 273 NRC-reported incidents for Indiana in 2015 with known causes, 10 were attributed to natural disaster (flood or other natural phenomenon), while 263 were attributed to manmade disasters (derailment, dumping, equipment failure, operator error, over pressuring, transport accident, or trespasser) or other indeterminate causes (U.S. Coast Guard, 2015a). For example, in March 2015, during a construction project at Gary Airport in Gary, IN, an excavation unearthed 3,000 gallons of an unknown pooled chemical. The chemical filled the ditches and created a strong odor, causing nausea and dizziness among the construction personnel. (U.S. Coast Guard, 2015b) Such incidents present unique, hazardous challenges to telecommunication workers responding during natural or manmade disasters. Such incidents present unique, hazardous challenges to telecommunication workers responding during natural or manmade disasters.

Spotlight on Indiana Natural Disaster Sites: June 2008 Flooding in Central and Southern Indiana

In June 2008, heavy rainfall combined with saturated soils from a wetter than normal spring caused extensive flooding along the White River Basin in central and southern Indiana. More than 650 roads and 60 bridges were damaged, including Interstates 65 and 70, and the entire transportation network of Greene County, IN. Additionally, more than 100 dams or levees, and 56 water supply or wastewater treatment facilities were damaged. The flooding resulted in 8,400 evacuations and water rescues, three fatalities, five injuries, and hundreds of millions in damages. Columbus, IN was the most severely impacted community, with nearly all roadways impassable and a flooded hospital that forced evacuation of its 157 patients (Figure 5.1.15-5). (USGS, 2008)

Figure 5.1.15-5: Patient Evacuation from Columbus Regional Hospital on June 7, 2008

Source: (Associated Press, 2008)

Public Health and Safety

Hazards present during natural and manmade disasters are often far-reaching, affecting large geographic areas and affecting all populations living within the area. Similar to telecommunication workers, the general public faces risks during these types of disasters, such as compromised transportation infrastructure and utilities, potential for exposure to unknown chemical and biologic hazards, and inadequate medical support. In 2014, Indiana had five weather-related fatalities (three due to flooding and two due to wind) and three non-fatal injuries. By comparison, 384 weather-related fatalities and 2,203 injuries were reported nationwide the same year (NWS, 2015b).

5.2. 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 as a result of construction activity. 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 Proposed 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.

5.2.1. Infrastructure

5.2.1.1 Introduction

This section describes potential impacts to infrastructure in Indiana associated with construction, deployment, and operation of the Proposed Action and Alternatives. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

5.2.1.2 Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on infrastructure were evaluated using the significance criteria presented in Table 5.2.1-1. As described in Section 5.2, 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.

Table 5.2.1-1: Impact Significance Rating Criteria for Infrastructure

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Transportation system capacity and safety	Magnitude or Intensity	Creation of substantial traffic congestion/delay and/or a substantial increase in transportation incidents (e.g., crashes, derailments).	Effect that is potentially significant, but with mitigation is less than significant.	Minimal change in traffic congestion/delay and/or transportation incidents (e.g., crashes, derailments).	No effect on traffic congestion or delay, or transportation incidents.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Permanent: Persisting indefinitely.		Short-term effects will be noticeable for up to the entire construction phase or a portion of the operational phase.	NA
Capacity of local health, public safety, and emergency response services	Magnitude or Intensity	Impacted individuals or communities cannot access health care and/or emergency services, or access is delayed, due to the Proposed Action 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

5.2.1.3 Description of Environmental Concerns

Transportation System Capacity and Safety

The primary concerns for transportation system capacity and safety related to FirstNet activities would primarily occur during the construction phases of deployment. Depending on the exact site locations and placement of new assets in the field, temporary impacts on traffic congestion, railway use, airport or harbor operations, or use of other transportation corridors could occur if site locations were near or adjacent to roadways and other transportation corridors, requiring temporary closures (lane closures on roadways, for example). Coordination would be necessary with the relevant transportation authority (i.e., departments of transportation, airport authorities, railway companies, and harbormasters) to ensure proper coordination during deployment. Based on the impact significance criteria presented in Table 5.2.1-1, 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 maintenance would become necessary during operations.

Capacity of Local Health, Public Safety, and Emergency Response Services

The capacity of local health, public safety, and emergency response services would experience less than significant impacts during construction or operation phases. During deployment and system optimization, existing services would likely remain operational in a redundant manner ensuring continued operations and availability of services to the public. The only potential impact would be extremely rare – 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 local health, public safety, and emergency response services through enhanced communications infrastructure, thereby increasing capacity for and enhancing the ability of first responders to communicate during emergency response situations. Based on the impact significance criteria presented in Table 5.2.1-1, potential negative impacts would be less than significant. Substantial beneficial impacts are likely to result from implementation.

Modifies Existing Public Safety Response Telecommunication Practices, Physical Infrastructure, or Level of Service in a manner that directly affects Public Safety Communication Capabilities and Response Times

The Proposed Action and alternatives contemplated by FirstNet would not cause negative impacts to existing public safety response telecommunication practices, physical infrastructure, or level of service in a manner that directly affects public safety communication capabilities and response times. Based on the impact significance criteria presented in Table 5.2.1-1, any potential impacts would be less than significant during deployment. As described above, during deployment and system optimization, existing services would likely remain operational in a redundant manner ensuring continued operations and availability of services to the public. Once operational, state, and local public safety organizations would need to evaluate telecommunication practices and standard operating procedures (SOPs). FirstNet's mission is to complement such practices and SOPs in a positive manner; therefore, only beneficial or complementary impacts would be anticipated. Public safety communication capabilities and response times would be expected to also experience beneficial impacts through enhanced communications abilities. It is possible that FirstNet would be upgrading physical telecommunications infrastructure, thus the infrastructure would also experience a positive and beneficial impact. Disposal or reuse of old public safety communications infrastructure would also likely need to be considered once the specifics are known. Any negative impacts would be expected to be less than significant given the short-term nature of the deployment activities.

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.[134] Anticipated impacts would be less than significant due to the limited extent and temporary nature of the deployment.

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 Proposed Action 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 Proposed Action contemplated, the draw or use of power from the transmission facilities may need to be examined; however, it is not anticipated that such

[134] 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.

use of power would have negative impacts, due to the local nature of the proposed activities and the widespread availability and use of the power grid in the United States.

5.2.1.4 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 Proposed Actions 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 Proposed Actions that would be conducted at these small entry and exit points are not likely to produce perceptible changes or disruption of transportation, telecommunications, or utility services.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber would have no impacts to infrastructure resources.
- 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 telecommunications in the local area or region would not be changed.
  - 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.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Although lighting up of dark fiber would have no impacts to infrastructure resources as mentioned above, installation of new associated huts or equipment, if required, could impact infrastructure resources, depending on the exact siting of such installation activities.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water would not impact infrastructure resources because there would be no local infrastructure to impact, other than harbor operations. However, impacts to infrastructure resources could potentially occur as result of the construction of landings and/or facilities on shores or the banks of water bodies that the accept submarine cable, depending on the exact site location and proximity to existing infrastructure.
  - Installation of Optical Transmission or Centralized Transmission Equipment: Installation of transmission equipment such as small boxes or huts, or access roads could potentially impact infrastructure. Impacts could include disruption of service in transportation corridors, disruption of service to telecommunications infrastructure, or other temporary impacts.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads might result in temporary or unintended impacts to current utility services during installation or interconnection activities. Generally, however, these deployment activities would be independent and would not be expected to interfere with other existing towers and structures. In addition, installation activities would have beneficial impacts due to expansion of infrastructure at a local level. Such activities could enhance public safety infrastructure, and other telecommunications as the site could potentially be available for subsequent collocation.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would result in localized impacts to that tower and such as minor disruptions in services. As a result of collocation of equipment, the potential addition of power units, structural hardening, and physical security measures could potentially have beneficial impacts on existing infrastructure assets, depending on the site specific plans.
  - Deployable Technologies: Deployable technologies such as COWs, COLTs, and SOWs are comprised of cellular base stations, sometimes with expandable antenna masts, and generators that may require connection 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.
- 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 have the potential to temporarily interfere with existing public safety telecommunications systems,

which could potentially impact emergency levels of service and response times and current commercial communications systems. Given that construction activities would occur on existing structures, transportation capacity and safety and access to emergency services would not be impacted.

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, although likely minor, 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), and would be regionally based around the on-going phase of deployment, and minor. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

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. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

5.2.1.5 Alternatives Impact Assessment

The following section assesses potential impacts to infrastructure associated with the Deployable Technologies Alternative and the No Action Alternative.[135]

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to infrastructure as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts to infrastructure even if deployment requires expansion of infrastructure, such as paving of previously unpaved surfaces or other new infrastructure built to support deployment. This is primarily due to the small amount of paving or new infrastructure that might have to be constructed to accommodate the deployables. The site-specific location of deployment would need to be considered, and any local infrastructure assets (transportation, telecommunications, or utilities) would need to be considered, planned for, and managed accordingly to try and avoid any negative impacts to such resources. Beneficial impacts could be realized, as deployable technologies are used when other infrastructure is impaired in some way; so deployable technologies could provide continuity of service during emergency events. These impacts are expected to be less than significant.

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

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

with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment, as part of routine maintenance or inspection occurs off an established access roads or utility ROWs, or if additional maintenance-related construction activities occur within public road and utility ROWs, less than significant impacts would likely still occur to transportation systems or utility services due to the limited amount of new infrastructure needed to accommodate the deployables. Chapter 19, BMPs and Mitigation Measures, provides a listing of the 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 from deployment and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 5.1.1, Infrastructure. The state also would not realize beneficial impacts to infrastructure resources described above.

5.2.2. Soils

5.2.2.1 Introduction

This section describes potential impacts to soil resources in Indiana associated with deployment and operation of the Proposed Action and Alternatives. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

5.2.2.2 Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on soil resources were evaluated using the significance criteria presented in Table 5.2.2-1. As described in Section 5.2, 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 5.2.2-1: Impact Significance Rating Criteria for Soils

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Soil erosion	Magnitude or Intensity	Severe, widespread, and observable erosion in comparison to baseline, high likelihood of encountering erosion-prone soils.	Effect that is potentially significant, but with mitigation is less than significant.	Perceptible erosion in comparison to baseline conditions; low likelihood of encountering erosion-prone soil types.	No perceptible change in baseline conditions.
	Geographic Extent	State or territory.		Region or county.	NA
	Duration or Frequency	Chronic or long-term erosion not likely to be reversed over several years.		Isolated, temporary, or short-term erosion that that is reversed over few months or less.	NA
Topsoil mixing	Magnitude or Intensity	Clear and widespread mixing of the topsoil and subsoil layers.	Effect that is potentially significant, but with mitigation is less than significant.	Minimal mixing of the topsoil and subsoil layers has occurred.	No perceptible evidence that the topsoil and subsoil layers have been mixed.
	Geographic Extent	State or territory.		Region or county.	NA
	Duration or Frequency	NA		NA	NA
Soil compaction and rutting	Magnitude or Intensity	Severe and widespread, observable compaction and rutting in comparison to baseline.	Effect that is potentially significant, but with mitigation is less than significant.	Perceptible compaction and rutting in comparison to baseline conditions.	No perceptible change in baseline conditions.
	Geographic Extent	State or territory.		Region or county.	NA
	Duration or Frequency	Chronic or long-term compaction and rutting not likely to be reversed over several years.		Isolated, temporary, or short term compaction and rutting that is reversed over a few months or less.	No perceptible change in baseline conditions.

NA = Not Applicable

5.2.2.3 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 Indiana and other states with similar geography and weather patterns is the erosion of construction site soils to natural waterways, where the sediment could impair water and habitat quality, and potentially affect aquatic plants and animals (NRCS, 2000). Areas exist in Indiana that have steep slopes (i.e., greater than 20 percent) or where the erosion potential is medium to high, including locations with Aqualfs, Aquents, Udalfs, Udepts, and Udults (see Section 5.1.2.4, Soil Suborders and Figure 5.1.2-2).

Based on the impact significance criteria presented in Table 5.2.2-1, building of FirstNet's network deployment sites could cause potentially significant erosion at locations with highly erodible soil and steep grades. Furthermore, deployment sites that are large-scale or adjacent to other construction sites (i.e., cumulatively large-scale sites) could result in long-term erosion that might not be reversed for several years.

To the extent practicable, FirstNet would attempt to minimize ground disturbing construction in areas with high erosion potential due to steep slopes or soil type. Where construction is required in areas with a high erosion potential, FirstNet could implement BMPs and mitigation measures to avoid or minimize impacts, and minimize the periods when exposed soil is open to precipitation and wind (see Chapter 19).

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 5.2.2-1, and due to the relatively small scale (less than 1 acre) of most FirstNet Proposed Action sites, minimal topsoil mixing is anticipated. Additionally, implementation of BMPs and mitigation measures (Chapter 19) could further reduce potential impacts.

Soil Compaction and Rutting

Soil compaction and rutting at construction sites could involve heavy land clearing equipment such as bulldozers and backhoes, trenchers and directional drill rigs to install buried fiber, and cranes to install towers and aerial infrastructure. Heavy equipment could cause perceptible compaction and rutting of susceptible soils, particularly if BMPs and mitigation measures are not implemented.

Soils with the highest potential for compaction or rutting were identified by using the STATSGO2 database (see Section 5.1.2.4, Soil Suborders). The most compaction susceptible soils in Indiana are Aquents, Aquepts, Aquolls, and Saprists, hydric soils and with poor drainage conditions. These soils constitute approximately 26 percent of Indiana's land area,[136] mostly in the south-central and northeastern portions of the state (see Figure 5.1.2-2). 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 5.2.2-1, the risk of soil compaction and rutting resulting from FirstNet deployment activities would be less than significant due to the extent of susceptible soils in the state.

5.2.2.4 Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could deploy various types of facilities or infrastructure. Depending on the physical nature and location of FirstNet facilities or infrastructure and the specific Proposed Action, some Proposed Actions 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.

[136] This percentage was calculated by dividing the acres of soils that fall within the suborders listed above by the total soil land cover for the state.

- Satellites and Other Technologies
    - Satellite-Enabled Devices and Equipment: Deployment of temporary or portable equipment that use satellite technology, including COWs, COLTs, SOWs, satellite phones, and video cameras, or adding equipment to satellites launched for other purposes, would not impact soil resources because those activities would not require ground disturbance.

Activities with the Potential to Have Impacts

Implementation of the Preferred Alternatives could include potential deployment-related impacts to soil resources resulting from ground disturbance activities, including soil erosion, topsoil mixing, and soil compaction and rutting. The types of deployment activities that could be part of the Preferred Alternative and result in potential impacts to soil resources include the following:

- Wired Projects
    - New Build – Buried Fiber Optic Plant: New fiber optic cable installation usually requires trenching, plowing (including vibratory plowing), or directional boring, as well as construction of hand holes, pulling vaults, junction boxes, huts, and POP structures that require ground disturbance. Impacts from fiber optic plant installation and structure construction, as well as associated grading and restoration of the disturbed ground when construction is completed, could result in soil erosion, topsoil mixing, or soil compaction and rutting.
    - New Build – Aerial Fiber Optic Plant: Installation of new utility poles, and replacement/upgrading of existing poles and structures could potentially impact soil resources resulting from ground disturbance for pole/structure installation (soil erosion and topsoil mixing), and heavy equipment use from bucket trucks operating on existing gravel or dirt roads (soil compaction and rutting). Potential impacts to soils are anticipated to be small-scale and short-term.
    - Collocation on Existing Aerial Fiber Optic Plant: Topsoil removal, soil excavation, and excavated material placement during the replacement of poles and structural hardening could result in soil erosion and topsoil mixing. Heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in soil compaction and rutting.
    - New Build – Submarine Fiber Optic Plant: Installation of fiber optic plants in or near bodies of water could potentially impact soil resources at and near the landings or facilities on shores or the banks of water bodies that accept the submarine cable. Soil erosion and topsoil mixing could potentially occur as result of grading, foundation excavation, or other ground disturbance activities. Perceptible soil compaction and rutting could potentially occur due to heavy equipment use during these activities depending on the duration of the construction activity.
    - Installation of Optical Transmission or Centralized Transmission Equipment: Installation of optical transmission equipment or centralized transmission equipment, including

associated new utility poles, hand holes, pulling vault, junction box, hut, and POP structure installation, would require ground disturbance that could potentially impact soil resources. Potential impacts to soils resulting from soil erosion, topsoil mixing, soil compaction, and rutting are anticipated to be small-scale and short-term.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures, such as generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads, or access roads could result in impacts to soil resources. Land/vegetation clearing, excavation activities, landscape grading, and other ground disturbance activities during the installation of new wireless towers and associated structures or access roads could result in soil erosion or topsoil mixing, and heavy equipment use during these Proposed Actions could result in soil compaction and rutting.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to soils. However, if additional power units are needed, structural hardening, and physical security measures are needed they may require 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 Proposed Actions could result in soil erosion and topsoil mixing. Heavy equipment use associated with these Proposed Actions 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 Proposed Actions 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. Chapter 19, BMPs and Mitigation Measures, provides a listing of the 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. These impacts are expected to be less than significant due to the temporary nature and small scale of operations activities with the potential to create impacts. Chapter 19, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

5.2.2.5 Alternatives Impact Assessment

The following section assesses potential impacts to soils associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to soil resources as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts to soil resources if deployment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. In addition, impacts to soils could occur on paved surfaces if the acceptable load of the surface is exceeded. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in soil erosion and topsoil mixing. Heavy equipment use associated with these Proposed Actions may result in soil compaction and rutting. In addition, implementation of deployable technologies themselves could also result in soil compaction and rutting if deployed in unpaved areas. However, these potential impacts are expected to be less than significant due to the small scale and short term nature of the deployment. Chapter 19, BMPs and Mitigation Measures, provides a listing of the 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. Chapter 19, BMPs and Mitigation Measures, provides a listing of the 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 5.1.2, Soils.

5.2.3. Geology

5.2.3.1 Introduction

This section describes potential impacts to Indiana geology resources associated with deployment and operation of the Proposed Action and Alternatives. Chapter 19, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

5.2.3.2 Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on geology resources were evaluated using the significance criteria presented in Table 5.2.3-1. As described in Section 5.2, 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.

Table 5.2.3-1: 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 Proposed Action 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 Proposed Action could be located within an earthquake hazard zone or active fault.	No likelihood of a Proposed Action 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 Proposed Action 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 Proposed Action could be located near a volcanic ash area of influence.	No likelihood of a Proposed Action 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 Proposed Action could be located within a landslide area.	Effect that is potentially significant, but with mitigation is less than significant.	Low likelihood that a Proposed Action could be located within a landslide area.	No likelihood of a Proposed Action 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 Proposed Action 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 Proposed Action could be located within an area with a hazard for subsidence.	Proposed Action located outside an area with a hazard for subsidence.
	Geographic Extent	Areas with a high hazard for subsidence (e.g., karst terrain) are highly prevalent within the state/territory.		Areas with a high hazard for subsidence occur within the state/territory, but may be avoidable.	Areas with a high hazard for subsidence do not occur within the state/territory.
	Duration or Frequency	NA		NA	NA
Potential Mineral and Fossil Fuel Resource Impacts	Magnitude or Intensity	Severe, widespread, observable impacts to mineral and/or fossil fuel resources.	Effect that is potentially significant, but with mitigation is less than significant.	Limited impacts to mineral and/or fossil resources.	No perceptible change in mineral and/or fossil fuel resources.
	Geographic Extent	Regions of mineral or fossil fuel extraction areas are highly prevalent within the state/territory.		Mineral or fossil fuel extraction areas occur within the state/territory, but may be avoidable.	Mineral or fossil fuel extraction areas do not occur within the state/territory.
	Duration or Frequency	Long-term or permanent degradation or depletion of mineral and fossil fuel resources.		Temporary degradation or depletion of mineral and fossil fuel resources.	NA
Potential Paleontological	Magnitude or Intensity	Severe, widespread, observable impacts to paleontological resources.	Effect that is potentially significant, but with mitigation is less than significant.	Limited impacts to paleontological and/or fossil resources.	No perceptible change in paleontological resources.

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Resource Impacts	Geographic Extent	Areas with known paleontological resources are highly prevalent within the state/territory.		Areas with known paleontological resources occur within the state/territory, but may be avoidable.	Areas with known paleontological resources do not occur within the state/territory.
	Duration or Frequency	NA		NA	NA
Surface Geology, Bedrock, Topography, Physiography, and Geomorphology	Magnitude or Intensity	Substantial and measurable degradation or alteration of surface geology, bedrock, topography, physiographic characteristics, or geomorphological processes.	Effect that is potentially significant, but with mitigation is less than significant	Minor degradation or alteration of surface geology, bedrock, topography that do not result in measurable changes in physiographic characteristics or geomorphological processes.	No degradation or alteration of surface geology, bedrock, topography, physiographic characteristics, or geomorphologic processes.
	Geographic Extent	State/territory.		State/territory.	NA
	Duration or Frequency	Permanent or long-term changes to characteristics and processes.		Temporary degradation or alteration of resources that is limited to the construction and deployment phase.	NA

NA = Not Applicable

5.2.3.3 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

A concern related to deployment is placement of equipment in highly active seismic zones. Equipment that is exposed to earthquake activity is subject to misalignment, alteration, or, in extreme cases, destruction; all of these activities could result in connectivity loss.

As discussed in Section 5.1.3.8, the majority of Indiana is not at risk to significant earthquake events. As shown in Figure 5.1.3-4, southwestern Indiana is at greatest risk to earthquakes throughout the state, though no earthquake over magnitude 6.0 on the Richter scale has ever occurred in the state. Based on the impact significance criteria presented in Table 5.2.3-1, 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 or near parts of Indiana, some amount of infrastructure could be subject to earthquake hazards, in which case BMPs and mitigation measures (see Chapter 19) would help avoid or minimize the potential impacts.

