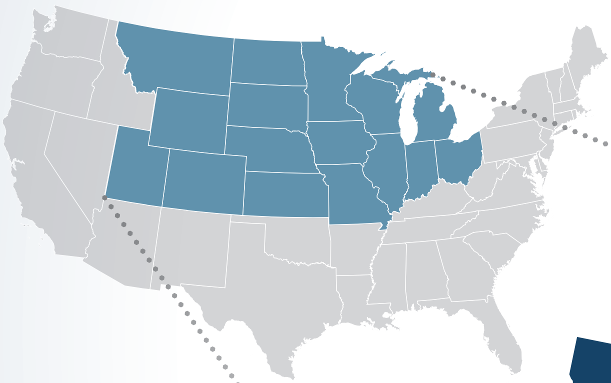
FirstNet®

Nationwide Public Safety Broadband Network

Draft Programmatic Environmental Impact Statement for the Central United States

VOLUME 6 - CHAPTER 8



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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 6 - CHAPTER 8

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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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8. MICHIGAN

Michigan was populated for centuries by American Indian tribes with a rich cultural history. Michigan was held by the French during early colonial times, and then by Britain until the end of the Revolutionary War. Although the British continued to occupy Michigan until 1794, the Ordinance of 1787 made Michigan part of the United States' Northwest Territory. In 1837, Michigan became the 26th state to enter the Union (Legislative Council, State of Michigan, 2002). Michigan is bordered by Canada and the Great Lakes to the north, east, and west; and by Wisconsin, Indiana, and Ohio to the south. This chapter provides details about the existing environment of Michigan as it relates to the proposed action.

General facts about Michigan are provided below:

- **State Nickname**: The Wolverine State
- **Land Area:** 56,538.90 square miles; **U.S. Rank**: 11 (U.S. Census Bureau, 2015a)
- **Capital:** Lansing
- **Counties:** 83 (State of Michigan, 2015a)
- **2014 Estimated Population:** Over 9.9 million people; **U.S. Rank:** 8 (U.S. Census Bureau, 2015x)
- **Most Populated Cites:** Detroit, Grand Rapids, Warren, Sterling Heights, and Ann Arbor (State of Michigan, 2015a)
- **Main Rivers:** Saginaw River, Grand River, Kalamazoo River, St. Joseph River, Detroit River, Clinton River, Huron River, and St. Mary's River
- **Bordering Waterbodies:** Lake Superior, Lake Michigan, Lake Huron, and Lake Erie
- **Mountain Ranges:** Porcupine Mountains and Huron Mountains
- **Highest Point:** Mt. Arvon (1,975 ft) (USGS, 2015a)

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8.1. AFFECTED ENVIRONMENT

8.1.1. Infrastructure

8.1.1.1. Definition of the Resource

This section provides information on key Michigan 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 man-made 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 man-made 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 8.1.1.3 provides an overview of the traffic and transportation infrastructure in Michigan, including road and rail networks and airport facilities. Michigan 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 Michigan are presented in more detail in Section 8.1.1.4. Section 8.1.1.5 describes specific public safety communications infrastructure and commercial telecommunications infrastructure in Michigan. An overview of utilities in Michigan, such as power, water, and sewer, are presented in Section 8.1.1.5.

8.1.1.2. Specific Regulatory Considerations

Multiple Michigan laws and regulations pertain to the state's public utility and transportation infrastructure and its public safety community. Table 8.1.1-1 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.] § 1401(26)).

Table 8.1.1-1: Relevant Michigan Infrastructure Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
MCL: Chapter 30 Civilian Defense: MAC: State Police	Michigan Department of State Police, Emergency Management and Homeland Security Division	Coordinates within the state the emergency management activities of county, municipal, state, and federal governments.
MCL: Chapter 460 Public Utilities	Michigan Public Service Commission	Regulates and controls public and certain private utilities and provides for energy efficiency and alternate energy source use.
MCL: Chapters 220-224 General Highway Law; Chapter 474 State Transportation: MAC: Transportation	Michigan Department of Transportation (MDOT)	Oversees the development and operation of the state's transportation systems.

8.1.1.3. Transportation

This section describes the traffic and transportation infrastructure in Michigan, including specific information related to the road networks, airport facilities, rail networks, harbors, and ports. The movement of vehicles is commonly referred to as traffic, as well as the circulation along roads. Roadways in the state can range from multilane road networks with asphalt surfaces, to unpaved gravel or private roads. The information regarding existing transportation systems in Michigan are based on a review of maps, aerial photography, and federal and state data sources.

The MDOT has jurisdiction over freeways and major roads, airports, railroads, mass transit, and ports in the state; local counties have jurisdiction for smaller streets and roads. The mission of the MDOT is "providing the highest quality integrated transportation services for economic benefit and improved quality of life" (MDOT, 2015a).

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

- 122,141 miles of public roads (FHWA, 2014) and 11,072 bridges (FHWA, 2015a);
- 3,900 miles of freight rail network (MDOT, 2011);
- 464 aviation facilities, including airstrips and heliports (FAA, 2015a);
- 83 harbors (DNR, 2015a); and
- 3 major ports that includes both public and private facilities.

Road Networks

As identified in Figure 8.1.1-1, the major urban centers of the state from north to south are Mount Pleasant-Alma, Saginaw-Midland-Bay City, Grand Rapids-Wyoming-Muskegon, Lansing-East Lansing-Owosso, Kalamazoo-Battle Creek-Portage, and Detroit-Warren-Ann Arbor (including the neighboring city of Sterling Heights) (U.S. DoC, 2013). Michigan has four 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 8.1.1-2 lists the interstates and their start/end points in Michigan. 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 8.1.1-2: Michigan Interstates

Interstate	Southern or western terminus in MI	Northern or eastern terminus in MI
I-69	IN line in Coldwater	I-94 in Port Huron
I-75	OH line near Erie	Canada line at Sault Ste. Marie
I-94	IN line in New Buffalo	Canada line in Port Huron
I-96	U.S. 31 in Norton Shores	I-75 in Detroit

Sources: (USDOT, 2014)

In addition to the Interstate System, Michigan 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 8.1.1-1 illustrates the major transportation networks, including roadways, in Michigan. Section 8.1.8, Visual Resources, describes the National and State Scenic Byways found in Michigan 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 FHWA. Michigan has three National Scenic Byways (FHWA, 2015c):

- Copper Country Trail,
- River Road Scenic Byway, and
- Woodward Avenue (M-1) – Automotive Heritage Trail.

State Scenic Byways are roads with statewide interest; State Scenic Byways are designated and managed by MDOT. Some State Scenic Byways may be designated on portions of National Scenic Byways. Michigan has 14 State Scenic Byways that crisscross the entire state[2] (MDOT, 2015b):

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

- Iron River Byway
- UP Hidden Coast Byway
- Route 123
- Tunnel of Trees Byway
- Sunrise Side Byway
- Leelanau Scenic Byway
- Old Mission Byway
- Bay City Byway
- Frankenmuth Byway
- Route