Volcanic Activity

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

Landslides

Similar to seismic hazards, another concern would be placement of equipment in areas that are highly susceptible to landslides. Equipment that is exposed to landslides is subject to misalignment, alteration, or, in extreme cases, destruction; all of these activities could result in connectivity loss.

As discussed in Section 5.1.3.8, the majority of Indiana is at low to moderate risk of experiencing landslide events. The highest potential for landslides in Indiana is found near areas underlain by the Kope Formation, specifically in Indiana’s suburbs of the greater Cincinnati (Ohio) area, and portions of southwestern Indiana near the New Madrid seismic zone. Based on the impact significance criteria presented in Table 5.2.3-1, 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. To the extent practicable, FirstNet would avoid deployment in areas that are susceptible to landslide events.

However, given that some of Indiana's major cities, such as Bloomington, are in areas that experience landslides with moderate to high frequency, some amount of infrastructure be subject to landslide hazards. Where infrastructure is subject to landslide hazards, BMPs and mitigation measures, as discussed in Chapter 19, could help avoid or minimize the potential impacts.

Land Subsidence

As discussed in Section 5.1.3.8 and shown in Figure 5.1.3-6, portions of Indiana are vulnerable to land subsidence due to karst topography and mine collapse. Based on the impact significance criteria presented in Table 5.2.3-1, 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 located in mining areas. Equipment that is exposed to land subsidence, such as sinkholes created by karst topography is subject to misalignment, alteration, or, in extreme cases, destruction. Significant long-term land subsidence, due to factors such as aquifer compaction, could lead to relative sea level rise[137] and inundation of equipment. All of these activities could result in connectivity loss. To the extent practicable, FirstNet would avoid deployment in known areas of karst topography or in areas that are subject to sea level rise. However, where infrastructure is subject to landslide hazards, BMPs and mitigation measures, as discussed in Chapter 19 (BMPs and Mitigation Measures), could help avoid or minimize the potential impacts.

Potential 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 5.2.3-1, impacts to mineral and fossil fuel resources are unlikely as the Proposed Action could only be potentially significant if FirstNet's deployment locations were to cause severe, widespread, observable impacts to mineral and/or fossil fuel resources. To the extent practicable and feasible, FirstNet would likely avoid construction in areas where these resources exist.

Potential Paleontological Resource Impacts

Equipment installation and construction activities that require ground disturbance could damage existing paleontological resources, which are both fragile and irreplaceable. Based on the impact significance criteria presented in Table 5.2.3-1, impacts to paleontological resources could be potentially significant if FirstNet's buildout/deployment locations uncovered paleontological resources during construction activities. As discussed in Section 5.1.3.7, fossils are abundant throughout parts of Indiana. 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

[137] 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, 2015h)

considered on a site-by-site basis. BMPs and mitigation measures (see Chapter 19) could further help avoid or minimize the potential impacts.

Surface Geology, Bedrock, Topography, Physiography, and Geomorphology

Equipment installation and construction activities that require modification or removal of the surrounding terrain could cause irreparable damage to that area's geology, topography, physiography, or geomorphology. Based on the impact significance criteria presented in Table 5.2.3-1, impacts would be less than significant as FirstNet's deployment is unlikely 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 19) could be implemented to help avoid or minimize the potential impacts.

5.2.3.4 Potential Impacts of the Preferred Alternative

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

Deployment Impacts

Implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some Proposed Actions have the potential to be impacted by geologic hazards, some Proposed Actions could result in potential impacts to geology, and other Proposed Actions 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 Proposed Actions that would be conducted at these small entry and exit points are not likely to produce perceptible changes.

Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to geologic resources because there would be no ground disturbance.

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

Activities with the Potential to Have Impacts

Potential deployment-related impacts to geologic resources, or resulting from geologic hazards due to implementation of the Preferred Alternative, would encompass a range of impacts that could occur as a result of ground disturbance activities, including loss of mineral and fuel resources and paleontological resources. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to geologic resources, or impacts from geologic hazards, include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of points of presence (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 or near bodies of water is not expected to impact geologic resources including marine paleontological resources. However, impacts to equipment could potentially occur as a result of construction of landings and/or facilities on shores or the banks of water bodies that

accept the submarine cable, depending are the exact site location and proximity to locations that are susceptible to landslides, earthquakes, and other geologic hazards.

- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts and require ground disturbance in locations that are susceptible to geologic hazards (e.g., land subsidence, landslides, or earthquakes), it is possible that they could be affected by that hazard.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to geologic resources. Land/vegetation clearing, excavation activities, landscape grading, and other ground disturbance activities during the installation of new wireless towers and associated structures or access roads could result in erosion or disturbance of geologic resources. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in ground disturbance. However, if additional power units, structural hardening, and physical security measures required ground disturbance, such as grading, or excavation activities, impacts to geologic resources could occur due to ground disturbance. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
  - Deployable Technologies: Implementation of deployable technologies could result in potential impacts to geologic resources depending on the technology and location proposed for deployment. Potential impacts may result if deployment of vehicles (i.e., SOWs, COWs, COLTs, 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, or the use of portable devices that use satellite technology would not impact geologic resources because those Proposed Actions 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 Proposed Actions could potentially involve ground disturbance resulting from land/vegetation clearing, topsoil removal, excavation, excavated material placement, trenching or directional boring, construction of access roads and other impervious surfaces, landscape grading, and heavy equipment movement. Potential impacts to geological resources associated with deployment could include minimal removal of bedrock or mineral resources, or adverse impacts to installed equipment resulting from geologic hazards (e.g., seismic hazards, landslides, and land subsidence). Specific FirstNet projects are likely to be small scale; correspondingly, disturbance to geologic resources for those types of projects with the potential to impact geologic resources is also expected to be small scale as a result; these impacts are expected to be less than significant. Chapter 19, BMPs and Mitigation Measures, provides a listing of the 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 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, volcanic activity, landslides, and land subsidence. Chapter 19, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

5.2.3.5 Alternatives Impact Assessment

The following section assesses potential impacts to geology associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to geology as a result of implementation of this alternative could be as described below.

Deployment Impacts

Implementation of deployable technologies on existing paved surfaces would not result in impacts to geologic resources (or from geologic hazards) as there would be no ground disturbance and mobile technologies could be moved to avoid geologic hazards. Potential impacts may result if deployment of vehicles (i.e., SOWs, COWs, COLTs, or UAVs) occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These impacts are expected to be less than significant due to the minor amount of paving or new infrastructure needed to accommodate the deployables. Chapter 19, BMPs and Mitigation Measures, provides a listing of the 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 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 subject to increased seismic activity, volcanic activity, landslides, and land subsidence. Chapter 19, BMPs and Mitigation Measures, provides a listing of the 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) from construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 5.2.3, Geology.

5.2.4. Water Resources

5.2.4.1 Introduction

This section describes potential impacts to water resources in Indiana associated with deployment and operation of the Proposed Action and Alternatives. Chapter 19, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

5.2.4.2 Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on water resources were evaluated using the significance criteria presented in Table 5.2.4-1. As described in Section 5.2, 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 5.2.4-1: Impact Significance Rating Criteria for Water Resources

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Water Quality (groundwater and surface water) - sedimentation, pollutants, nutrients, water temperature	Magnitude or Intensity	Groundwater contamination creating a drinking quality violation, or otherwise substantially degrade groundwater quality or aquifer; local construction sediment water quality violation, or otherwise substantially degrade water quality; water degradation poses a threat to the human environment, biodiversity, or ecological integrity. Violation of various regulations including: CWA, SDWA.	Effect that is potentially significant, but with mitigation is less than significant.	Potential impacts to water quality, but potential effects to water quality would be below regulatory limits and would naturally balance back to baseline conditions.	No changes to water quality; no change in sedimentation or water temperature, or the presence of water pollutants or nutrients.
	Geographic Extent/Context	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Chronic and long term changes not likely to be reversed over several years or seasons.		Impact is temporary, lasting no more than six months.	NA
Floodplain degradation[a]	Magnitude or Intensity	The use of floodplain fill, substantial increases in impervious surfaces, or placement of structures within a 500-year flood area that will impede or redirect flood flows or impact floodplain hydrology. High likelihood of encountering a 500-year floodplain within a state or territory.	Effect that is potentially significant, but with mitigation is less than significant.	Activities occur inside the 500-year floodplain, but do not use fill, do not substantially increase impervious surfaces, or place structures that will impede or redirect flood flows or impact floodplain hydrology, and do not occur during flood events. Low likelihood of encountering a 500-year floodplain within a state or territory.	Activities occur outside of floodplains and therefore do not increase fill or impervious surfaces, nor do they impact flood flows or hydrology within a floodplain.

Type of Effect	**Effect Characteristics**	**Impact Level**			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Chronic and long term changes not likely to be reversed over several years or seasons.		Impact is temporary, lasting no more than one season or water year, or occurring only during an emergency.	NA
Drainage pattern alteration	Magnitude or Intensity	Alteration of the course of a stream of a river, including stream geomorphological conditions, or a substantial and measurable increase in the rate or amount of surface water or changes to the hydrologic regime.	Effect that is potentially significant, but with mitigation is less than significant.	Any alterations to the drainage pattern are minor and mimic natural processes or variations.	Activities do not impact drainage patterns.
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Impact occurs in perennial streams, and is ongoing and permanent.		Impact is temporary, lasting no more than six months.	NA
Flow alteration	Magnitude or Intensity	Consumptive use of surface water flows or diversion of surface water flows such that there is a measurable reduction in discharge.	Effect that is potentially significant, but with mitigation is less than significant.	Minor or no consumptive use with negligible impact on discharge.	Activities do not impact discharge or stage of waterbody (stream height).
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Impact occurs in perennial streams, and is ongoing and permanent.		Impact is temporary, not lasting more than six months.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Changes in groundwater or aquifer characteristics	Magnitude or Intensity	Substantial and measurable changes in groundwater or aquifer characteristics, including volume, timing, duration, and frequency of groundwater flow, and other changes to the groundwater hydrologic regime.	Effect that is potentially significant, but with mitigation is less than significant.	Any potential impacts to groundwater or aquifers are temporary, lasting no more than a few days, with no residual impacts.	Activities do not impact groundwater or aquifers.
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Impact is ongoing and permanent.		Impact is temporary, not lasting more than six months.	NA

[a] Since public safety infrastructure is considered a critical facility, Proposed Actions should avoid the 500-year floodplain wherever practicable, per the Executive Orders on Floodplain Management (EO 11988 and EO 13690).
NA = Not Applicable

5.2.4.3 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 503(d) of the CWA requires states to identify impaired waters. For these impaired waters, states must consider the development of a Total Maximum Daily Load (TMDL) or other strategy to reduce the input of the specific pollutant(s) restricting waterbody uses, in order to restore and protect such uses.

Most of Indiana's rivers and streams are in good condition, although more than half of Indiana's estuaries, bays, and lakes are impaired (see Table 5.1.4-2 and Figure 5.1.4-3). Legacy discharges of polychlorinated biphenyl (PCBs), dioxins, and pesticides have affected all of Indiana's Great Lakes shoreline, which have resulted in fish consumption advisories for many species. Groundwater quality within the state is generally good (USEPA, 2015a) (USGS, 1999).

Construction 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 could increase erosion. Impacts to water quality may occur from post construction vegetation management, such as herbicides, that may leach into groundwater or move to surface waters through soil erosion or runoff, spray drift, or inadvertent direct overspray. Fuel, oil, and other lubricants from equipment could contaminate groundwater and surface waters if carried in runoff. Other water quality impacts could include changes in temperature, pH or dissolved oxygen levels, water odor, color, or taste, or addition of suspended solids.

Soil erosion or the introduction of suspended solids into waterways from implementation of the Preferred Alternative could contribute to degradation of water quality. If the Proposed Action and Alternatives would disturb more than 1 acre of soil, a state or USEPA NPDES Construction General Permit (CGP) would be required. As part of the permit application for the CGP, a stormwater pollution prevention plan (SWPPP) would need to be prepared containing BMPs that would be implemented to prevent, or minimize the potential for, sedimentation and erosion. Adherence to the CGP and the BMPs would help prevent sediment and suspended solids from entering the waterways and ensure that effects on water quality during construction would not be adverse.

Deployment activities associated with the Proposed Action have the potential to increase erosion and sedimentation around construction and staging areas. Grading activities associated with construction would potentially result in a temporary increase in the amount of suspended solids running off construction sites. If a storm event were to occur, construction site runoff could result in sheet erosion of exposed soil. If not adequately controlled, water runoff from these areas would have the potential to degrade surface water quality. Implementing BMPs and mitigation measures could help reduce potential impacts to surface water quality.

Expected deployment activities would not violate applicable state, federal, or local regulations, cause a threat to the human environment, biodiversity, or ecological integrity through water degradation, or cause a sediment water quality violation from local construction, or otherwise substantially degrade water quality.

Therefore, based on the impact significance criteria presented in Table 5.2.4-1, 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 Proposed Action area. If trenching[138] or tower construction were to occur near or below the existing water table (depth to water), then dewatering would be anticipated at the location. Residual contaminated groundwater could be encountered during dewatering activities. Construction activities would need to comply with Indiana dewatering requirements. Any groundwater extracted during dewatering activities or as required by a dewatering permit may need to be treated prior to discharge or disposed of at a wastewater treatment facility.

Due to average thickness of most Indiana aquifers, there is potential for groundwater contamination within a watershed or multiple watersheds. Thus, it is unlikely that the majority of FirstNet's deployment locations would result in a drinking quality violation, or otherwise substantially degrade groundwater quality or aquifer, and based on the impact significance criteria presented in Table 5.2.4-1, 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 of flooding. Some Proposed Actions 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 5.2.4-1, floodplain degradation impacts would be potentially less than significant since the majority of FirstNet's likely deployment activities, on the watershed or subwatershed level, would occur inside the 500-year floodplain, would use minimal fill, would not substantially increase impervious surfaces, structures would not impede or redirect flood flows or impact floodplain hydrology, and would not occur during flood events with the exception of deployable technologies which may be

[138] 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).

deployed in response to an emergency. Additionally, any effects would likely be temporary, lasting no more than one season or water year,[139] or occur only during an emergency

See Chapter 19, 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 to floodplain degradation.

Drainage Pattern Alteration

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

According to the significance criteria in Table 5.2.4-1, 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 Proposed Actions that could have minor changes to the drainage patterns include:

- Land uses with pervious surfaces that create limited stormwater runoff.
- Activities designed so that 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 drainage patterns would be less than significant. BMPs and mitigation measures could be implemented to further reduce any potentially significant impacts.

Flow Alteration

Flow alteration refers to the modification of flow characteristics, relative to natural conditions. Human activities may change the amount of water reaching a stream, divert flow through artificial channels, or alter the shape and location of streams. Surface water and groundwater withdrawals could alter flow by reducing water volumes in streams. Withdrawals may return to the surface/groundwater system at a point further downstream, be removed from the watershed

[139] A water year is defined as "the 12-month period October 1, for any given year through September 30, of the following year. The water year is designated by the calendar year in which it ends and which includes 9 of the 12 months." (USGS, 2016c)

through transpiration by crops, lawns or pastures, or be transferred to another watershed altogether (e.g., water transferred to a different watershed for drinking supply). Altered flow could increase flooding and introduce more erosion and potential for pollution. Alternatively, if water is diverted from its normal flow, the opposite may occur; wetlands and streams may not receive as much water as necessary to maintain the ecology and previous functions.

Activities that do not impact discharge or stage of waterbody (stream height) are not anticipated to have an impact on flow, according to Table 5.2.4-1. Projects that include minor consumptive use of surface water with less than significant impacts on discharge (do not direct large volumes of water into different locations) on a temporary (no more than six months) are likely to have less than significant impacts on flow alteration, on a watershed or subwatershed level. Examples of projects likely to have less than significant impacts include:

- Construction of any structure in a 100-year or 500-year floodplain that is built above base flood elevation pursuant to floodplain management regulations.
- Land uses that are maintaining or increasing pervious surfaces.
- Land uses that do not change the flow of water or drainage patterns off site or into surface water bodies that have not received that volume of stormwater previously.
- Minor clearing or grading activities.

Since the Proposed Actions would not likely alter flow characteristics or change the hydrologic regime, impacts would be less than significant impacts to flow alteration. BMPs and mitigation measures (Chapter 19) could be implemented to further reduce impacts.

Changes in Groundwater or Aquifer Characteristics

As described in Section 5.1.4.7, approximately 25 percent (6 million) of Indiana residents rely on groundwater as a source of potable water. Groundwater is an important natural resource used by industrial, commercial, agricultural, and residential uses for manufacturing, irrigation, and drinking water purposes. Generally, the water quality of Indiana's aquifers is suitable for drinking and daily water needs. Once a groundwater supply is exhausted or contaminated, it is very expensive, and sometimes impossible, to replace. Water supply demand from the deployment activities is unlikely to exceed safe and sustainable withdrawal capacity rate of the local supply or aquifer.

Storage of generator fuel over groundwater or an aquifer would likely cause any impacts to water quality. Activities that may cause changes is groundwater or aquifer characteristics include:

- Excavation, mining, or dredging during or after construction.
- Any liquid waste, including but not limited to wastewater, generation.
- Storage of petroleum or chemical products.
- Private and public water supplies often use groundwater as a water source. To maintain a sustainable system, the amount of water withdrawn from these groundwater sources must be balanced with the amount of water returned to the groundwater source (groundwater recharge).

Deployment activities will likely have be less than significant impacts since they would not substantially deplete supplies of potable groundwater, as any construction dewatering would be short-term. The siting of deployment activities should, as practicable and feasible, be considered to avoid areas that would extract groundwater from potable groundwater sources in the area.

5.2.4.4 Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action 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 Proposed Actions 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 Proposed Actions 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, attached to satellites launched for other purposes, and the use of portable devices that use satellite technology would not impact water resources because those Proposed Actions would not require ground disturbance.

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

Activities with the Potential to Have Impacts

Potential deployment-related impacts to water resources because of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including impaired water quality. The types of deployment activities that could be part of the Preferred Alternative and result in potential impacts to water resources include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to water resources. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites. The amount of impact depends on the land area affected, installation technique, and location. Trenching would not be expected to occur near or below the existing water table (depth to water). Implementing BMPs and mitigation measures could reduce impact intensity.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water could impact water resources from a short-term increase in suspended solids in the water as a result of the construction of landings and/or facilities on shores or the banks of water bodies that accept the submarine cable, depending on the exact site location and proximity to water bodies. Site-specific impact assessment could 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 hardening could result in ground disturbance 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.

- 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 and mitigation measures 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.
  - 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 water resources. However, if the onsite delivery of additional power units, structural hardening, and physical security measures required ground disturbance, impacts to water resources could occur, including increased suspended solids leading to impaired water quality and impacts to groundwater from excavation.
  - 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. Chapter 19, BMPs and Mitigation Measures, provides a listing of the 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. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described 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 mountainous activities would be conducted along existing roads and utility rights-of-way. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. Impacts to water quality would likely be less than significant for operations and maintenance activities. Impacts to surface and groundwater quality from routine operations and maintenance, such as herbicide application to control vegetation, are not expected. Chapter 19, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

5.2.4.5 Alternatives Impact Assessment

The following section assesses potential impacts to water resources associated with the Deployable Technologies Alternative and the No Action Alternative.[140]

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,

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

usable infrastructure. There would be no collocation of equipment and minimal new construction. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to 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. These Proposed Actions 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 activities could also result in indirect impacts on water quality if fuels leak into surface or groundwater; these impacts are not expected to be significant. The amount of potential 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). Chapter 19, BMPs and Mitigation Measures, provides a listing of the 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 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. Chapter 19, BMPs and Mitigation Measures, provides a listing of the 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 5.1.4, Water Resources.

5.2.5. Wetlands

5.2.5.1 Introduction

This section describes potential impacts to wetlands in Indiana associated with deployment and operation of the Proposed Action and Alternatives. Chapter 19, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

5.2.5.2 Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on wetlands were evaluated using the significance criteria presented in Table 5.2.5-1. As described in Section 5.2, 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 5.2.5-1: 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 504 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. Category 1 are the highest quality, highest functioning wetlands
[2] Indirect effects are those resulting from direct effects, but they occur elsewhere in space and/or time. Includes indirect hydrologic effects (wetting or drying) that in turn alters wetland function or type
[3] Wetland functions include hydrologic, ecological, geomorphic, and social functions typically assessed for wetlands as part of USACE compensatory mitigation planning. Typical functions assessed may include flood attenuation, bank stabilization, water quality, organic matter input/transport, nutrient processing, wildlife habitat, T/E species habitat, biodiversity, recreational/social value.
NA = Not Applicable

5.2.5.3 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 could be further reduced by implementing BMPs and mitigation measures (see Chapter 19).

There are approximately 900,000 acres of palustrine, riverine, and lacustrine wetlands throughout Indiana (USFWS, 2014a). Palustrine (freshwater) wetlands are found in forested lowlands, on river and lake floodplains, and other areas across the state; riverine and lacustrine wetlands are found adjacent to rivers and lakes throughout the state, as presented in Section 5.1.5.

Based on the impact significance criteria presented in Table 5.2.4-1, the deployment activities would most likely have less than significant direct impacts on wetlands. Additionally, deployment activities would be unlikely to violate applicable federal, state, or local regulations.

As presented in Section 5.1.5.4, Wetlands of Special Concern or Value, Indiana provides priority protection to a group of wetland types known as 'Rare and Ecologically Important Wetland Types.' These wetlands include acid bog, acid seep, circumneutral bog, circumneutral seep, cypress swamp, dune and swale, fen, forested fen, forested swamp, marl beach, muck flat, panne, sand flat, sedge meadow, shrub swamp, sinkhole pond, sinkhole swamp, wet floodplain forest, wet prairie, and wet sand prairie. Each of these wetland types are described in Table 5.1.5-1.

If any of the proposed deployment activities were to occur in these high quality wetlands, potentially significant impacts could occur. High quality wetlands occur throughout the state, and are not always included on state maps; therefore, site-specific analysis would likely be needed. BMPs and mitigation measures could be implemented to help 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 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 5.2.5-1, 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) could cause potentially significant impacts. In addition, introduction and establishment of invasive species to high quality wetlands within a watershed or multiple watersheds could be 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, site-specific locations will be subject to an environmental review to help ensure environmental concerns are addressed. Potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures (see Chapter 19).

Examples of Proposed Actions that could have other direct effects to wetlands in Indiana 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 could alter water level response times, depths, and duration of water detention. Reduction of watershed infiltration capacity could cause wetland water depths to rise more rapidly following storm events.
- Direct Hydrologic Changes (flooding or draining): Greater frequency and duration of flooding could destroy native plant communities, as could depriving them of their water supply. Hydrologic changes could make a wetland more vulnerable to pollution. Increased water depths or flooding frequency could distribute pollutants more widely through a wetland. Sediment retention in wetlands is directly related to flow characteristics, including degree and pattern of channelization, flow velocities, and storm surges.
- Direct Soil Changes: Changes in soil chemistry could lead to degradation of wetlands that have a specific pH range and/or other parameters.
- Water Quality Degradation (spills or sedimentation): The loss of wetlands results in a depletion of water quality both in the wetland and downstream. Filtering of pollutants by wetlands is an important function and benefit. High levels of suspended solids

(sedimentation) could reduce light penetration, dissolved oxygen, and overall wetland productivity. Toxic materials in runoff could interfere with the biological processes of wetland plants, resulting in impaired growth, mortality, and changes in plant communities.

Indirect Effects:[141] Change in Function(s)[142] or Change in Wetland Type

Indirect effects to wetlands could include change in wetland function or conversion of a resource to another type (i.e., wetland to an open body of water). The construction of curb and gutter systems diverts surface runoff and could cause flooding or wetlands to dry out, depending on the direction of diversion. Indirect effects to both 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, site-specific locations will be subject to an environmental review to help ensure environmental concerns are addressed. Potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures (see Chapter 19).

Examples of functions related to wetlands in Indiana 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. Correspondingly, disturbance of the wetlands (e.g., dredging or filling) could proportionately reduce water storage function.
- Bank Stabilization: By reducing the velocity and volume of flow, wetlands provide erosion control, floodwater retention, and reduce stream sedimentation.
- Water Quality: Water quality impacts on wetland soils could eventually threaten a wetland's existence. Where sediment inputs exceed rates of sediment export and soil consolidation, a wetland would gradually become filled.
- Nutrient Processing: Wetland forests retain ammonia during seasonal flooding. Wetlands absorb metals in the soils and by plant uptake via the roots. They also allow metabolism of oxygen-demanding materials and reduce fecal coliform populations. These pollutants are often then buried by newer plant material, isolating them in the sediments.
- 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 could have impacts on the preferred food supply and animal cover.

[141] 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.
[142] 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.

- 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 5.2.5-1, impacts to lower quality wetlands (e.g., not rare or unique, that have low productivity and species diversity, and those that are already impaired or impacted by human activity), would be considered potentially less than significant. Since the majority of the 2 million acres of wetlands in Indiana are not considered high quality, deployment activities would likely have less than significant indirect impacts on wetlands in the state. BMPs and mitigation measures could be implemented, as feasible and practicable, to reduce potential impacts to wetlands.

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

5.2.5.4 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 Proposed Actions, wetland delineations could be required to determine the exact location of all wetlands, including high quality wetlands, as well as a functional assessment by an experienced wetland delineator.

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some Proposed Actions 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 Proposed Actions 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 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/or 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 or near bodies of water could potentially impact wetlands found along shorelines as a result of the construction of landings and/or facilities on shores or the banks of water bodies that accept the submarine cable, depending on the exact site location and proximity to wetlands. 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 Proposed Actions, 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 Proposed Actions 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 (see Chapter 19) could help 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 Proposed Actions could also result in other direct impacts on wetlands if fuels leak into nearby waterbodies or wetlands.

Deployment of drones, balloons, or blimps, piloted aircraft could have other direct impacts on wetlands if fuels spill or other chemicals seep into nearby waterbodies or wetlands.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or underwater cables; installation of security/safety lighting and fencing; and deployment of aerial platforms. Depending on the deployment Proposed Action 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 amount of land disturbance (generally less than one acre) and the short timeframe of deployment activities. To minimize any potential impacts to wetlands, BMPs and mitigation measures would be implemented in compliance with any issued federal, state, and local permits. Chapter 19, BMPs and Mitigation Measures, provides a listing of the 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 could be ongoing other potential 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 ROWs. Chapter 19, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

5.2.5.5 Alternatives Impact Assessment

The following section assesses potential impacts to water resources associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred

Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to wetlands as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts to wetlands. Some staging or launching/landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in direct and/or indirect impacts to wetlands from a temporary increase in the amount of suspended solids running off construction sites to nearby surface waters. The amount of impact depends on the land area affected, installation technique, and proximity to wetlands, and wetland type; however, impacts are expected to be less than significant due to the small scale and temporary duration of expected FirstNet deployment activities in any one location. To minimize any potential impacts to wetlands, BMPs and mitigation measures would be implemented in compliance with any issued federal, state, and local permits. Chapter 19, BMPs and Mitigation Measures, provides a listing of the 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 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. Chapter 19, BMPs and Mitigation Measures, provides a listing of the 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 5.1.5, Wetlands.

5.2.6. Biological Resources

5.2.6.1 Introduction

This section describes potential impacts to terrestrial vegetation, wildlife, fisheries and aquatic habitat, and threatened and endangered species in Indiana associated with deployment and operation of the Proposed Action and its Alternatives. Chapter 19, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

5.2.6.2 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 5.2.6-1. As described in Section 5.2, 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 5.2.6.3, 5.2.6.4, and 5.2.6.5, respectively, are presented as a range of possible impacts.

Refer to Section 5.2.6.6 for impact assessment methodology and significance criterial associated with threatened and endangered species in Indiana.

Table 5.2.6-1: Impact Significance Rating Criteria for Terrestrial Vegetation, Wildlife, Fisheries, and Aquatic Habitats

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Direct Injury/Mortality	Magnitude or Intensity	Population-level or sub-population injury /mortality effects observed for at least one species depending on the distribution and the management of said species. Events that may impact endemics, or concentrations during breeding or migratory periods. Violation of various regulations including: MBTA and Bald and Golden Eagle Protection Act (BGEPA).	Effect that is potentially significant, but with BMPs and mitigation measures is less than significant.	Individual mortality observed but not sufficient to affect population or sub-population survival.	No direct individual injury or mortality would be observed.
	Geographic Extent	Regional effects observed within Indiana for at least one species. Anthropogenic[143] 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

[143] Anthropogenic: "Made by people or resulting from human activities. Usually used in the context of emissions that are produced as a result of human activities" (USEPA, 2016c).

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Vegetation and Habitat Loss, Alteration, or Fragmentation	Magnitude or Intensity	Population-level or sub-population effects observed for at least one species or vegetation cover type, depending on the distribution and the management of the subject species. Impacts to terrestrial, aquatic, or riparian habitat or other sensitive natural community vital for feeding, spawning/breeding, foraging, migratory rest stops, refugia, or cover from weather or predators. Violation of various regulations including: MBTA and BGEPA.	Effect that is potentially significant, but with BMPs and mitigation measures is less than significant.	Habitat alteration in locations not designated as vital or critical for any period. Temporary losses to individual plants within cover types, or small habitat alterations take place in important habitat that is widely distributed and there are no cover type losses or cumulative effects from additional projects.	Sufficient habitat would remain functional to maintain viability of all species. No damage or loss of terrestrial, aquatic, or riparian habitat from project would occur.
	Geographic Extent	Regional effects observed within Indiana for at least one species. Anthropogenic disturbances that lead to the loss or alteration of nutritional or habitat resources for endemics or a significant portion of the population or sub-population located in a small area during a specific season.		Effects realized at one location.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within one to three years.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	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: MBTA and BGEPA.	Effect that is potentially significant, but with BMPs and mitigation measures is less than significant.	Individual injury/mortality observed but not sufficient to affect population or sub-population survival. Partial exclusion from resources in locations not designated as vital or critical for any given species or life stage, or exclusion from resources that takes place in important habitat that is widely distributed. Anthropogenic disturbances are measurable but minimal as determined by individual behavior and propagation, and the potential for habituation or adaptability is high given time.	No stress or avoidance of feeding or important habitat areas. No reduced population resulting from habitat abandonment.
	Geographic Extent	Regional or site specific effects observed within Indiana for at least one species. Behavioral reactions to anthropogenic disturbances depend on the context, the time of year age, previous experience, and activity. Anthropogenic disturbances that lead to startle responses of large groupings of individuals during haulouts, resulting in injury or mortality.		Effects realized at one location.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within one to three years.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Effects to Migration or Migratory Patterns	Magnitude or Intensity	Population-level or sub-population effects observed for at least one species depending on the distribution and the management of said species. Temporary or long-term loss of migratory pattern/path or rest stops due to anthropogenic activities. Violation of various regulations including: MBTA and BGEPA.	Effect that is potentially significant, but with BMPs and mitigation measures is less than significant.	Temporary loss of migratory rest stops due to anthropogenic activities take place in important habitat that is widely distributed and there are no cumulative effects from additional projects.	No alteration of migratory pathways, no stress or avoidance of migratory paths/patterns due to project.
	Geographic Extent	Regional effects observed within Indiana for at least one species. Anthropogenic disturbances that lead to exclusion from nutritional or habitat resources during migration, or lead to changes of migratory routes for endemics or a significant portion of the population or sub-population located in a small area during a specific season.		Effects realized at one location when population is widely distributed, and not concentrated in affected area.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within one to three years.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Reproductive Effects	Magnitude or Intensity	Population or sub-population level effects in reproduction and productivity over several breeding/spawning seasons for at least one species depending on the distribution and the management of said species. Violation of various regulations including: MBTA and BGEPA.	Effect that is potentially significant, but with BMPs and mitigation measures is less than significant.	Effects to productivity are at the individual rather than population level. Effects are within annual variances and not sufficient to affect population or sub-population survival.	No reduced breeding or spawning success.
	Geographic Extent	Regional effects observed within Indiana for at least one species. Anthropogenic disturbances that lead to exclusion from prey or habitat resources required for breeding/spawning or stress, abandonment, and loss of productivity for endemics or a significant portion of the population or sub-population located in a small area during the breeding/spawning season.		Effects realized at one location.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several breeding/spawning seasons for at least one species.		Temporary, isolated, or short-term effects that are reversed within one breeding season.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Invasive Species Effects	Magnitude or Intensity	Extensive increase in invasive species populations over several seasons.	Effect that is potentially significant, but with BMPs and mitigation measures is less than significant.	Mortality observed in individual native species with no measurable increase in invasive species populations.	No loss of forage and cover due to the invasion of exotic or invasive plants introduced to project sites from machinery or human activity.
	Geographic Extent	Regional impacts observed throughout Indiana.		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

5.2.6.3 Terrestrial Vegetation

Impacts to terrestrial vegetation occurring in Indiana 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 5.2.6-1, 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. 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 disturbances 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. About 64 percent of Indiana has experienced extensive land use change due to cropland creation and about 10 percent of the state has experienced extensive land use change due to urbanization. However, a portion of the state, about 24 percent, remains as unfragmented forest, particularly the Hoosier National Forest and Brown County State Park (NRCS, 2010).

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 could be recommended to help minimize or avoid potential impacts.

Indirect Injury/Mortality

Indirect effects are effects that are caused by the Proposed Action and are later in time or farther removed in distance, but are still reasonably foreseeable (40 CFR 1508.8[b]). Indirect injury/mortality could include stress related to disturbance. The alteration of soils or hydrology within a localized area could result in stress or mortality of plants. Construction activities that remove large quantities of soil in the immediate vicinity of trees could cause undue stress to trees from root exposure, although this is unlikely to occur due to the small size of expected FirstNet activities. Increasing or decreasing hydrology in an area as an indirect effect, could lead to moisture stress and/or mortality of plant species that are adapted to specific hydrologic regimes.

Indirect injury/mortality impacts vary depending on the species, time of year and duration of construction or deployment, though BMPs and mitigation measures could help to minimize or avoid the potential impacts.

Effects to Migration or Migratory Patterns

No effects to the long-term migration or migratory patterns for terrestrial vegetation (e.g., forest migration) are expected as a result of the Proposed Action, given the small scale of deployment activities.

Reproductive Effects

No reproductive effects to terrestrial vegetation are expected as a result of the Proposed Action given the small scale of deployment activities.

Invasive Species Effects

When human activity results in a species entering an ecosystem new to it, the species is classified as introduced or, depending on its ability to spread rapidly and outcompete native species, invasive. The introduction of invasive species could 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 could sometimes dramatically increase. The unnaturally large population numbers could then have severe impacts to the environment, local economy, and human health. Invasive species could out-compete the native species for food and habitats and sometimes even cause their extinction. The Indiana Noxious Weed Law (IC 15-16-7-2) stipulates that the Indiana Department of Agriculture be responsible for the establishment of the statewide noxious weed list and updates to that list, as necessary. In addition, the Act further stipulates that each county is responsible for implementing and enforcing noxious weed management through a county weed control board. Indiana also regulates exotic weeds under the Exotic Weed Law (IC 14-8-2-87.5). A total of nine state-listed noxious weeds/complexes are regulated in Indiana. Of these species/complexes, seven of them are terrestrial and two are aquatic species.

The potential to introduce invasive plants within construction zones and during long-term site maintenance could occur from vehicles and equipment being transported from one region to another, or when conducting revegetation of a site after deployment activities are complete. BMPs 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 construction/deployment and operational activities.

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to terrestrial vegetation resources and others would not. In addition, 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,[144] 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

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

vehicle would be very unlikely to impact biological resources, it is anticipated that this activity would have no impact on sterrestrial vegetation.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to terrestrial vegetation as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct injury/mortality; vegetation and habitat loss, alteration, or fragmentation; indirect injury/mortality; and invasive species effects. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to terrestrial vegetation include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to terrestrial vegetation. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects. Implementation of BMPs and mitigation measures could help to avoid or minimize potential impacts.
  - New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public ROWs or private easements as well as the construction of access roads, POPs, huts, or 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. Implementation of BMPs and mitigation measures could help avoid or minimize potential impacts.
  - Collocation on Existing Aerial Fiber Optic Plant: Land clearing and excavation during replacement of poles and structural hardening could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in 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 shores or the banks of water bodies that accept the submarine cables, depending on the exact site location and proximity to terrestrial vegetation. Effects could include direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects. Implementation of BMPs and mitigation measures could help avoid or minimize potential impacts.
  - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required construction of access roads, trenching,

and/or land clearing, such disturbance could result in direct or indirect injury to plants, vegetation loss, and invasive species effects.

- Wireless Projects
  - New Wireless Communication Towers 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. Chapter 19, BMPs and Mitigation Measures, provides a listing of the 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 be less than significant 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 to terrestrial vegetation due to the small scale of expected activities. These potential impacts could result from accidental spills from maintenance equipment or release of herbicides and because these areas would not be allowed to revert to a more natural state. If usage of heavy equipment or land clearing activities occurs off established roads or corridors as part of routine maintenance or inspections, direct or indirect injury/mortality to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species could occur to terrestrial vegetation, however impacts are expected to be less than significant due to the small scale of expected activities. Chapter 19, BMPs and Mitigation Measures, provides a listing of the 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 new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to terrestrial vegetation as a result of implementation of this alternative could be as described below.

Deployment Impacts

As described above, implementation of deployable technologies could result in less than significant impacts from land/vegetation clearing, excavation, and paving activities. These activities could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects. Greater frequency and duration of deployments could change the magnitude of impacts. However, impacts are expected to remain less than significant due to the relatively small scale of FirstNet activities at individual locations. Chapter 19, BMPs and Mitigation Measures, provides a listing of the 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 could 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 5.1.6.3, Terrestrial Vegetation.

5.2.6.4 Wildlife

Impacts to amphibians and reptiles, terrestrial mammals, birds, and terrestrial invertebrates occurring in Indiana 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 5.2.6-1: Impact Significance Rating Criteria for Terrestrial Vegetation, Wildlife, Fisheries, and Aquatic Habitats, 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 (although minimal) for some FirstNet projects, impacts to individual behavior of animals would be short-term and direct injury or mortality impacts at the population-level or sub-population effects would not likely be observed.

Terrestrial Mammals

Vehicle strikes are common sources of direct mortality or injury to both small and large mammals in Indiana. 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 (FHWA, 2015e). 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 tree-roosting bats, and particularly maternity colonies are present at a site location, removal of trees during land clearing activities could result in direct injury/mortality if bats are utilizing them as roost trees or for rearing young. The scale of this impact would be expected to be small and would be depended on the location and type of deployment activity, and tree removal. Site avoidance measures could be implemented to help avoid disturbance to bats.

Birds

Mortalities from collisions or electrocutions with manmade cables and wires are environmental concerns for avian species and could violate MBTA and BGEPA. Generally, collision events occur to night-migrating birds, “poor” fliers (e.g., ducks), night-migrating birds, heavy birds (e.g., swans and cranes), and birds that fly in flocks; while species susceptible to electrocution are birds of prey, ravens, and thermal soarers, typically having large wing spans (Gehring, Kerlinger, & and Manville, 2011).

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

Direct injury and mortality of birds could occur to ground-nesting birds when nests are either disturbed or destroyed during land clearing, excavation and trenching, and other ground disturbing activities. Removal of trees during land clearing activities, could also result in direct injury/mortality to forest dwelling birds if they are utilizing them as roost trees for resting or shelter from predators and inclement weather, or as nest trees for rearing young. The scale of this impact would be associated with the amount of tree removal and the abundance of forest-dwelling birds roosting/nesting in the area. These impacts could be particularly pronounced in IBAs within the state as these areas provide them with essential habitat that supports various life stages (Hill, et al., 1997). Direct injury/mortality are not anticipated to be widespread or affect bird populations due to the small scale of likely FirstNet actions.

Direct mortality and injury to birds of Indiana 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 (see Chapter 19), potential impacts could potentially be minimized. Additionally, potential impacts under MBTA and BGEPA could be addressed through BMPs and mitigation measures developed in consultation with USFWS.

Reptiles and Amphibians

In Indiana, reptiles and amphibians occur in a wide variety of habitats are widespread throughout the state (IDNR, 2015m). 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 amphibians are discussed in Section 5.2.6.6, Threatened and Endangered Species and Species of Conservation Concern.

Terrestrial Invertebrates

The terrestrial invertebrate populations of Indiana 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 disturbances 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. About 64 percent of Indiana has experienced extensive land use change due to cropland creation and about 10 percent of the state has experienced extensive land use change due to urbanization. However, a portion of the state, about 24 percent, remains as unfragmented forest, particularly the Hoosier National Forest and Brown County State Park (USGS, 2011).

Additionally, habitat loss could occur through exclusion, directly or indirectly, preventing an animal from accessing an optimal habitat (e.g., breeding, forage, or refuge), either by physically preventing use of a habitat or by causing an animal to avoid a habitat, either temporarily or long-term. It is expected that activities associated with the Proposed Action would cause exclusion effects only in very special circumstances, as in most cases an animal could fly, swim, or walk to a nearby area that would provide refuge.

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

Terrestrial Mammals

Mammals occupy a wide range of habitats throughout Indiana and may experience localized effects of habitat loss or fragmentation. Removal or loss of vegetation may impact large mammals (e.g., bobcats) by decreasing the availability of forest for cover from predators or foraging. Loss of cover may increase predation on both breeding adults as well as their young. The loss, alteration, or fragmentation of forested habitat would also impact some small mammals (e.g., bats, foxes) that utilize these areas for roosting, foraging, sheltering, and for rearing their young. Loss of habitat or exclusions from these areas could be avoided or minimized by implementing BMPs and mitigation measures.

Birds

The direct removal of migratory bird nests is prohibited under the MBTA. The USFWS and the IDNR provide regional guidance on the most critical time periods (e.g., breeding season) to avoid vegetation clearing. The removal and loss of vegetation could affect avian species directly by loss of nesting, foraging, stopover, and cover habitat.

Noise disturbance and human activity, as discussed previously, could directly restrict birds from using their preferred resources. Greater human activity of longer duration would increase the likelihood that birds would avoid the area, possibly being excluded from essential resources. These impacts could be particularly pronounced if birds temporarily avoid IBAs within the state as these areas provide them with essential habitat that supports various life stages (Hill, et al., 1997).

The degree to which habitat exclusion affects birds depends on many factors. The impact to passerine[145] species from disturbance or displacement from construction activities is likely to be short-term with minor effects from exclusion. Exclusion from resources concentrated in a small migratory stop area during peak migration could have major impacts to species that migrate in large flocks and concentrate at stop overs (e.g., shorebirds). BMPs and mitigation measures, including nest avoidance during construction-related activities, could help to avoid or minimize the potential impacts to birds from exclusion of resources, as appropriate.

Reptiles and Amphibians

Important habitats for Indiana's amphibians and reptiles typically consist of wetlands and the surrounding upland forest. Impacts are expected to be less than significant. If proposed project sites were unable to avoid sensitive areas, BMPs and mitigation measures (see Chapter 19) could help avoid or minimize the potential impacts.

Filling or draining of wetland breeding habitat (see Section 5.2.4, Water Resources) and alterations to ground or surface water flow from development associated with the Proposed Action may also have effects on Indiana's amphibian and reptile populations, though BMPs and mitigation measures would help to avoid or minimize the potential impacts.[146]

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. Impacts to sensitive invertebrate species are discussed below in Section 5.2.6.6, Threatened and Endangered Species and Species of Concern.

[145] 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.
[146] See Section 5.2.5, Wetlands, for a discussion of BMPs for wetlands.

Indirect Injury/Mortality

Indirect injury/mortality impacts vary depending on the species, time of year and duration of deployment, though BMPs and mitigation measures could help to avoid or minimize the potential impacts.

Terrestrial Mammals

Stress from repeated disturbances during critical time periods (e.g., roosting and mating) could reduce the overall fitness and productivity of young and adult terrestrial mammals. Indirect effects could occur to roosting bats from noise, light, or human disturbance causing them to leave their roosting locations or excluding them from their summer roosting/maternity colony roosts. For example, some bat species establish summer roosting or maternity colonies in the same general area that they return to year and after year. The majority of FirstNet deployment activities would be short-term in nature; therefore, repeated disturbances would be unlikely to occur. 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, could 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. 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, especially during the breeding seasons, could cause stress resulting in lower productivity. The majority of FirstNet deployment activities would be short-term in nature, therefore repeated disturbances would be likely to 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 Indiana’s amphibians and reptiles, terrestrial mammals, birds, and terrestrial invertebrates are described below.

Terrestrial Mammals

Some large mammals (e.g., bobcats) will perform short seasonal migrations between foraging/breeding habitats and denning habitats. Some small mammals (e.g., bats) also have migratory routes that include spring and fall roosting areas between their summer maternity roosts and hibernacula.[147] Any clearance, drilling, and construction activities needed for network deployment, including noise associated with these activities, has the potential to divert mammals from these migratory routes. Impacts can vary depending on the species, time of year of construction/operation, and duration, but are generally expected to be less than significant. Implementation of BMPs and mitigation measures would help to further avoid or minimize the potential impacts.

Birds

Because many birds have extremely long migrations, protection efforts for critical sites along migratory routes must be coordinated over vast distances often involving many different countries. For example, as a group, shorebirds migrating through Indiana undertake some of the longest-distance migrations of all animals. According to the Indiana chapter of the National Audubon Society (NAS), a total of 41 IBAs have been identified in Indiana, including breeding,[148] migratory stop-over, feeding, and over-wintering areas, and a variety of habitats such as native grasslands, forests, and wetland/riparian[149] areas (NAS, 2015). These IBAs are widely distributed throughout the state, although the largest concentrations of IBAs in the region around Lake Michigan and the southern tip of Indiana near the confluence of the Ohio and Wabash Rivers. 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, and impacts are expected to be less than significant. BMPs and mitigation measures could help to further avoid or minimize effects to migratory pathways.

Reptiles and Amphibians

Several species of salamanders and frogs are known to seasonally migrate. For example, wood frogs (*Rana sylvatica*) 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). Mortality and barriers to movement could occur as result of the Proposed Action (Berven & Grudzien, 1990) (Calhoun & DeMaynadier, 2007).

Species that use streams as dispersal or migratory corridors may be impacted if these waterways are restricted or altered, but and impacts are expected to be less than significant. BMPs and mitigation measures could help to further avoid or minimize the potential impacts.

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[147] A location chosen by an animal for hibernation.

[148] Breeding range: "The area utilized by an organism during the reproductive phase of its lifecycle and during the time that young are reared" (USEPA, 2015r).

[149] Riparian: "Referring to the areas adjacent to rivers and streams with a differing density, diversity, and productivity of plant and animal species relative to nearby uplands" (USEPA, 2015r).

Terrestrial Invertebrates

The proposed deployment activities would be expected to be short-term or temporary in nature. No effects to migratory patterns of Indiana'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 could affect the overall population of individuals.

Terrestrial Mammals

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

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. The majority of FirstNet deployment or operation activities are likely to be small scale in nature, and 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, several turtle species lay eggs in exposed soil in late spring or summer.

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 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 could have a dramatic effect on natural resources.

FirstNet deployment or operation activities could result in short-term or temporary changes to specific project sites, although these sites are expected to return to their natural state in a year or two. 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.

Potential invasive species effects to Indiana's wildlife are described below.

<u>Terrestrial Mammals</u>

In Indiana, feral hogs (*Sus scrofa*) adversely impact several native large and small mammals. They feed on young mammals, destroy native vegetation resulting in erosion and water resource concerns, and could carry/transmit disease to livestock and humans (USDA, 2015b).

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 further minimized following BMPs in Chapter 19.

<u>Birds</u>

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 Indiana, mute swans could impact native waterfowl and wetland birds causing nest abandonment or impacts to rearing young due to their aggressive behavior. Further, this invasive bird could lead to declines in submerged aquatic vegetation that support native fish and other wildlife (USDA, 2015b). Although FirstNet deployment activities could result in short-term or temporary changes to specific project sites; these sites are expected to return to their natural state in a year or two. Invasive bird species are not expected to be introduced at project sites as part of the deployment activities.

<u>Reptiles and Amphibians</u>

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. Although FirstNet deployment activities could result in short-term or temporary changes to specific project sites, these sites are expected to return to their natural state in a year or two. Invasive reptile or amphibian species are not expected to be introduced at project sites from machinery or laborers during deployment activities.

<u>Terrestrial Invertebrates</u>

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 could pose a threat to Indiana's forest and agricultural resources. Species such as the gypsy moth (*Lymantria dispar*), hemlock woolly adelgid (*Adelges tsugae*), emerald ash borer (*Agrilus planipennis*), and Asian longhorn beetle (*Anoplophora glabripennis*) are known to cause irreversible damage to native forests. The potential to introduce invasive invertebrates within construction zones and during long-term site maintenance could occur from vehicles and equipment being transported from one region to another, or when conducting revegetation of a site after deployment activities are complete. BMPs and mitigation measures (see Chapter 19) would help to avoid or minimize 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 construction/deployment and operational activities.

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to wildlife resources and others would not. In addition, and as described in this section, infrastructure developed under the Preferred Alternative could result in a range of impacts, from no impacts to less than significant impacts, depending on the deployment scenario or site-specific conditions. The wildlife that would be affected would depend on the ecoregion, the species' phenology and the nature and extent of the habitats affected.

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 and the use of portable devices that use satellite technology would not impact wildlife if 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. Implementation of BMPs and mitigation measures could help avoid or minimize potential impacts.
  - New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public ROWs or private easements as well as the construction of access roads, POPs, huts, or facilitates to house outside plant equipment could result in potential impacts to wildlife resources. Impacts may vary depending on the number or individual poles installed and the extent of ground disturbance, but could include direct injury/mortality of 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 or near bodies of water and construction of landings and/or facilities on shores or the banks of water bodies that accept the submarine cables could potentially impact wildlife (see Section 5.2.4, 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/or 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 additional 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. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.
- Deployable Aerial Communications Architecture: 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. Chapter 19, BMPs and Mitigation Measures, provides a listing of the 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 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 be less than significant. Chapter 19, BMPs and Mitigation Measures, provides a listing of the 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 new construction. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to wildlife resources as a result of implementation of this alternative could be as described below.

Deployment Impacts

As described above, implementation of deployable technologies could result in less than significant impacts from direct and indirect injury or mortality events, changes in migratory patterns, disturbance, or displacement. Greater frequency and duration of deployments could change the magnitude of impacts depending on species, life history, and region of the state. However, impacts are expected to remain less than significant because deployment activities are expected to be temporary, likely affecting only a small number of wildlife. See Chapter 19, 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, although impacts could vary greatly among species and geographic region, 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. Chapter 19, BMPs and Mitigation Measures, provides a listing of the 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 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 5.1.6.4, Terrestrial Wildlife.

5.2.6.5 Fisheries and Aquatic Habitats

Impacts to fisheries and aquatic habitats occurring in Indiana 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, 2012d) Based on the impact significance criteria presented in Table 5.2.6-1, 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 could help to avoid or minimize potential impacts to fisheries and aquatic invertebrate population survival.

Vegetation and Habitat Loss, Alteration, or Fragmentation

Habitat impacts are primarily physical disturbances that result in alterations in the amount or quality of a habitat. As with all of the effects categories, the magnitude of the impact depends on the duration, location, and spatial scale of the system and associated activities. Habitat fragmentation is the breaking down of continuous and connected habitat, and impeding access to resources and mates.

Depending on the location, construction of new infrastructure and long-term facility maintenance could result in the shoreline habitat alteration in localized areas; in some instances, the permanent loss of riparian vegetation could occur, which could lead to water quality impacts and in turn aquatic habitat alteration. Habitat loss is not likely to be widespread or affect populations of species as a whole; fish species would be expected to swim to a nearby location, depending on the nature of the deployment activity. Additionally, deployment activities with the potential for impacts to sensitive aquatic habitats would be addressed through BMPs and mitigation measures, as defined through consultation with the appropriate resource agency.

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 5.2.4, 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 could affect the overall population of individuals. Restrictions to spawning/breeding areas for fish and aquatic invertebrates and the alteration of water quality through sediment infiltration, obstruction of natural water flow, or loss of submerged vegetation resulting from the deployment of various types of infrastructure, are expected to be less than significant. BMPs and mitigation measures, as feasible and appropriate, 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 construction/deployment and operational activities.

Deployment Impacts

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

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 fisheries 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 disturbance.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact fisheries and aquatic habitats if those activities would not require ground disturbance.

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

Activities with the Potential to Have Impacts

Potential /deployment-related impacts to fisheries and aquatic habitats as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct injury/mortality; vegetation and habitat loss, alteration, or fragmentation; effects to migratory patterns; indirect injury/mortality; reproductive effects; and invasive species effects. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to fisheries and aquatic habitats include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to fisheries and aquatic habitats. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities, particularly if they occur adjacent to water resources that support fish, could result in habitat loss, alteration and fragmentation; indirect injury/mortality; and invasive species effects. Implementation of BMPs and mitigation measures could help to avoid or minimize potential impacts.
  - 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. If areas to be disturbed would result in erosion or sedimentation into aquatic habitats, impacts to fisheries and aquatic habitats could occur, but it is expected effects would be temporary and not conducted in locations designated as vital or critical for any period.
  - 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 if conducted near a water resource that supports fish.

- Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Although lighting up of dark fiber would have no impacts to fisheries and aquatic habitats as mentioned above, installation of new associated huts or equipment or construction for laterals/drops, if required near water resources, could result in direct injury/mortality; habitat loss and alternation; effects of migratory patterns; indirect injury or mortality; reproductive effects; and invasive species effects.
- New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water and construction of landings and/or facilities on the shore or the banks of water bodies that accept the 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 if BMPs 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, particularly near water resources that support fish, such disturbance could result in habitat loss, alteration and fragmentation; indirect injury/mortality, and invasive species effects.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads is not expected to result in impacts to fisheries and aquatic habitats as towers and structures would not be constructed in waterbodies. Land/vegetation clearing, excavation activities, landscape grading, and other disturbance activities during the installation of new wireless towers and associated structures or access roads, particularly if they occur near waterbodies that support fish, could result in habitat loss or indirect injury/mortality, although highly unlikely. Refer to Section 5.4, 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. Refer to Section 5.4, Radio Frequency Emissions, for more information on RF 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 significant due to the small scale of deployment activities and the limited number of species expected to be impacted. Chapter 19, BMPs and Mitigation Measures, provides a listing of the 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 due to accidental spills from maintenance equipment or pesticide runoff near fish habitat are expected to result in less than significant effects to fisheries and aquatic habitats due to the limited nature of such activities and the likely small quantities of potentially harmful liquids used.

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, although impacts are expected to be less than significant. These features could also continue to disrupt movements of fish passage. In addition, the presence of new access roads and transmission line ROWs near water resources may increase human use of the surrounding areas, which could increase disturbance to fisheries and aquatic habitats resulting in effects to migratory pathways, indirect injury/mortalities, reproductive effects, as well as the potential introduction and spread of invasive species as explained above. Fisheries and aquatic habitat may also be impacted if increased access leads to an increase in the legal or illegal take of biota. However, impacts are expected to be less than significant 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 or habitats are anticipated to be impacted. Chapter 19, BMPs and Mitigation Measures, provides a listing of the 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 new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to fisheries and aquatic habitats as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts from habitat loss, alteration, and fragmentation; indirect injury/mortality, and invasive species effects. Greater frequency and duration of deployments could change the magnitude of impacts depending on species, life history, and region of the state. However, impacts are expected to remain less than significant due to the limited nature of expected deployment activities. Chapter 19, BMPs and Mitigation Measures, provides a listing of the 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 could vary greatly among species and geographic region but they are still expected to remain less than significant due to the small scale of expected FirstNet activities in any particular location. Chapter 19, BMPs and Mitigation Measures, provides a listing of the 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 5.1.6.5, Fisheries and Aquatic Habitats.

5.2.6.6 Threatened and Endangered Species and Species of Conservation Concern

This section describes potential impacts to threatened and endangered species in Indiana 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 19, 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 5.2.6-2. The categories of impacts for threatened and endangered species and their habitats are defined as may affect, likely to adversely affect; may affect, not likely to adversely affect; and no effect. Characteristics of each effect type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes across the state, the potential impacts to threatened and endangered species addressed below are presented as a range of possible impacts.

Table 5.2.6-2: Impact Significance Rating Criteria for Threatened and Endangered Species

Type of Effect	Effect Characteristics	Impact Level		
		May Affect, Likely to Adversely Affect	May Affect, Not Likely to Adversely Affect	No Effect
Injury/Mortality of a Listed Species	Magnitude or Intensity	As per the ESA, this impact threshold applies at the individual level so applies to any mortality of a listed species and any impact that has more than a negligible potential to result in unpermitted take of an individual of a listed species. Excludes permitted take.	Does not apply in the case of mortality (any mortality unless related to authorized take falls under likely to adversely affect category). Applies to a negligible injury that does not meet the threshold of take due to its low level of effect and/or ability to fully mitigate the effect. Includes permitted take.	No measurable effects on listed species.
	Geographic Extent	Any geographic extent of mortality or any extent of injury that could result in take of a listed species.	Any geographic extent that does not meet the threshold of take due to its low level of effect and/or ability to fully mitigate the effect. Typically applies to one or very few locations.	
	Duration or Frequency	Any duration or frequency that could result in take of a listed species.	Any duration or frequency that does not meet the threshold of take due to its low level of effect and/or ability to fully mitigate the effect. Typically applies to infrequent, temporary, and short-term effects.	
Reproductive Effects	Magnitude or Intensity	Any reduction in breeding success of a listed species.	Changes in breeding behavior (e.g., minor change in breeding timing or location) that are not expected to result in reduced reproductive success.	No measurable effects on listed species.
	Geographic Extent	Reduced breeding success of a listed species at any geographic extent.	Changes in breeding behavior at any geographic extent that are not expected to result in reduced reproductive success of listed species. Typically applies to one or very few locations.	
	Duration or Frequency	Any duration or frequency that could result in reduced breeding success of a listed species.	Infrequent, temporary, or short-term changes in breeding behavior that do not reduce breeding success of a listed species within a breeding season.	
Behavioral Changes	Magnitude or Intensity	Disruption of normal behavior patterns (e.g., breeding, feeding, or sheltering) that could result in take of a listed species.	Minor behavioral changes that would not result in take of a listed species.	No measurable effects on listed species.

Type of Effect	**Effect Characteristics**	**Impact Level**		
		May Affect, Likely to Adversely Affect	**May Affect, Not Likely to Adversely Affect**	**No Effect**
	Geographic Extent	Any geographic extent that could result in take of a listed species.	Changes in behavior at any geographic scale that are not expected to result in take of a listed species. Typically applies to one or very few locations.	
	Duration or Frequency	Any duration or frequency that could result in take of a listed species.	Infrequent, temporary, or short-term changes that are not expected to result in take of a listed species.	
Loss or Degradation of Designated Critical Habitat	Magnitude or Intensity	Effects to any of the essential features of designated critical habitat that would diminish the value of the habitat for the survival and recovery of the listed species for which the habitat was designated.	Effects to designated critical habitat that would not diminish the functions or values of the habitat for the species for which the habitat was designated.	No measurable effects on designated critical habitat.
	Geographic Extent	Effects to designated critical habitat at any geographic extent that would diminish the value of the habitat for listed species. Note that the likely to adversely affect threshold for geographic extent depends on the nature of the effect. Some effects could occur at a large scale but still not appreciably diminish the habitat function or value for a listed species. Other effects could occur at a very small geographic scale but have a large adverse effect on habitat value for a listed species.	Effects realized at any geographic extent that would not diminish the functions and values of the habitat for which the habitat was designated. Typically applies to one or few locations within a designated critical habitat.	
	Duration or Frequency	Any duration or frequency that could result in reduction in critical habitat function or value for a listed species.	Any duration or frequency that would not diminish the functions and values of the habitat for which the habitat was designated. Typically applies to Infrequent, temporary, or short-term changes.	

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 5.2.6-2, 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 Indiana are described below.

<u>Terrestrial Mammals</u>

Two endangered and one threatened mammal species are federally listed and known to occur in Indiana; they include the gray bat (*Myotis grisescens*), Indiana bat (*Myotis sodalist*), and northern long-eared bat (*Myotis septentrionalis*). Direct mortality or injury to the federally listed Indiana bat or northern long-eared bat could occur if tree clearing activities occurred at roosting sites while bats were present. Direct mortality or injury to the federally listed gray bat could occur if caves were flooded or blocked off while bats were present. While projects would not likely directly affect winter hibernacula (e.g., caves), human disturbance in and around these sites when bats are present could lead to adverse effects to these species; when disturbed by noise or light, bats awaken resulting in a loss of body fat needed to help them survive in the spring.

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 19, may be implemented as appropriate to further minimize potential impacts.

<u>Birds</u>

One endangered and two threatened bird species are federally listed and known to occur in Indiana; they include the least tern (*Sterna antillarum*), piping plover (*Charadrius melodus*), and red knot (*Calidris canutus rufa*). Depending on the project type and location, direct mortality or injury to these birds could occur from collisions or electrocutions with man-made cables and wires, vehicle strikes, or by disturbance or destruction of nests during ground disturbing activities. 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 19, may be implemented as appropriate to further minimize potential impacts.

Fish

No federally listed fish are known to occur in Indiana. Therefore, no injury or mortality effects to federally threatened and endangered fish are expected as a result of the Proposed Action.

Reptiles and Amphibians

One reptile species is federally listed as threatened and known to occur in Indiana, the copperbelly water snake (*Nerodia erythrogaster neglecta*). The majority of FirstNet deployment projects would not occur in an aquatic environment. Direct mortality or injury to this species are unlikely but could occur from entanglements resulting from the Proposed Action. 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 19, may be implemented as appropriate to further minimize potential impacts.

No federally listed amphibians are known to occur in Indiana. Therefore, no injury or mortality effects to federally threatened and endangered amphibians are expected as a result of the Proposed Action.

Invertebrates

Eleven endangered and one threatened invertebrate species are federally listed and known to occur in Indiana as summarized in Table 5.1.6-6. Ten of these species are mollusks and two of these species are terrestrial invertebrates. The majority of FirstNet deployment projects would not occur in an aquatic environment. Direct mortality or injury to the mollusk species are unlikely but could occur from entanglements resulting from the Proposed Action. Direct mortality or injury could occur to the terrestrial invertebrate species if land clearing or excavation activities associated with the Proposed Action occur in an area inhabited by one of these species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

Plants

Three endangered and three threatened plant species are federally listed and known to occur in Indiana; they include the eastern prairie fringed orchid (*Platanthera leucophaea*), Mead's milkweed (*Asclepias meadii*), pitcher's thistle (*Cirsium pitcheri*), running buffalo clover (*Trifolium stoloniferum*), Short's goldenrod (*Solidago shortii*), and Short's bladderpod (*Physaria globosa*). 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. 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 19, may be implemented as appropriate to further minimize potential impacts.

Reproductive Effects

Reproductive effects are considered those that either directly or indirectly reduce the breeding success of a listed species either by altering its breeding timing or location, or reducing the rates of growth, maturation, and survival of offspring, which could affect the breeding success. Potential effects to federally listed terrestrial mammals, birds, terrestrial reptiles, amphibians, fish, invertebrates, and plants with known occurrence in Indiana 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 19, may be implemented as appropriate to further minimize potential impacts.

Birds

Noise, light, or human disturbance within nesting areas could cause federally listed birds to relocate to less desirable locations, or cause stress to individuals reducing survival and reproduction. 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 19, may be implemented as appropriate to further minimize potential impacts.

Reptiles and Amphibians

Changes in water quality, especially during the breeding seasons, could cause stress to reptiles resulting in lower productivity. Further, land clearing activities, noise, and human disturbance during the critical time periods (e.g., mating, nesting) could lower fitness and productivity. 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 19, may be implemented as appropriate to further minimize potential impacts.

No federally listed amphibians are known to occur in Indiana. Therefore, no reproductive effects to federally threatened and endangered amphibians are expected as a result of the Proposed Action.

Fish

No federally listed fish are known to occur in Indiana. Therefore, no reproductive effects to federally threatened and endangered fish are expected as a result of the Proposed Action.

Invertebrates

Changes in water quality from ground disturbing activities could cause stress resulting in lower productivity for federally listed mollusks known to occur in Indiana. In addition, introduction of invasive aquatic species could indirectly affect mollusks as a result of fish populations that they rely on for their reproductive cycle being altered. Impacts to food sources utilized by the federally listed terrestrial invertebrates could lead to potential adverse effects on these species. Deployment activities are not expected to cause changes to water quality that could result in impacts. 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 19, 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 and amphibians, fish, invertebrates, and plants with known occurrence in Indiana 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 19, 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 use sites throughout the Northern Great Plains and Great Lakes Area in the spring and summer as breeding habitat and them migrate in the fall and winter to coastal habitats in the south (USFWS, 2015l). Disturbance in stopover, foraging, or breeding areas (visual or noise) or habitat loss/fragmentation could cause stress to individuals causing them to abandon areas for less desirable habitat and potentially reduce over fitness and productivity. Activities related to the Proposed Action, such as aerial deployment or construction activities, may affect, but are not likely to adversely affect, federally listed birds. 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 19, may be implemented as appropriate to further minimize potential impacts.

Reptiles and Amphibians

Habitat loss or alteration, particularly from fragmentation or invasive species, could adversely affect nesting and foraging sites of the federally listed reptile species, resulting in reduced survival 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 19, may be implemented as appropriate to further minimize potential impacts.

No federally listed amphibians are known to occur in Indiana. Therefore, no behavioral effects to federally threatened and endangered amphibians are expected as a result of the Proposed Action.

Fish

No federally listed fish are known to occur in Indiana. Therefore, no behavioral changes to federally threatened and endangered fish are expected as a result of the Proposed Action.

Invertebrates

Changes in water quality, habitat loss or alternation, and introduction of aquatic invasive species could impact food sources for federally listed mussels resulting in lower productivity. Disturbances to food sources utilized by the federally listed terrestrial species, especially during the breeding season, could impact survival. 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 19, 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. There are two species in Indiana with designated critical habitat, as described in Section 5.1.6.6 and below.

Terrestrial Mammals

No designated critical habitat occurs for terrestrial mammals in Indiana. 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 designated critical habitat occurs for birds in Indiana. 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.

Reptiles and Amphibians

There is no designated critical habitat occurs for reptiles or amphibians in Indiana. 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 Indiana. 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

One federally listed invertebrate species in Indiana has federally designated critical habitat. Critical habitat for the rabbitsfoot (*Quadrula cylindrica cylindrica*) was designated in Carroll, Pulaski, Tippecanoe, and White counties. Land clearing, excavation activities, and other ground disturbing activities in these regions of Indiana could lead to habitat loss or degradation, which could lead to adverse effects to these invertebrates depending on the duration, location, and spatial scale of the associated activities. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented, as necessary. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

No critical habitat has been designated for the other federally listed invertebrate species in Indiana; therefore, no effect to these species from the loss or degradation of designated critical habitat is expected as a result of the Proposed Action.

Plants

One federally listed plant species in Indiana has federally designated critical habitat. Critical habitat for the Short's bladderpod (*Physaria globosa*) was designated as 20 units in Posey County. Land clearing, excavation activities, and other ground disturbing activities in this region of Indiana could lead to habitat loss or degradation, which could lead to adverse effects to these plants depending on the duration, location, and spatial scale of the associated activities.

Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

No critical habitat has been designated for the other federally listed plant species in Indiana; therefore, no effect to these 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 effects to threatened and endangered species and others would not. In addition, and as explained in this section, the same type of Proposed Action infrastructure could result in a range of no affect to may affect but not likely to adversely affect 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 on threatened and endangered species or their habitat under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance, including noise, associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. Although threatened and endangered species and their habitat could be impacted, it is anticipated that effects to threatened and endangered species would be temporary, infrequent, and likely not conducted in locations designated as vital or critical for any period.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts 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, attaching equipment to satellites launched for other purposes, and the use of portable devices that use satellite technology would

have no effect on threatened or endangered species if those activities would not require ground disturbance.

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

Activities that May Affect Listed Species

Potential deployment-related effects to threatened and endangered species and their habitats as a result of implementation of the Preferred Alternative would encompass a range of effects that could occur, including direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. The types of infrastructure 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 effects 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.
  - New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public ROWs or private easements as well as the construction of access roads, POPs, huts, or facilitates to house outside plant equipment could result in potential effects to threatened and endangered species and their habitat. Impacts may vary depending on the number or individual poles installed, but could include direct injury/mortality, reproductive effects, 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 or near bodies of water and construction of landings and/or facilities on shores or the banks of water bodies

that accept the submarine cables could potentially affect threatened and endangered species and their habitat, particularly aquatic species (see Section 5.2.4, Water Resources, for a discussion of potential impacts to water resources), depending on the exact site location and proximity to threatened and endangered species. 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 affect 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, effects would be similar to new wireless construction. Hazards related to 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 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. Deployment of drones, balloons, 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. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.

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 to adversely affect protected species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operational activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. 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. 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 19, BMPs and Mitigation Measures, 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. Additional BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Alternatives Impact Assessment

The following section assesses potential effects to threatened and endangered species associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential effects to threatened and endangered species as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies may affect, but is not likely to adversely affect, threatened and endangered species 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 19, BMPs and Mitigation Measures, 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the nationwide, interoperable, public safety broadband network would not be deployed; therefore there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no effect on threatened and endangered species as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 5.1.6.6, Threatened and Endangered Species and Species of Concern.

5.2.7. Land Use, Recreation, and Airspace

5.2.7.1 Introduction

This section describes potential impacts to land use, recreation, and airspace resources in Indiana associated with deployment and operation of the Proposed Action and Alternatives. Chapter 19, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

5.2.7.2 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 5.2.7-1. As described in Section 5.2, 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 5.2.7-1: 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 Proposed Action.		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 Proposed Action.		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

5.2.7.3 Description of Environmental Concerns

Direct Land Use Change

Changes in land use could be influenced by the deployment, operation, and maintenance of facilities or other infrastructure, and the acquisition of rights-of-way or easement. The deployment, operation, and maintenance of structures, towers, roads, and other permanent features could conflict with exiting development or land use. The installation of poles, towers, structures, or other above-ground facilities or assets could have short- or long-term effects to existing development or land use based on the characteristics of the structures or facilities, such as the location, type, or height. In addition, the acquisition of 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 ROW, 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 5.2.7-1, less than significant impacts would be anticipated given the size and nature of the majority of the proposed deployment activities. Direct land use changes would be minimized and isolated at specific locations and all required permits would be obtained; only short-term impacts during the construction phase would be expected.

Indirect Land Use Change

Changes in surrounding land use patterns and options for surrounding land uses could be influenced by the deployment, operation, and maintenance of facilities and the acquisition of rights-of-way or easement. The deployment, operation, and maintenance of structures, towers, roads, and other permanent features could conflict with surrounding land use patterns and options for surrounding land uses. The installation of poles, towers, structures, or other above-ground facilities or assets could have short- or long-term effects to surrounding land use patterns or options for surrounding land uses based on the characteristics of the structures or facilities, such as the location, type, or height. In addition, the acquisition of ROWs or easements and the construction of roads to access facilities and locations could influence changes in surrounding land uses. The effects from these actions would depend on the geographic location; compatibility with surrounding land uses; and characteristics of the 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 5.2.7-1, less than significant impacts would be anticipated as any new land use would be small scale; 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 5.2.7-1, 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 5.2.7-1, 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 5.2.7-1, airspace impacts are not likely to change or alter flight patterns or airspace usage. Drones, balloons, and piloted aircraft would likely only be deployed in an emergency and for a short period of time, FirstNet would not impact airspace resources.

5.2.7.4 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 Proposed Actions would result in potential impacts to land use, recreation, and airspace resources and others would not. In addition, and as explained in this section, the same type of Proposed Action infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

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

- Wired Projects
    - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring alongside the road in utility corridors or within public road rights-of-way.
        - Land Use: See Activities Likely to Have Impacts below.
        - Recreation: See Activities Likely to Have Impacts below.
        - Airspace: No impacts to airspace would be anticipated since the Proposed Actions 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*.
    - 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 Proposed Actions 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 Proposed Actions 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*.
    - 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 Proposed Actions 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 Proposed Actions 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 Proposed Actions would not directly or indirectly result in changes to existing and surrounding land uses.
    - Recreation: Use of existing dark fiber would not impact recreation because it would not impede access to recreational resources.
    - Airspace: Lighting of dark fiber would have no impacts to airspace.
  - New Build – Submarine Fiber Optic Plant: Installing cables in or near bodies of water and the construction of landings and/or facilities on shores or the banks of water bodies that accept the 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*.
  - 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 Proposed Actions 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*.

- Wireless Projects
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, structure, or building.
    - Land Use: There would be no impacts to existing and surrounding land uses. The potential addition of power units, structural hardening, and physical security measures would not impact existing or surrounding land uses.
    - Recreation: See Activities Likely to Have Impacts below.
    - Airspace: See Activities Likely to Have Impacts below.
  - Deployable Technologies: 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 Aboveground Level (AGL) or do not trigger any of the other FAA obstruction to airspace criteria.
- 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 Proposed Actions 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 deployment-related impacts to land use, recreation resources, or airspace as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including changes to existing and surrounding land uses. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to land use resources include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring alongside the road in utility corridors or within public road rights-of-way.
    - <u>Land Use:</u> Construction activities could temporarily restrict existing and surrounding land uses at isolated locations.
    - <u>Recreation:</u> It is anticipated that plowing, trenching, or directional boring may cause temporary, localized restrictions to recreational land or activities, which may persist during the deployment phase. It is reasonable to anticipate that small reductions in visitation to localized areas may occur during the deployment phase.
    - <u>Airspace:</u> No impacts are anticipated – see previous section.
  - 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.
    - <u>Land Use:</u> No impacts are anticipated – see previous section.
    - <u>Recreation:</u> Installation of fiber optic cable in existing conduits occurs in previously disturbed areas, which may include areas used for recreational purposes. It is possible that access to recreational lands or activities may be restricted during the deployment phase or a portion of the operations phase.
    - <u>Airspace:</u> No impacts are anticipated – see previous section.
  - New Build – Aerial Fiber Optic Plant: Installing new poles and hanging cables on previously disturbed or new (undisturbed) ROWs or easements and the potential construction of access roads.

    - Land Use: These Proposed Actions 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 or near bodies of water and the construction of landings and/or facilities on shores or the banks of water bodies that accept the submarine cable.
    - Land Use: Deployment 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 other criteria. 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 Indiana'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 nair navigation facilities.
  - 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 Indiana airports. Potential impacts to airspace (such as SUAs and MTRs) may be possible depending on the planned use of drones, piloted aircraft, and 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 Proposed Actions could potentially involve activities. 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. Chapter 19, BMPs and Mitigation Measures, provides a listing of the 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 because there would be no ground disturbance, no airspace activity, and no access restrictions to recreational lands. If routine maintenance or inspection activities would conflict with existing or surrounding land uses, impact recreation resources, or conflict with airspace, impacts could result as explained above. Operation of the Deployable Technologies options of the Preferred Alternative could result in the temporary presence of deployable vehicles and equipment (including airborne equipment), potentially for up to two years in some cases. The degree of change in the visual environment (see Section 5.2.8, 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. Chapter 19, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

5.2.7.5 Alternatives Impact Assessment

The following section assesses potential impacts to land use, recreation resources, and airspace associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to land use, recreation, and airspace resources as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts to land use. While a single deployable technology may have imperceptible impact, multiple technologies operating in close proximity for longer periods could impact existing and surrounding land uses. There could be impacts to recreation activities during the deployment of technologies if such deployment were to occur within or near designated recreation areas. Enjoyment of activities dependent upon the visibility of wildlife or scenic vistas may be affected, however, impacts would be less than significant due to the temporary nature of likely deployment activities. If deployment triggers any obstruction criterion or results in changes to flight patterns and airspace restrictions, FirstNet (or its partners) would consult with the FAA to determine how to proceed. Chapter 19, BMPs and Mitigation Measures, provides a listing of the 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 land use, recreation resources, or airspace associated with routine inspections of the Deployable Technologies Alternative, assuming that the same access roads used for deployment are also used for inspections. Operation of deployable technologies would result in land use, land ownership, airspace, and recreation (access and enjoyment) similar in type to those described for the Preferred Alternative. The frequency and extent of those potential impacts would be greater than for the Proposed Action because under this Alternative, deployable technologies would be the only options available. As a result, this alternative would require a larger number of terrestrial and airborne deployable vehicles and a larger number of deployment locations in—all of which would potentially affect a larger number of properties and/or areas of airspace. Overall these potential impacts would be less than significant due to the temporary nature of deployment activities. Chapter 19, BMPs and Mitigation Measures, provides a listing of the 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 5.1.7, Land Use, Recreation, and Airspace.

5.2.8. Visual Resources

5.2.8.1 Introduction

This section describes potential impacts to visual resources in Indiana associated with deployment and operation of the Proposed Action and Alternatives. Chapter 19, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

5.2.8.2 Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on visual resources were evaluated using the significance criteria presented in Table 5.2.8-1. As described in Section 5.2, 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.

Table 5.2.8-1: 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.

5.2.8.3 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 Indiana, residents and visitors travel to many national monuments, historic sites, state parks, and areas with water resources, including the areas around Lake Michigan, the Ohio River, and the Wabash River. If lands considered visually significant or scenic were subject to vegetation loss or removal, short- or long-term effects to viewsheds or scenic resources could occur. Bare ground or interruption of a landscape due to vegetation removal could be considered an adverse change in the aesthetic character of scenic resources or viewsheds. New towers or structures constructed within scenic areas could disrupt the perceived aesthetic character or scenery of an area. If new towers were constructed to a height that required lighting, nighttime vistas could be affected in areas where the night skies do not have light disruptions or are within unpopulated areas.

Based on the impact significance criteria presented in Table 5.2.8-1, 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. The majority of FirstNet deployment activities would not cause negative impacts to the aesthetic character to a noticeable degree; therefore, less than significant impacts would be anticipated. However, some projects, such a towers, facilities, or infrastructure could cause a negative impact on the aesthetic character of local viewsheds depending on their size and location. 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.

Based on the impact significance criteria presented in Table 5.2.8-1, lighting that illuminates the night sky, 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, although potentially minimized to less than significant with implementation of BMPs and mitigation measures. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

5.2.8.4 Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some Proposed Actions 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 Proposed Actions 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 as long as those Proposed Actions 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 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 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 the project; installation of a hut or POP would be permanent, whereas ground disturbing activities would be short-term. In most cases, development in or next to existing roadways would not affect visual resources unless vegetation were removed or excavation occurred in scenic areas.
  - New Build – Aerial Fiber Optic Plant: Construction and installation of new or replacement poles and hanging cables could result in impacts to the aesthetic character of scenic resources or viewsheds depending on the location of the installation. In most cases, development in public rights-of-ways would not affect visual resources unless vegetation were removed or construction occurred in scenic areas. If new lighting were necessary, impacts to night skies could occur. Construction of new roadways could result in linear disruptions to the landscape, surface disturbance, and vegetation removal; all of which could impact the aesthetic character of scenic resources or viewsheds, depending on the location of the installation.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water would not impact visual resources. However, impacts to the aesthetic character of scenic resources or viewsheds could potentially occur as result of the construction of landings and/or facilities on shores or the banks of water bodies that accept the submarine cable, depending on the exact site location and proximity to scenic resources or viewsheds.
  - 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 NPS 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 or areas of surface disturbance, or additional nighttime lighting.

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. Chapter 19, BMPs and Mitigation Measures, provides a listing of the 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. Chapter 19, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

5.2.8.5 Alternatives Impact Assessment

The following section assesses potential impacts to visual resources associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to infrastructure as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in potential impacts to visual resources if long-term deployment occurs in scenic areas. If staging or landing areas (depending on the type of technology) require surface disturbance or vegetation clearing, or if these areas were within scenic landscapes or required new nighttime lighting, impacts could occur to the aesthetic character of scenic resources or viewsheds. These impacts are expected to be less than significant as generally they would be limited to the deployment location and could often be screened or otherwise blocked from view. Chapter 19, BMPs and Mitigation Measures, provides a listing of the 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.

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 5.1.8, Visual Resources.

5.2.9. Socioeconomics

5.2.9.1 Introduction

This section describes potential impacts to socioeconomics in Indiana associated with deployment and operation of the Proposed Action and Alternatives. Chapter 19, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

5.2.9.2 Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on socioeconomics were evaluated using the significance criteria presented in Table 5.2.9-1. As described in Section 5.2, 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 5.2.9-1: 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 Proposed Action.		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 Proposed Action.		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 Proposed Action activities at the state/territory level.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated cities/towns.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
	Duration or Frequency	Persists during the life of the Proposed Action.		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 Proposed Action.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA

NA = Not Applicable

5.2.9.3 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 due to below average public safety communication services. Improved services would reduce response times and improve responses (provide a better fit of the response to the need). These effects would reduce the potential for economic losses and thus support investments in property and greater market value for property. Any increases in property values are most likely in areas that have low property values and below average public safety communication services. Increases are less likely in areas that already have higher property value. As discussed in Existing Environment, property values vary across Indiana. Median values of owner-occupied housing units in the 2009–2013 period ranged from over $154,000 in the greater Bloomington area, to just over $80,000 in the Terre Haute 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 et al., 2013). Essentially, analysts compare the value of multiple properties while statistically controlling for differences in property attributes, in order to isolate the effect of a specific attribute such as proximity of a communications tower.

A recent literature review examined such studies in the United States, Germany, and New Zealand (Bond et al., 2013). These studies all focused on residential properties. One study identified a positive effect on price in one neighborhood due to the presence of a wireless communications tower. Most studies identified negative effects on price. Generally, these negative effects were small: an approximately two percent decrease in property price. In one case, the average reduction in price was 15 percent. In all cases, the effects declined rapidly with distance, with some cases showing no effect beyond 100 meters (328 feet) and one case showing effects up to about 300 meters (984 feet).

Based on review of the particulars of each study, the literature review authors hypothesize that many additional factors regarding communications towers, besides distance, may affect property value. These include the type, height, size, and appearance of communication towers; grouping of towers; the level of activity in the property market at the time properties are listed or sold; and the level of negative local media focus on potential health effects of communication towers at the time properties are listed or sold.

Economic Benefits or Adverse Impacts Related to changes in Spending, Income, Industries, and Public Revenues

Developing the NPSBN may increase economic activity as governments and partners 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 this). 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 gains are beneficial, and would be especially welcomed in areas that have high unemployment. As discussed in Existing Environment, unemployment rates (as shown by the unemployment rate map and selected economic indicators table) vary across Indiana. The average unemployment rate in 2014 was 6.0 percent, slightly lower than the national rate of 6.2 percent. Counties with unemployment rates below the national average (that is, better employment performance) were distributed throughout most of the state, generally around the top 10 population concentrations, with a few exceptions. The highest unemployment rates were generally in the counties around the Terra Haute area and the Indiana portion of the Chicago area.

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 5.2.9-1: Impact Significance Rating Criteria for Socioeconomics because they would not constitute a "high level of job creation *at the state or territory level.*"

Changes in Population Number or Composition

In general, changes in population numbers occur when employment increases or decreases to a degree that affects the decisions of workers on where they can find employment; that is, when workers and their families move to or leave an area because of employment opportunities or the lack thereof. As noted above, deployment and operation of the NPSBN is likely to generate new employment opportunities (directly and indirectly), but employment changes would not be large enough in any state to be considered significant. Therefore, it is highly unlikely that the NPSBN would lead to significant changes in population numbers according to the significance criteria table above. Further, it is unlikely that the NPSBN would lead to any measurable changes in population numbers in any geographic areas, with the possible exception of cities where companies that win major NPSBN contracts establish centers for NPSBN deployment and operation activities. Smaller numbers of employees in any area would not produce measurable population changes because population is always in flux due to births, deaths, and in-migration and out-migration for other reasons.

Population composition refers to age, gender, race, ethnicity, and other characteristics of the individuals making up a population. Given the low potential for changes to population numbers, it is highly unlikely that the NPSBN would lead to any changes in population composition.

5.2.9.4 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 they represent economic activity that would result, for instance, in expenditures and generation of income. Even if the expenditure and income generation levels are very small for each Proposed Action, and not significant across the entire state, they are measurable socioeconomic impacts.

Activities Likely to Have No Impacts

- Satellites and Other Technologies
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch

vehicle would be very unlikely to impact socioeconomics, it is anticipated that this activity would have no impact on socioeconmic resources.

Activities with the Potential to Have Impacts

Potential impacts to socioeconomics for the Preferred Alternative would encompass a range of impacts that could result from deployment activities. The discussion below summarizes how the four types of socioeconomic impacts discussed above and listed again here apply to each type of deployment activity. For greater detail on the nature of these impacts, see the Description of Environmental Concerns section above.

- Impacts to Real Estate;
- Changes to Spending, Income, Industries, and Public Revenues;
- Impacts to Employment; and
- Changes in Population Number or Composition.

Positive impacts on property values would generally not result from one or a few particular activities, but instead would result from the totality of the new NPSBN infrastructure and operational systems that enable improved public safety services to currently underserved areas. Similarly, any change to population numbers in a few locations as discussed above would result from large contract awards and contractor decisions about employee locations, not from specific deployment activities. Therefore, these types of impacts are not included in the activity-focused discussions below.

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Installation of fiber optic cable in existing conduit would have the following types of socioeconomic impacts:
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
  - Collocation on Existing Aerial Fiber Optic Plant: Collocation of new aerial fiber optic plant on existing utility poles and other structures would have the following types of socioeconomic impacts:
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.

- Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.

- Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber would be conducted electronically through existing infrastructure, and would have the following types of socioeconomic impacts:
  - Changes to Spending, Income, Industries, and Public Revenues – Labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
  - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
- New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water, and associated onshore activities at existing facilities or construction of landings and/or facilities on shores or the banks of water bodies that accept the submarine cable 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 et al., 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 et al., 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., parked vehicles in new parking lots), 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 Proposed Actions would have beneficial socioeconomic impacts. To the extent that certain Proposed Actions could have adverse impacts to property values, those impacts are also expected to be less than significant, as described above. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

The discussion above characterized the impacts of each type of activity. The socioeconomic impacts of all activities considered together would also be less than significant. Even when considered together, the impacts would be very small relative to the total economic activity and property value of any region or the state. In addition, with the possible exception of property values (the literature is not clear on this subject), 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 state. Chapter 19, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

5.2.9.5 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 no minimal construction of towers and facilities. 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. The potential impacts are anticipated to be less than significant as described above. Chapter 19, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts

Operation Impacts

All operational activities represent economic activity and thus have socioeconomic impacts. These impacts would primarily be beneficial, and because they are small individually, overall impacts would be less than significant.

The ongoing presence of facilities for housing and maintaining deployable technologies may have adverse aesthetic aspects (e.g., large areas of pavement and large numbers of parked vehicles) or other aspects (e.g., noise and traffic) that could negatively affect the value of surrounding properties. The potential for such impacts is higher under this alternative than the Preferred Alternative because it is likely that these facilities would be more numerous, present over a larger geographic extent, and used with greater frequency and duration. These impacts, if they occur, would be less than significant as they would be limited to a relatively small number of sites within the region and state. Chapter 19, BMPs and Mitigation Measures, provides a listing of the 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 5.1.9, Socioeconomics.

5.2.10. Environmental Justice

5.2.10.1 Introduction

This section describes potential impacts to environmental justice in Indiana associated with deployment and operation of the Proposed Action and Alternatives. Chapter 19, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

5.2.10.2 Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on environmental justice were evaluated using the significance criteria presented in Table 5.2.10-1. As described in Section 5.2, 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 5.2.10-1: 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 Proposed Action.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA

NA = Not Applicable

5.2.10.3 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 et al., 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 Proposed Actions, 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.

Environmental justice populations are often highly localized. Construction impacts are localized, and property value impacts of wireless telecommunications Proposed Actions rarely extend beyond 300 meters (984 feet) of a communications tower (Bond et al., 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 Existing Environment (Section 5.1.10.4) as having moderate potential or high potential for environmental justice populations would particularly warrant further screening. As discussed in Section 5.1.10.3, Indiana's population has lower percentages of minorities than the region or the nation, and higher rates of poverty. Indiana has many areas with High and Moderate potential for environmental justice populations. The distribution of these High and Moderate potential areas is fairly even across the state, and occurs both within and outside of the 10 largest population concentrations. Further analysis using the data developed for the screening analysis in Section 5.1.10.4, Environmental Justice Screening Results, may be useful. In addition, USEPA's EJSCREEN tool and USEPA's lists of environmental justice grant and cooperative agreement recipients may help identify local environmental justice populations (USEPA, 2016a; USEPA, 2015n).

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 Proposed Actions that are problematic based on the adverse impact criterion of environmental justice may also have beneficial impacts on those same environmental justice communities.

5.2.10.4 Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could deploy various types of facilities or infrastructure. Depending on the physical nature and location of FirstNet facilities or infrastructure and the specific Proposed Action, some Proposed Actions 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.

  - Collocation on Existing Aerial Fiber Optic Plant: Collocation of new aerial fiber optic plant on existing utility poles and other structures would have no impact on environmental justice communities because there would be no disturbance for pole/structure installation. Heavy equipment use would be temporary and limited to primarily bucket trucks operated from existing roads, with no impact on environmental justice communities. Environmental justice impacts associated with the construction of new poles to accept aerial fiber or on short to accept submarine cable are addressed below, and depend on the proximity of such infrastructure to the landing site.
  - 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.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water would not impact environmental justice because there would be no ground disturbance or other impacts associated with this Proposed Action 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. Impacts associated with the construction of landings and/or facilities on shores or the banks of water bodies that accept the submarine cable are addressed below.
  - 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. Impacts associated with construction activities for new boxes or huts are addressed below.
- Wireless Projects
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would include mounting or installing equipment (such as antennas) on an existing facility. This Proposed Action 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. Impacts associated with collocation requiring construction for additional power units or other equipment are addressed below.
- 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. Thus, if the Proposed Action would does not involve new construction, 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 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 environmental justice communities, it is anticipated that this activity would have no impact on environmental justice issues.

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 generate noise and dust, or disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water would not impact environmental justice because there would be no ground disturbance or other impacts associated with this Proposed Action 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 or the banks of water bodies that accept the submarine cable could temporarily generate noise and dust, or disrupt traffic, depending on the exact site location and proximity to environmental justice communities. If these effects occur disproportionately in environmental justice communities, they could 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 (See Socioeconomics Environmental Consequences for additional discussion) (Bond et al., 2013). 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 Proposed Action 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.
- 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. Thus, as discussed above, this Proposed Action would only potentially impact environmental justice communities if it involves new construction that generates noise and dust, or disrupts traffic, and occurs disproportionately in environmental justice communities.

In general, 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 problematic from an environmental justice perspective if they occur disproportionately in environmental justice communities. Impacts are expected to be less than significant. Chapter 19, BMPs and Mitigation Measures, provides a listing of the 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 primarily of routine maintenance and inspection of fixed infrastructure. It is anticipated that such Proposed Actions would not result in environmental justice impacts, as the intensity of these Proposed Actions would be low (low potential for objectionable effects such as noise and dust) and their duration would be very short. Routine maintenance and inspection would not adversely affect property values, for the same reasons. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment activities that involve construction. Impacts are expected to be less than significant. Chapter 19, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Activities with the Potential to Have Impacts

Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment activities that involve construction.

In addition, the types of operation activities that could be part of the Preferred Alternative and result in potential impacts to environmental justice communities include the following:

- Wireless Projects
  - Deployable Technologies: COWs, COLTs, and SOWs and aerial deployable technologies may require storage, staging, and launch/landing areas (for aerial deployables). The ongoing presence of such facilities 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 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.

5.2.10.5 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 no minimal construction of towers and facilities. The specific infrastructure associated with the Deployable Technologies

Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to environmental justice communities resulting from implementation of this alternative could be as described below.

Deployment Impacts

As explained above, deployable technologies such as COWs, COLTs, and SOWs, along with aerial deployable technologies, could require storage, staging, and launch/landing areas. To the extent such areas require new construction, noise, and dust could be generated temporarily, and traffic could be disrupted. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts. Impacts are expected to be less than significant because they would be temporary in nature. Chapter 19, BMPs and Mitigation Measures, provides a listing of the 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. Chapter 19, BMPs and Mitigation Measures, provides a listing of the 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 5.1.10.

5.2.11. Cultural Resources

5.2.11.1 Introduction

This section describes potential impacts to cultural resources in Indiana associated with deployment and operation of the Proposed Action and Alternatives. Chapter 19, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

5.2.11.2 Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on cultural resources were evaluated using the significance criteria presented in Table 5.2.11-1. As described in Section 5.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to cultural resources addressed in this section are presented as a range of possible impacts.

Table 5.2.11-1: Impact Significance Rating Criteria for Cultural Resources

Type of Effect	Effect Characteristics	Impact Level			
		Adverse Effect	**Mitigated Adverse Effect[1]**	**Effect, but Not Adverse**	**No Effect**
Physical damage to and/or destruction of historic properties[2]	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	Adverse effect that has been procedurally mitigated through Section 106 process.	Effects to a non-contributing portion of a single or many historic properties.	No direct effects to historic properties.
	Geographic Extent	Direct effects APE.		Direct effects APE.	Direct effects APE.
	Duration or Frequency	Permanent direct effects to a contributing portion of a single or many historic properties.		Permanent direct effects to a non-contributing portion of a single or many historic properties.	No direct effects to historic properties.
Indirect effects to historic properties (i.e., visual, noise, vibration, atmospheric)	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	Adverse effect that has been procedurally mitigated through Section 106 process.	Effects to a contributing or non-contributing portion of a single or many historic properties.	No indirect effects to historic properties.
	Geographic Extent	Indirect effects APE.		Indirect effects APE.	Indirect effects APE.
	Duration or Frequency	Long-term or permanent indirect effects to a single or many historic properties.		Infrequent, temporary, or short- or long-term or permanent indirect effects to a single or many historic properties.	No indirect effects to historic properties.
Loss of character defining attributes of historic properties	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	Adverse effect that has been procedurally mitigated through Section 106 process.	Effects to a non-contributing portion of a single or many historic properties.	No direct or indirect effects to historic properties.
	Geographic Extent	Direct and/or indirect effects APE.		Direct and/or indirect effects APE.	Direct and/or indirect effects APE.

Type of Effect	Effect Characteristics	Impact Level			
		Adverse Effect	**Mitigated Adverse Effect[1]**	**Effect, but Not Adverse**	**No Effect**
	Duration or Frequency	Long-term or permanent loss of character defining attributes of a single or many historic properties.		Infrequent, temporary, or short-term changes to character defining attributes of a single or many historic properties.	No direct or indirect effects to historic properties.
Loss of access to historic properties	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	Adverse effect that has been procedurally mitigated through Section 106 process.	Effects to a non-contributing portion of a single or many historic properties.	No segregation or loss of access to historic properties.
	Geographic Extent	Any area surrounding historic properties that would cause segregation or loss of access to a single or many historic properties.		Any area surrounding historic properties that could cause segregation or loss of access to a single or many historic properties.	No segregation or loss of access to historic properties.
	Duration or Frequency	Long-term or permanent segregation or loss of access to a single or many historic properties.		Infrequent, temporary, or short-term changes in access to a single or many historic properties.	No segregation or loss of access to historic properties.

[1] Whereas mitigation measures for other resources discussed in this PEIS may be developed to achieve an impact that is "Less than Significant with Mitigation Incorporated," historic properties are considered to be "non-renewable resources," given their very nature. As such, any and all unavoidable adverse effects to historic properties, per Section 106 of the NHPA (as codified in 36 CFR Part 800.6), would require FirstNet to consult with the SHPO/THPO and other consulting parties, including Indian Tribes and Native Hawaiian Organizations, to develop appropriate mitigation.

[2] Per NHPA, a "historic property" is defined as any district, archaeological site, building, structure, or object that is either listed or eligible for listing in the NRHP. Cultural resources present within a Proposed Action'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.

NA = Not Applicable

5.2.11.3 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 5.2.11-1, direct deployment impacts could be potentially significant if FirstNet's deployment locations were in areas with moderate to high probabilities for archaeological deposits, within historic districts, or at historic properties. To the extent practicable, FirstNet would attempt to minimize activities in areas with archaeological deposits or within historic districts. However, given archaeological sites and historic properties are present throughout Indiana, some deployment activities may be in these areas, in which case BMPs (see Chapter 19) would help avoid or minimize the potential impacts.

Indirect Effects to Historic Properties (i.e., visual, noise, vibration, atmospheric)

The potential for indirect effects to historic properties would be present during deployment of the proposed facilities/infrastructure and during trenching, grading, and/or foundation excavation activities. Indirect effects include the introduction of visual, noise, atmospheric, and/or vibration effects that diminish a property's historic integrity. The greatest likelihood of potentially significant impacts from indirect effects would be from the deployment of equipment in areas that would cause adverse visual effects to historic properties. To the extent practicable, FirstNet would attempt to minimize activities in areas within or adjacent to historic districts or properties.

Loss of Character Defining Attributes of Historic Properties

Deployment of FirstNet equipment has the potential to cause the loss of character defining attributes of historic properties; such attributes are the features of historic properties that define their NRHP eligibility. Examples of such impacts would be the loss of integrity of archaeological sites through ground disturbing activities, and direct impacts to historic buildings from equipment deployment that adversely alter historic architectural features. See Chapter 19, 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.

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 American Indians. It is anticipated that FirstNet would identify potential impacts to such areas through the NHPA consultation process, and would minimize deployment activities that would cause such loss of access.

5.2.11.4 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 Proposed Actions 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 Proposed Actions 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 Proposed Actions would not require ground disturbance or create perceptible visual effects.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact cultural resources, it is anticipated that this activity would have no impact on cultural resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to cultural resources as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur as a result of ground disturbance activities, including destruction of cultural or historic artifacts. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to cultural resources include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POP, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to cultural resources. Soil disturbance and heavy equipment use associated with plowing, trenching, or directional boring as well as land/vegetation clearing, excavation activities, and landscape grading associated with construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in the disturbance of archaeological sites, and the associated structures could have visual effects on historic properties.
  - New Build – Aerial Fiber Optic Plant: Ground disturbance during the installation of new utility poles and the use of heavy equipment during the installation of new utility poles and hanging of cables could result in the disturbance of archaeological sites, and the associated structures could have visual effects on historic properties.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water could impact cultural resources, as coastal areas of Indiana near Lake Michigan where sea level was lower during glacial periods (generally the Middle Archaic Period and earlier) have the potential to contain archaeological sites. Impacts to cultural resources could also potentially occur as result of the construction of landings and/or facilities on shore or the banks of water bodies that accept the submarine cable, depending on the exact site location and proximity to cultural, historic, and archaeological sites (archaeological deposits tend to be associated with bodies of water and have high probabilities for archaeological deposits), and Indiana has numerous maritime archaeological sites associated with 19th century expansion.
  - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts and require no ground disturbance, there would be no impacts to cultural resources. If installation of transmission equipment required grading or other ground disturbance to install small boxes or huts, or access roads, there could potentially be impacts to cultural resources. Ground disturbance could impact archaeological sites, and the associated structures could have visual effects on historic properties.
  - Collocation on Existing Aerial Fiber Optic Plant: Soil excavation and excavated material placement during the replacement of poles and structural hardening could result in direct and indirect effects to cultural resources, although any effects to access would be short-

term. Heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in direct and indirect effects to cultural resources.

- Wireless Projects
  - New Wireless Communication Towers: Deployment of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to historic properties. Land/vegetation clearing, excavation activities, landscape grading, and other ground disturbance activities during the deployment of new wireless towers and associated structures or access roads, could result in the disturbance of archaeological sites. The deployment of new wireless communication towers and their associated structures could result in visual impacts to historic properties or the loss of access to historic properties.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower could result in impacts to historic properties. Ground disturbance activities could result in the disturbance of archaeological sites, and the deployment of collocated equipment could result in visual impacts or physical damage to historic properties, especially in urban areas such as Indiana City that have larger numbers of historic public buildings.
  - Deployable Technologies: Implementation of deployable technologies could result in potential impacts to cultural resources if deployment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. In addition, impacts to historic properties could occur if the deployment is long-term, or if the deployment involves aerial technologies with the potential for visual or other indirect impacts.

In general, the abovementioned Proposed Actions 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 effect, but not adversely effect, cultural resources as the potential adverse effects would be temporary and limited to the area near individual Proposed Action deployment sites. 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. Chapter 19, BMPs and Mitigation Measures, provides a listing of the 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 effect to cultural resources associated with routine inspections of the Preferred Alternative. If usage of heavy equipment as part of routine maintenance or inspections occurs off established access roads or corridors, or if the acceptable load of the surface is exceeded, ground disturbance impacts on archaeological sites could result as explained above. These potential impacts would be associated with ground disturbance or modifications of properties, however, due to the small scale of expected activities, these actions could affect but would likely not adversely affect cultural resources. In the event that maintenance and inspection activities occur off existing roads, FirstNet would engage in consultation as required under Section 106 of the NHPA. Chapter 19, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

5.2.11.5 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 no 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 Proposed Actions could result in impacts to archaeological sites. These activities could effect, but not adversely affect, cultural resources due to the limited amount of expected ground disturbing activities and the short-term nature of deployment activities. However, in the event that land/vegetation clearing is required, FirstNet would engage in consultation as required under Section 106 of the NHPA. Chapter 19, BMPs and Mitigation Measures, provides a listing of the

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. Chapter 19, BMPs and Mitigation Measures, provides a listing of the 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 5.1.11, Cultural Resources.

5.2.12. Air Quality

5.2.12.1 Introduction

This section describes potential impacts to Indiana's air quality from deployment and operation of the Proposed Action and Alternatives. Chapter 19, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

5.2.12.2 Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on Indiana's air quality were evaluated using the significance criteria presented in Table 5.2.12-1. As described in Section 5.2, 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 Indiana's air quality addressed in this section are presented as a range of possible impacts.

Table 5.2.12-1: Impact Significance Rating Criteria for Indiana

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

5.2.12.3 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 unpredictable timeframes (if power is lost to a site, for example). Impacts are likely to be less than significant due to the mobile nature of the sources and the temporary and short-term duration of deployment activities. Although unlikely, the emissions of criteria pollutants could impair the air quality of the region and potentially affect human health. Potential impacts to air quality from emissions may occur in areas where the current air quality exceeds, or has a history of exceeding, one or more NAAQS. Areas exist in Indiana that are in maintenance or nonattainment for one or more criteria pollutants, particularly, ozone is a state-wide issue (see Section 5.1.12, Air Quality and Figure 5.1.12-1). The majority of the counties in Indiana are designated as maintenance areas for one or more of the following pollutants: CO, Lead, PM_{10}, $PM_{2.5}$, O_3, and SO_2 (Table 5.1.12-5); counties located in the southern portion of the state are designated nonattainment or maintenance for two NAAQS pollutants (Figure 5.1.12-1).

Based on the significance criteria presented in Table 5.2.12-1, impacts would likely be less than significant given the size and nature of the majority of the proposed deployment activities. The majority of FirstNet's deployment activities would not be located in sensitive areas nor would a large number of emission sources be deployed/operated long-term in the same area from fixed or mobile sources or construction activities. Less than significant emissions could occur for any of the criteria pollutants within attainment areas in Indiana; however, NAAQS exceedances are not anticipated. Given that nonattainment areas are present throughout Indiana (Figure 5.1.12-1), 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.

Based on the significance criteria presented in Table 5.2.12-1, air emission impacts could be potentially significant if:

- The majority of FirstNet's buildout/deployment locations were in these sensitive areas; or
- A large number of emission sources were deployed/operated long-term in the same area.

To the extent practicable, FirstNet would likely attempt to minimize emissions, particularly in nonattainment and maintenance. However, given nonattainment areas are present throughout Indiana, FirstNet may complete some Proposed Actions in these areas, in which case BMPs would help to avoid or minimize potential impacts.

5.2.12.4 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 Proposed Actions 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 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 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 air quality, it is anticipated that this activity would have no impact on air quality.

Activities with Potential Impacts to Air Quality

Construction, deployment, and operation activities related to the Preferred Alternative could impact air quality by generating various quantities of criteria and air pollutant emissions. It is expected that such impacts would be less than significant due to the shorter duration and localized nature of the Proposed Actions. The types of infrastructure deployment scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to air quality include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber as well as land/vegetation clearing, excavation activities, and landscape grading could result in fugitive dust and products of combustion from the use of vehicles and heavy equipment.
  - New Build – Aerial Fiber Optic Plant: The use of heavy equipment during the installation of new poles and hanging cables, as well as constructing access roads, POP huts, or other associated facilities to house plant equipment could result in products of combustion from the use of vehicles and machinery, as well as fugitive dust emissions from site preparation.
  - Collocation on Existing Aerial Fiber Optic Plant: Excavation equipment used during pole replacement, and other heavy equipment used for structural hardening or reinforcement, could result in products of combustion from the use of vehicles and heavy equipment, as well as fugitive dust from site preparation.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water could generate products of combustion from vessels used to lay the cable. In addition, the construction of landings and/or facilities on shores or the banks of water bodies that accept the 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 are needed, structural hardening,

and physical security measures required grading or excavation, then exhaust and fugitive dust from heavy equipment used for these Proposed Actions 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 Proposed Actions would be products of combustion from burning fossil fuels in internal combustion engines and fugitive dust from site preparation activities and vehicles traveling on unpaved road surfaces. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the construction impacts. These impacts are anticipated to be less than significant due to the limited nature of the deployment. Chapter 19, BMPs and Mitigation Measures, provides a listing of the 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. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

5.2.12.5 Alternatives Impact Assessment

The following section assesses potential impacts to air quality associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific equipment associated with the Deployable Technologies Alternative could include heavy trucks with onboard generators, aerial vehicles (e.g., UASs or other aircraft), and ground support vehicles and other equipment for aerial deployment. The stand-alone Deployable Technologies Alternative differs from the Preferred Alterative in the number of mobile and aerial vehicles likely to deploy, the distances traveled from storage locations, and the duration of deployment. The potential impacts to air quality are as follows:

Deployment and Operation Impacts to Air Quality

Implementing deployable technologies could result in products of combustion from mobile equipment deployed via heavy trucks using internal combustion engines associated with the vehicles and onboard generators. While a single deployable vehicle may have an insignificant impact, multiple vehicles operating for longer periods, in close proximity, may have a cumulative impact 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.

5.2.13. Noise

5.2.13.1 Introduction

This section describes potential noise impacts from construction, deployment, and operation of the Proposed Action and Alternatives in Indiana. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

5.2.13.2 Impact Assessment Methodology and Significance Criteria

The noise impacts of the Proposed Action were evaluated using the significance criteria presented in Table 5.2.13-1. As described in Section 5.2, 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 Indiana addressed in this section are presented as a range of possible impacts.

Table 5.2.13-1: 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 Proposed Action 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 Proposed 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.

5.2.13.3 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 5.2.13-1, 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.

5.2.13.4 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 Proposed Actions 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:

- Wired Projects
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up dark fiber would require no construction and have no noise impacts. Impacts that may result if any construction activity is required are discussed below.
- Wireless Projects
  - Deployable Technologies: The type of deployable technology used would dictate the types of noise generated. For example, balloons are expected to have minimal to no impact on the noise environment.
- 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 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 noise, it is anticipated that this activity would have no impact on noise.

Activities with the Potential for Noise Impacts

Construction, deployment, and operation activities related to the Preferred Alternative could create noise impacts from either the construction or operation of the infrastructure. The types of infrastructure deployment scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to air quality include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber as well as land/vegetation clearing, excavation activities, and landscape grading could result in high noise levels from the use of heavy equipment and machinery.
  - New Build – Aerial Fiber Optic Plant: The use of heavy equipment during the installation of new poles and hanging cables, as well as constructing access roads, POP huts, or other associated facilities to house plant equipment would be short-term and could result in increased noise levels from the use of vehicles and machinery.

- Collocation on Existing Aerial Fiber Optic Plant: Excavation equipment used during potential pole replacement, and other heavy equipment used for structural hardening or reinforcement, could result in temporary incrased 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 Proposed Action required the use of heavy equipment for grading or other purposes.
- New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water could generate noise if vessels are used to lay the cable. In addition, the construction of landings and/or facilities on shores or the banks of water bodies that accept the 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, depending on the exact site location and proximity to noise sensitive receptors.
- 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 Proposed Actions 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 would be achieved after some months (typically less than a year but could be a few hours for linear activities such as pole construction). Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

Operation activities associated with the Preferred Alternative would be less than significant for routine maintenance and inspection of the facilities because of the temporary nature of the activities which would not create new permanent sources of noise. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that potential noise impacts would be similar to or less than those described for the deployment activities. If usage of vehicles or heavy equipment as part of routine maintenance or inspections or onsite generator use occurs, potential noise impacts could result as explained above. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

5.2.13.5 Alternatives Impact Assessment

The following section assesses potential noise impacts associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific equipment associated with the Deployable Technologies Alternative would be heavy trucks with onboard generators, aerial vehicles (e.g., UASs or other aircraft), and ground support vehicles and equipment for aerial deployment. The stand-alone Deployable Technologies Alternative differs from the Preferred Alterative in the number of mobile and aerial vehicles likely to deploy, the distances traveled from storage locations and the duration of deployment. The potential noise impacts are as follows:

Deployment Impacts

Implementing deployable technologies could result in noise from mobile equipment deployed via heavy trucks, including not only onboard generators, but also the vehicles themselves. While a single deployable vehicle may have an insignificant impact, multiple vehicles operating for longer periods, in close proximity, may increase localized noise levels. Several vehicles traveling together could also create short-term noise impacts on residences or other noise-sensitive receptors as they pass by. With the exception of balloons, the deployment of aerial technology is anticipated to generate noise during all phases of flight. Aerial technologies would have the highest level of noise impact if they are required to fly above residential areas, areas with a high concentration of noise-sensitive receptors (i.e., schools or churches), or over national parks or other areas where there is an expectation of quiet and serenity on their way to their final destinations. Residences near deployment areas for aerial technologies (i.e., airports or smaller airfields) could also be affected during takeoff and landing operations. Additionally, routine maintenance and inspections of the deployable technologies are anticipated to be less than significant, given that these Proposed Actions are of low-intensity and short duration. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

Operation activities associated with the Deployable Technologies Alternative would be similar to several of the deployment activities related to routine maintenance and inspection of the facilities. Operation of generators could also generate noise in the area. However, deployable technologies could be deployed to areas with few existing facilities, so noise impacts could be minimal in those areas. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that potential noise impacts would be the same as those described for the deployment activities. If usage of vehicles or heavy equipment as part of routine maintenance or inspections occurs, potential noise impacts could result as explained above.

Operational impacts from aerial technologies would include repeated flyovers by UAS vehicles while they are needed in the area. This could generate less than significant short-term impacts on any residential areas or other noise-sensitive receptors under the flight path of these vehicles. However, once these operations cease, noise levels would quickly return to baseline levels. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, 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.

5.2.14. Climate Change

5.2.14.1 Introduction

This section describes potential impacts to climate and climate change-vulnerable resources in Indiana associated with deployment and operation of the Proposed Action and Alternatives. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

5.2.14.2 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 5.2.14-1. As described in Section 5.2, 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 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, 2015l), 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 Proposed Actions 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 Proposed Actions themselves (CEQ, 2014). Projects located in areas that are vulnerable to the effects of climate change (e.g., sea level rise) may be at risk. Analysis of these risks through the NEPA process could provide useful information to the Proposed Action planning to ensure these Proposed Actions are resilient to the impacts of climate change.

Table 5.2.14-1: Impact Significance Rating Criteria for Climate

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
Contribution to climate change through GHG emissions	Magnitude or Intensity	Exceedance of 25,000 metric tons of CO_2e/year, and global level effects observed.	Effect that is potentially significant, but with mitigation is less than significant.	Only slight change observed.	No increase in greenhouse gas emissions or related changes to the climate as a result of Proposed Action 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

5.2.14.3 Projected Future Climate

Climate model forecasts of future temperatures are highly dependent on emissions scenarios (low versus high). By mid-century under a high emissions scenario, the total number of hottest days (days above 95° F) is projected to increase by mid-century (2041 to 2070) as compared to a 1971 to 2000 baseline in the Midwest with the number of hottest days increasing by 5 to 20 days per year in Indiana depending on the region of the state. Additionally, much of the Midwest is projected to observe a longer frost-free season by mid-century as compared to a 1971 – 2000 baseline, where a frost-free season is defined as the period between the last occurrence of 32° F in the spring and the first occurrence of 32° F in the fall. In Indiana, the frost-free season under a high emissions scenario may extend greater than 25 days longer than the baseline years in some areas of the state (USGCRP, 2014a).

Indiana is bordered by Lake Michigan. The Great Lakes have recorded higher water temperatures and less ice cover as a result of changes in regional climate. Lake surface temperatures are projected to rise by as much as 7° F by 2050 and 12.1° F by 2100. Higher temperatures, increases in precipitation, and lengthened growing seasons favor production of blue-green and toxic algae that could harm water quality and aquatic life (USGCRP, 2014a).

Air Temperature

Figure 5.2.14-1 and Figure 5.2.14-2 illustrate the anticipated temperature changes for low and high GHG emission scenarios for Indiana from a 1969 to 1971 baseline.

Cfa **–** Figure 5.2.14-1 shows that by mid-century (2040 to 2059), temperatures in the entire state of Indiana under a low emissions scenario would increase by approximately 4° F, and by the end of the century (2080 to 2099) under a low emissions scenario temperatures in the entire state of Indiana would increase by approximately 6° F (USGCRP, 2009).

Figure 5.2.14-2 shows that under a high emissions scenario for the period (2040 to 2059), temperatures would increase by approximately 5° F. Under a high emissions scenario for the period (2080 to 2099) in the (Cfa) region of Indiana, temperatures would increase by approximately 9° F. (USGCRP, 2009)

Dfa **–** Temperatures in this region are expected to increase by mid-century (2040 to 2059) and by the end of the century (2080 to 2099) at the same rate as the Cfa region under a low emissions scenarios.

Under a high emissions scenario, by mid-century temperatures are projected to increase at the same rate as the Cfa region. By the end of the century (2080 to 2099), under a high emissions scenario, the southern portion of the Dfa region temperatures would increase by approximately 9° F. Temperatures in the southern portion of the Dfa region in Indiana would increase by approximately 10° F (USGCRP, 2009).

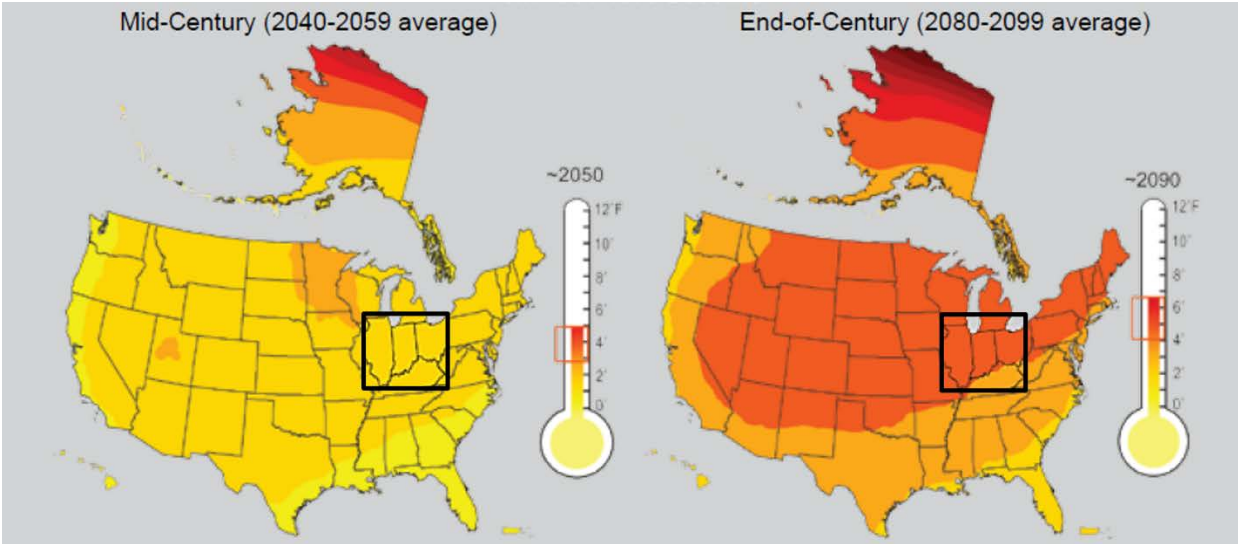

Figure 5.2.14-1: Indiana Low Emission Scenario Projected Temperature Change

Source: (USGCRP, 2009)

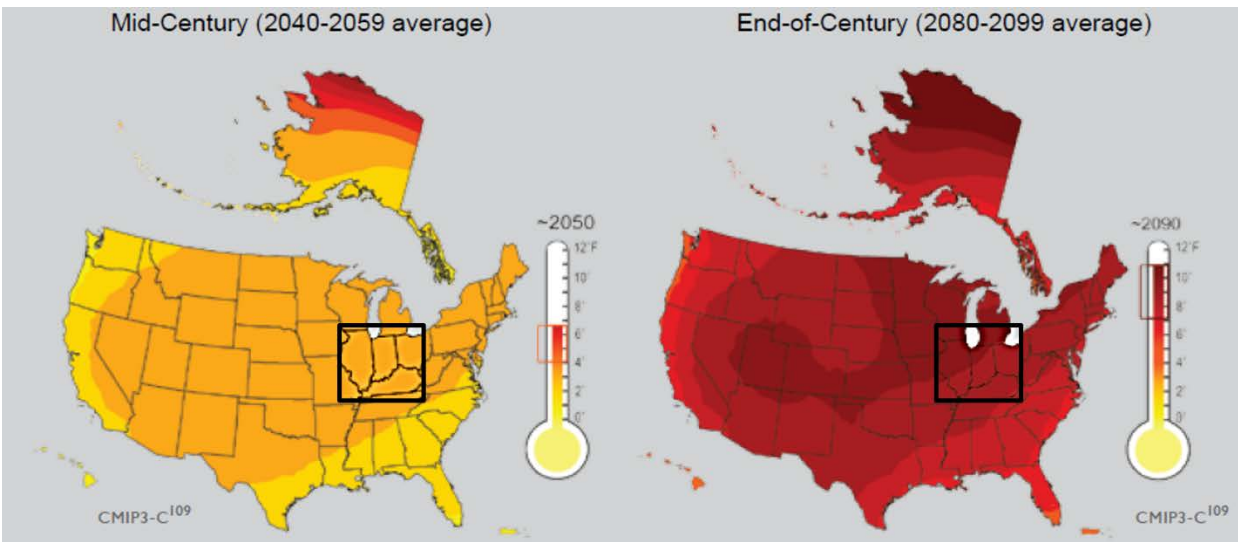

Figure 5.2.14-2: Indiana High Emission Scenario Projected Temperature Change

Source: (USGCRP, 2009)

Precipitation

Precipitation in the Midwest is greatest in the east, declining towards the west. Precipitation occurs about once every seven days in the western part of the region and once every three days in the southeastern part. The 10 rainiest days could contribute as much as 40 percent of total precipitation in a given year. Annual precipitation increased in the Midwest during the past century, with much of the increase driven by intensification of the heaviest rainfalls. This tendency towards more intense precipitation events is projected to continue in the future (USGCRP, 2014a).

Snowfall varies across the region, comprising less than 10 percent of total precipitation in the southern portion of the Midwest, to more than half in the northern portion of the Midwest, with as much as two inches of water available in the snowpack at the beginning of spring melt in the northern reaches of the river basins. When this amount of snowmelt is combined with heavy rainfall, catastrophic, widespread flooding could occur. Trends towards a decline in the frequency of high magnitude snowfall, but an increase in lake effect snowfall have been observed. These divergent trends and their inverse relationships with air temperatures make overall projections of regional impacts of the associated snowmelt extremely difficult. Flooding could also occur due to extreme precipitation in the absence of snowmelt. These warm-season events are also projected to increase in magnitude in the future (USGCRP, 2014a).

In the majority of Indiana, there is an expected increase of about 10 percent in the number of consecutive dry days under a high emissions scenarios by mid-century (2041 to 2070) as compared to the period (1971 – 2000). Under a high emissions scenario in eastern parts of the state there is a projected increase of about 20 percent in the number of consecutive dry days. An increase in consecutive dry days could lead to drought (USGCRP, 2014b). Figure 5.2.14-3 shows predicted seasonal precipitation change for an approximate 30-year period of 2071 to 2099 compared to a 1970 to 1999 approximate 30-year baseline.

Figure 5.1.14-3 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 5.2.14-3 shows a high emissions scenario, which assumes continued increases in emissions, with associated large increases in warming and major precipitation changes. (Note: white areas in the figures indicate that the changes are not projected to be larger than could be expected from natural variability.) (USGCRP, 2014b)

Cfa **–** shows that in a low emissions scenario in the 30-year period for 2071 to 2099, precipitation would increase by 10 percent in winter in portions of the Cfa region while other portions are not expected to have any change. During the spring, the entire state of Indiana is expected to experience a 10 percent increase in precipitation. However, there are no expected increases in precipitation in summer or fall other than fluctuations due to natural variability (USGCRP, 2014b).

Dfa **–** Precipitation changes for the Dfa region are consistent with projected changes for the Cfa region in spring, summer, and fall under a low emissions scenario. In winter, precipitation is expected to increase 10 percent or remain constant depending on the portion of the region (USGCRP, 2014b).

Under a high emissions scenario, precipitation changes for the Dfa region are consistent with projected changes for the Cfa region of Indiana in spring, summer, and fall. In winter, precipitation is expected to increase as much as 30 percent over the period 2071 to 2099 in some portions of the region while other portions are only projected to experience a 20 percent increase (USGCRP, 2014b).

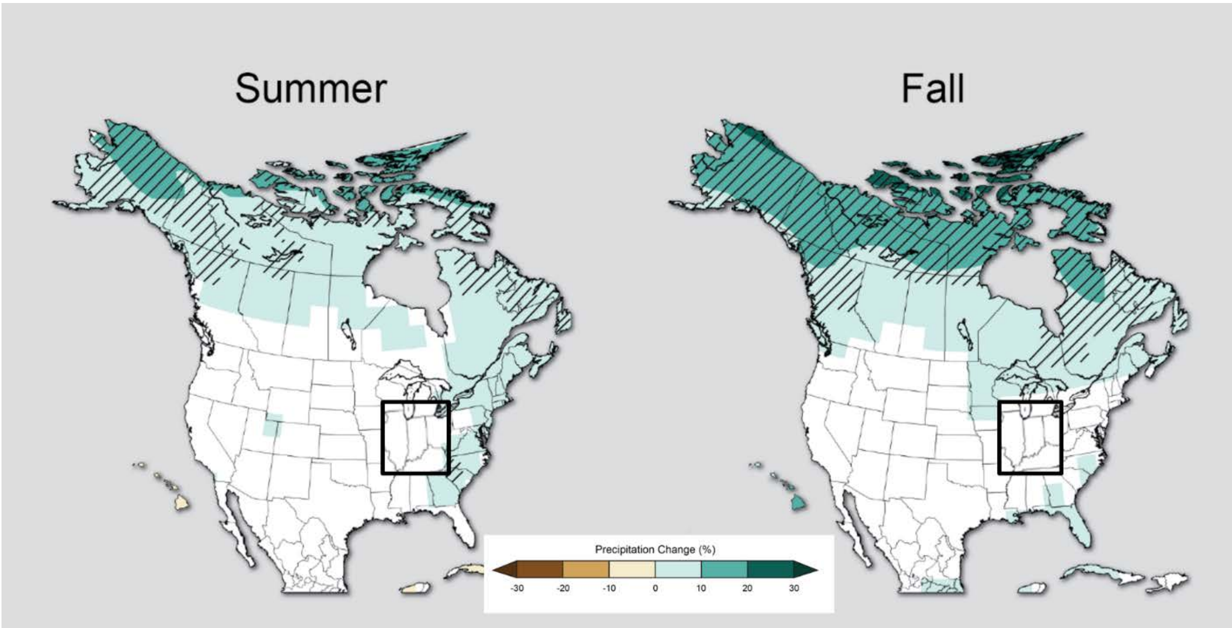

Figure 5.2.14-3: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a Low Emissions Scenario

Source: (USGCRP, 2014b)

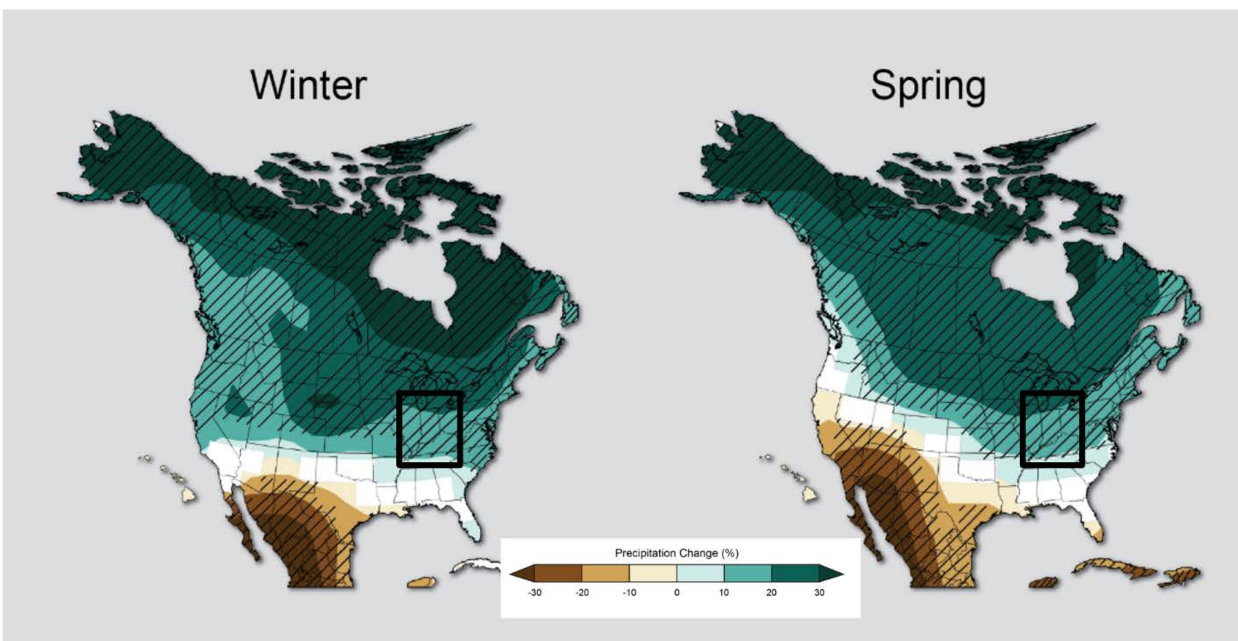

Figure 5.2.14-4: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a High Emissions Scenario

Source: (USGCRP, 2014b)

Severe Weather Events

It is difficult to forecast the impact of climate change on severe weather events such as winter storms and thunderstorms. Trends in thunderstorms 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. 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 establish definitive links between severe weather events and climate change (USGCRP, 2014c).

5.2.14.4 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 5.2.14-1, 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 Proposed Actions fall into two categories: short-term and long-term. Short-term emissions could be associated with deployment activities (vehicles and other motorized construction equipment) and would have no long-term or permanent impact on GHG emissions or climate change. Long-term (both temporary and permanent) emission increases could result from operations, including the use of grid-provided electricity by FirstNet equipment such as transmitters and optical fiber, and from the temporary use of portable or onsite electric generators (a less efficient, more carbon-intensive source of electricity), during emergency situations when the electric grid was down, for example after a hurricane.

A single large cell tower would typically require 20-60kW of power to operate (Balshe, 2011). The CO_2 emissions associated with the operation of the tower would depend on whether it was supplied by a stand-alone power source, such as a generator, or from the grid, and whether it was operating at full power on a continuous basis. A standard 60kW 3-phase diesel generator consumes approximately 5.0 gallons of diesel per hour (Diesel Service & Supply, 2016). Diesel fuel combustion emits 22.38 lbs of CO_2 per gallon (EIA, 2015i). A 60kW transmitter running on a generator would therefore be responsible for 1,221 kg of CO_2/day. Running continuously, the tower would cause the emission of 446 MT of CO_2 per year.

However, grid-provided electricity would result in less CO_2 emissions than on-site provided energy. Using the average carbon intensity of grid-provided electricity of 1,136.53 lbs/MWh (USEPA, 2015m), the same transmitter would be responsible for approximately 271 MT of CO_2 per year running continuously. Actual emissions would depend on the fuel mix and efficiency of the systems from which electricity was generated. 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 Proposed Action-related effects by magnifying or otherwise altering impacts in other resources areas. For example climate change may impact air quality, water resource availability, and recreation. These effects would vary from state to state depending on the resources in question and their relationship to climate change.

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. Based on the impact significance criteria presented in Table 5.2.14-1, climate change effects on FirstNet installations and infrastructure would be significant if they negatively affected the operation of these facilities.

5.2.14.5 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 Indiana, 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 Proposed Actions would result in potential impacts to GHG emissions, climate impacts in other resource areas, and FirstNet infrastructure and operations, and others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

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

- Wired Projects
    - Use of Existing Conduit – New Buried Fiber Optic Plant: There would be no short-term emissions associated with construction, as construction would not take place. The operational power requirements for optical networks are relatively low (significantly less than transmitters); the resulting GHG emissions will not be significant, and are likely to have no impacts.
    - 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.
- 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 these activities.

Activities with the Potential to Have Impacts

The deployment and use of energy-consuming equipment as a result of the implementation of the Preferred Alternative would result in GHG emissions whose significance would vary depending on their power requirements, duration and intensity of use, and number. The types of infrastructure deployment scenarios that could be part of the Preferred Alternative and result in potential impacts to GHG emissions and climate change include the following:

- Wired Projects
    - New Build - Buried Fiber Optic Plant: This activity would include plowing (including vibratory plowing), trenching, and directional boring, and could involve construction of POPs, huts, or other facilities to house outside plant equipment or hand holes to access fiber. These activities could generate GHG emissions.
    - New Build Aerial Fiber Optic Plant: These projects would require construction equipment for installing or replacing new poles and hanging cables as well as excavation and grading for new or modified right-of-ways or easements. It could also include construction of POPs, huts, or other facilities to house outside plant equipment. These activities could generate GHG emissions.

  - Collocation on Existing Aerial Fiber Optic Plant: These projects would require equipment for replacement of existing wiring and poles. GHG emissions associated with these projects would arise from use of machinery and vehicles to complete these activities.
  - New Build – Submarine Fiber Optic Plant: The deployment of small 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.
  - 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.
  - Deployable Aerial Communications Architecture: Emissions associated with the deployment and maintenance of a complete network solution of this type may be significant if large numbers of manned 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. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

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.

5.2.14.6 Alternatives Impact Assessment

The following section assesses potential impacts to climate associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration.

Deployment Impacts

As explained above, implementation of deployable technologies could involve use of fossil-fuel-powered vehicles, powered generators, and/or aerial platforms. There could be some emissions and soil and vegetation loss as a result of excavation and grading for staging and/or landing areas depending on the type of technology. GHG emissions are expected to be less than significant based on the defined significance criteria, since activities would be temporary and short-term.

Operations Impacts

Implementing land-based deployable technologies (COW, COLT, and SOW) could result in emissions from mobile equipment on heavy trucks using internal combustion engines associated with the vehicles and onboard generators. While a single deployable vehicle may have an insignificant impact, multiple vehicles operating for longer periods, in close proximity, may have a cumulative impact, although this impact is expected to be less than significant. Some staging or landing areas (depending on the type of technology) may require excavation, site preparation, and paving. Heavy equipment used for these activities could produce emissions as a result of burning fossil fuels in internal combustion engines. The deployment and operation of aerial technology is anticipated to generate pollutants during all phases of flight, except for balloons. These activities are expected to be less than significant due to 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 of time. Climate change effects such as temperature, precipitation changes, and extreme weather during operations would be expected but could have little to no impact on the deployed technology due to the temporary nature of deployment. However, if these technologies are deployed continuously (at the required location) for an extended period, climate change effects on infrastructure 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 5.1.14, Climate Change.

5.2.15. Human Health and Safety

5.2.15.1 Introduction

This section describes potential impacts to human health and safety in Indiana associated with deployment of the Proposed Action and Alternatives. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

5.2.15.2 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 5.2.15-1: Impact Significance Rating Criteria for Human Health and Safety. As described in Section 5.2, 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.

Table 5.2.15-1: Impact Significance Rating Criteria for Human Health and Safety

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
Exposure to Worksite Occupational Hazards as a Result of Activities at Existing or New FirstNet Sites	Magnitude or Intensity	Exposure to concentrations of chemicals above occupational regulatory limits and time weighted averages (TWAs). A net increase in the amount of hazardous or toxic materials or wastes generated, handled, stored, used, or disposed of, resulting in unacceptable risk, exceedance of available waste disposal capacity and probable regulatory violations. Exposure to recognized workplace safety hazards (physical and chemical). Violations of various regulations including: OSHA, RCRA, CERCLA, TSCA, EPCRA.	Effect is potentially significant, but with mitigation is less than significant.	No exposure to chemicals above health-protective screening levels. Hazardous or toxic materials or wastes could be safely and adequately managed in accordance with all applicable regulations and policies, with limited exposures or risks. No exposure to unsafe working conditions or other workplace safety hazards.	No exposure to chemicals, unsafe working conditions, or other workplace safety hazards.
	Geographic Extent	Regional impacts observed ("regional" assumed to be at least a county or county-equivalent geographical extent, could extend to state/territory).		Impacts only at a local/neighborhood level.	NA
	Duration or Frequency	Occasional frequency during the life of the Proposed Action.		Rare event.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Exposure to Hazardous Materials, Hazardous Waste, and Mine Lands as a Result of FirstNet Site Selection and Site-Specific Land Disturbance Activities	Magnitude or Intensity	Exposure to concentrations of chemicals above regulatory limits, or USEPA chemical screening levels protective of the general public. A net increase in the amount of hazardous or toxic materials or wastes generated, handled, stored, used, or disposed of, resulting in unacceptable risk, exceedance of available waste disposal capacity and probable regulatory violations. Site contamination conditions could preclude development of sites for the proposed use. Violations of various regulations including: OSHA, RCRA, CERCLA, TSCA, EPCRA. Unstable ground and seismic shifting.	Effect is potentially significant, but with mitigation is less than significant.	No exposure to chemicals above health-protective screening levels. Hazardous or toxic materials or wastes could be safely and adequately managed in accordance with all applicable regulations and policies, with limited exposures or risks. No exposure to unstable ground conditions or other workplace safety hazards.	No exposure to chemicals, unstable ground conditions, or other workplace safety hazards.
	Geographic Extent	Regional impacts observed ("regional" assumed to be at least a county or county-equivalent geographical extent, could extend to state/territory).		Impacts only at a local/neighborhood level.	NA
	Duration or Frequency	Occasional frequency during the life of the Proposed Action.		Rare event.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Exposure to Hazardous Materials, Hazardous Waste, and Occupational Hazards as a Result of Natural And Man-Made Disasters	Magnitude or Intensity	Exposure to concentrations of chemicals above regulatory limits, or USEPA chemical screening levels protective of the general public. Site contamination conditions could preclude development of sites for the proposed use. Physical and biologic hazards. Loss of medical, travel, and utility infrastructure.	Effect is potentially significant, but with mitigation is less than significant.	No exposure to chemicals above health-protective screening levels. Hazardous or toxic materials or wastes could be safely and adequately managed in accordance with all applicable regulations and policies, with limited exposures or risks. No exposure to unsafe conditions. No loss of medical, travel, or utility infrastructure.	No exposure to chemicals, unsafe conditions, or other safety and exposure hazards.
	Geographic Extent	Regional impacts observed ("regional" assumed to be at least a county or county-equivalent geographical extent, could extend to state/territory).		Impacts only at a local/neighborhood level.	NA
	Duration or Frequency	Occasional frequency during the life of the Proposed Action.		Rare event.	NA

NA = Not Applicable

5.2.15.3 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 Proposed Actions 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 5.2.15-1, 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 Proposed Actions that may present increased risk and higher potential for injury include working from heights (i.e., from towers and roof tops), ground-disturbing activities like trenching and excavating, confined space entry, operating heavy equipment, and the direct handling of hazardous materials and hazardous waste. Predominately, these hazards are limited to occupational workers, but may impact the general public if there are trespassers or if any physical of chemical hazard extends beyond the restricted access of proposed FirstNet work sites. For example, if fuel is spilled from an onsite fuel tank, the spilled fuel could migrate down gradient and infiltrate underground drinking water sources. The general public may then be exposed to hazardous chemicals in their drinking water if they utilize the same groundwater aquifer.

To protect occupational workers, OSHA mandates that employers be required to protect their employees from occupational hazards that could result in injury. Depending on the source of the hazard and the site-specific work conditions, OSHA generally recommends the following hierarchy for protecting onsite workers (OSHA, 2015c).

- 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,[150] 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

[150] Trench boxes: "framed metal structures inserted into open trenches to support trench faces, to protect workers from cave-ins and similar incidents" (OSHA, 2016c).

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, 2015c). To the extent practicable, FirstNet partner(s) would implement and abide by work practice controls through employee safety training and by developing site-specific health and safety plans (HASP). The HASPs would identify all potential hazardous materials and hazardous wastes, potential physical hazards, and applicable mitigation steps. Other components of a HASP identifying appropriate PPE for each task and the location of nearby medical facilities. Safety Data Sheets (SDS) describing the physical and chemical properties of hazardous materials used during FirstNet deployment and maintenance activities, as well as the physical and health hazards, routes of exposure, and precautions for safe handling and use would be kept and maintained at all FirstNet Proposed Action sites. In addition to HASPs and SDSs, 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, 2015c). 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 Proposed Action 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. (OSHA, 2015d)

Hazardous Materials, Hazardous Waste, and Mine Lands

The presence of environmental contamination and mine lands at FirstNet deployment sites has the potential to negatively impact health and safety of workers and the general public. Past or present contaminated media, such as soil and groundwater, may be present and become disturbed as a result of site activities. Mines may cause unstable surface and subsurface conditions as a result of underground shaft collapses or seismic shifting. Based on the impact significance criteria presented in Table 5.2.15-1, 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 IDNR, or through an equivalent commercial resource.

By screening sites for environmental contamination, mining activities, and reported environmental liabilities, the presence of historic contamination and unsafe ground conditions could be evaluated and may influence the site selection process. In general, the lower the density of environmental contamination or mining activities, the more favorable the site will be for FirstNet deployment Proposed Actions. If sites containing known environmental contamination (or mine lands) are selected for proposed FirstNet deployment Proposed Actions 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 Proposed Actions, if any soil or groundwater is observed to be stained or emitting an unnatural odor, it may be an indication of environmental contamination. When such instances are encountered, it may be necessary to stop work until the anomaly is further assessed through record reviews or environmental sampling. Proposed FirstNet deployment would attempt to avoid known contaminated sites. However, in the event that FirstNet is unable to avoid a contaminated site, then site analysis and remediation would be required under RCRA, CERCLA, Superfund, and applicable Indiana 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 IDNR 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 5.2.2-1, 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 Proposed Actions. 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.

5.2.15.4 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 5.1, 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 Proposed Actions 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 Proposed Actions.

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.
- 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 human health and safety.

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 or near bodies of water requires workers to operate over aquatic and/or marine environments, which presents opportunities for drowning. When working over water exposure to sun, high or low temperatures, wind, and moisture could impact worker safety. Construction of landings and/or facilities on shores or the banks of water bodies that accept the 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.
  - The use of deployable technologies could result in soil disturbance if land-based deployables are deployed on unpaved areas or if the implementation results in paving of previously unpaved surfaces. The use of heavy machinery presents the possibility for spills and soil and water contamination, and noise emissions could potentially impact human health; and vehicles and heavy equipment present the risk of workplace and road traffic accidents that could result in injury. Set-up of a cellular base station contained in a trailer with a large expandable antenna mast is not expected to result in impacts to human health and safety. However, due to the larger size of the deployable technology, site preparation or trailer stabilization may be required to ensure the self-contained unit is situated safely at the site. Additionally, the presence of a dedicated electrical generator would produce fumes and noise. The possibility of site work and the operation of a dedicated electrical generator have the potential for impacts to human health and safety. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions. Use of aerial vehicles would not involve telecommunication site work. Prior to deployment and when not in use, the aerial vehicles would likely require preventive

maintenance. Workers responsible for these activities may handle hazardous materials, not limited to fuel, solvents, and adhesives.

- Satellites and Other Technologies
    - Satellite-Enabled Devices and Equipment: The use of portable devices that utilize satellite technology would not impact human health and safety because there is no construction activities or use of hazardous materials. The installation of permanent equipment on existing structures may require workers to operate from heights or in sensitive environments. As a result, the potential for falling, overhead hazards, and falling objects is greater and there is a potential to impact human health and safety.

In general, the abovementioned FirstNet Proposed Actions could potentially involve site preparation work, construction activities, work in potentially harmful environments (road ROWs, work over water, historic environmental contamination, and mine lands), management of hazardous materials and hazardous waste, and weather exposure. Potential impacts to human health and safety associated with deployment of the Proposed Project could include injury from site preparation and operating heavy equipment, construction activities, falling/overhead hazards/falling objects, exposure, and release of hazardous chemicals and hazardous waste, and release of historic contamination to the surrounding environment. It is anticipated that potential health impacts associated with human exposure to environmental hazardous materials in air, water, or soil, the risk of road traffic, workplace accidents, and injuries, noise exposure, and risk of infectious disease transmission would be less than significant due to the small scale of likely FirstNet activities that would be temporary and of short duration. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described 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. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

5.2.15.5 Alternatives Impact Assessment

The following section assesses potential impacts to human health and safety associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable land-based infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to human health and safety as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts to human health and safety. The largest of the land-based deployable technologies may require site preparation work or stabilization work to ensure the self-contained trailers are stable. Heavy equipment may be necessary to complete the site preparation work. However, in general, the deployable technologies are small mobile units that could be transported as needed. While in operation, the units are parked and operate off electrical generators or existing electrical power sources. Connecting deployable technology to a power supply may present increased electrocution risk during the process of connecting power. If the power source is an electrical generator, then there would also likely be a need to manage 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. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As 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. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to 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 5.2.15, Human Health and Safety.

IN APPENDIX A – WATER RESOURCES

Table A-1: Indiana Outstanding Resource Waters

River Name	River Segment Description	Within the Great Lakes System
Big Pine Creek	In Warren County downstream of the State Road 55 bridge near the town of Pine Village to its confluence with the Wabash River	
Mud Pine Creek	In Warren County from the bridge on the County Road between Brisco and Rainsville to its confluence with Big Pine Creek	
Fall Creek	In Warren County from the old C.R. 119 bridge in the NW quarter of Section 21, Township 22N, Range 8W downstream to its confluence with Big Pine Creek	
Indian Creek	In Montgomery County from the County Road 650 West bridge downstream to its confluence with Sugar Creek	
Clifty Creek	In Montgomery County within the boundaries of Pine Hills Nature Preserve	
Bear Creek	In Fountain County from the bridge on County Road 450 North to its confluence with the Wabash River	
Rattlesnake Creek	In Fountain County from the bridge on County Road 450 North to its confluence with Bear Creek	
Small tributary to Bear Creek	In Fountain County within the Portland Arch Nature Preserve which enters Bear Creek at the sharpest bend and has formed the small natural bridge called Portland Arch	
Blue River	From the confluence of the West and Middle Forks of the Blue River in Washington County downstream to its confluence with the Ohio River	
South Fork of Blue River	In Washington County from the Horner's Chapel Road bridge downstream to its confluence with Blue River	
Lost River	Lost River and all surface and underground tributaries upstream from the Orangeville Rise (T2N, R1W, Section 6) and the Rise of Lost River (T2N, R1W, Section 7) and the mainstem of the Lost River from the Orangeville Rise downstream to its confluence with the East Fork of White River	
Cedar Creek	In Allen and DeKalb counties, from river mile 13.7 to its confluence with the St. Joseph River	x
Open waters of Lake Michigan	The Indiana portion of the open waters of Lake Michigan	x
Indiana Duens National Lakeshore	All waters incorporated in the Indiana Dunes National Lakeshore	x

Source: (Indiana General Assembly, 2015b)

ACRONYMS

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
ASL	Above Sea Level
ASPM	Aviation System Performance Metrics
ATC	Air Traffic Control
ATO	Air Traffic Organization
BGEPA	Bald and Golden Eagle Protection Act
BLM	Bureau of Land Management
BLS	Bureau of Labor Statistics
BNSF	Burlington Northern and Santa Fe Railway
CAA	Clean Air Act
CCD	Common Core of Data
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFOI	Census of Fatal Occupational Injuries
CGP	Construction General Permit
CH_4	Methane
CIMC	Cleanups in My Community
CIO	Chief Information Officer
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COLT	Cell On Light Truck
COW	Cell On Wheels
CRS	Community Rating System
CWA	Clean Water Act
CWS	Community Water Systems
DEQ	Department of Environmental Quality
DMV	Department of Motor Vehicles
DNR	Department of Natural Resources
DOD	Department of Defense
DOE	Department of Energy
EDACS	Enhanced Digital Access System
EFH	Essential Fish Habitat
EIA	Energy Information Agency
EMS	Emergency Medical Services
EO	Executive Order
EPCRA	Emergency Planning and Community Right to Know Act
ESRI	Environmental Systems Research Institute
FCC	Federal Communication Commission
FEMA	Federal Emergency Management Agency
FGDC	Federal Geographic Data Committee
FHWA	Federal Highway Administration

Acronym	**Definition**
FLM	Federal Land Manager
FLPMA	Federal Land Policy and Management Act of 1976
FRA	Federal Railroad Administration
FSDO	Flight Standards District Offices
FSS	Flight Service Station
GHG	Greenhouse Gas
GIS	Geographic Information System
GNIS	Geographic Names Information System
H_2S	Hydrogen Sulfide
HAP	Hazardous Air Pollutant
HASP	Health and Safety Plans
HHRA	Human Health Risk Assessment
IAC	Indiana Administrative Code
IBA	Important Bird Areas
IDEM	Indiana Department of Environmental Management
IDHS	Indiana Department of Homeland Security
IDOL	Indiana Department of Labor
IDNR	Indiana Department of Natural Resources
IFR	Instrument Flight Rules
IN	Indiana
IND	Indianapolis Airport
INDOT	Indiana Department of Transportation
IOSHA	Indiana Occupational Safety and Health Administration
IPCC	Intergovernmental Panel On Climate Change
IPSC	Integrated Public Safety Commission
ISDH	Indiana State Department of Health
ISP	Indiana State Police
IURC	Indiana Utility Regulatory Commission
JPG	Jefferson Proving Ground
LBS	Locations-Based Services
LID	Low Impact Development
LMR	Land Mobile Radio
LRR	Land Resource Regions
LTE	Long Term Evolution
MBTA	Migratory Bird Treaty Act
MDI	Methylene Diphenyl Diisocyanate
MHI	Median Household Income
MLRA	Major Land Resource Areas
MMT	Million Metric Tons
MSFCA	Magnuson-Stevens Fisheries Conservation Act
MSL	Mean Sea Level
N_2O	Nitrous Oxide
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NAICS	North American Industry Classification System
NAS	National Airspace System; National Audobon Society
NASAO	National Association of State Aviation Officials
NEPA	National Environmental Policy Act
NESCA	Nongame and Endangered Species Conservation Act
NFIP	National Flood Insurance Program
NHA	National Heritage Areas
NHL	National Historic Landmarks

Acronym	Definition
NHPA	National Historic Preservation Act
NICTD	Northern Indiana Commuter Transportation District
NIH	National Institute of Health
NIST	National Institute of Standards and Technology
NM	Nautical Miles
NNL	National Natural Landmarks
NOTAM	Notices To Airmen
NO_X	Oxides of Nitrogen
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NPS	National Park Service
NRC	National Response Center
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NSA	National Security Areas
NTFI	National Task Force On Interoperability
NTNC	Non-Transient Non-Community
NWI	National Wetlands Inventory
NWR	National Wildlife Refuges
OCIO	Office of the CIO
OE/AAA	Obstruction Evaluation and Airport Airspace Analysis
OSHA	Occupational Safety and Health Administration
OTR	Ozone Transport Region
PEIS	Programmatic Environmental Impact Statement
PEM	Palustrine Emergent Wetlands
PFO	Palustrine Forested Wetlands
PGA	Peak Ground Acceleration
POP	Points of Presence
PPE	Personal Protective Equipment
PSAP	Public Safety Answering Points
PSCR	Public Safety Communications Research
PSD	Prevention of Significant Deterioration
PSS	Palustrine Scrub-Shrub Wetlands
PTE	Potential to Emit
RACOM	Radio Communications
RCRA	Resource Conservation and Recovery Act
RF	Radio Frequency
SAA	Sense and Avoid
SASP	State Aviation System Plan
SBN	South Bend International Airport
SCEC	State Climate Extremes Committee
SCIP	Statewide Interoperable Communications Plan
SDS	Safety Data Sheets
SDWA	Safe Drinking Water Act
SF_6	Sulfur Hexafluoride
SGCN	Species of Greatest Conservation Need
SHPO	State Historic Preservation Office
SIP	State Implementation Plan
SO_2	Sulfur Dioxide
SO_3	Sulfur Trioxide
SOC	Standard Occupational Classification
SOP	Standard Operating Procedures

Acronym	Definition
SOW	System On Wheels
SO_X	Oxides of Sulfur
SPL	Sound Pressure Level
SRS	Statewide Radio System
STARCOMM	Siouxland Tristate Area Radio Communications
SUA	Special Use Airspace
SWAP	State Wildlife Action Plan
SWPPP	Storm Water Pollution Prevention Plan
THPO	Tribal Historic Preservation Office
TNC	Transient Non-Community Systems
TRI	Toxics Release Inventory
TSP	Total Suspended Particulates
TWA	Time Weighted Average
UA	Unmanned Aircraft
UAS	Unmanned Aircraft Systems
UHF	Ultra High Frequency
UIE	University of Indiana Extension
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VFR	Visual Flight Rules
VHF	Very High Frequency
VOC	Volatile Organic Compounds
WCS	Wetlands Classification Standard
WMA	Wildlife Management Areas
WMD	Wetland Management District
WONDER	Wide-Ranging Online Data For Epidemiologic Research
WWI	World War I
WWII	World War II

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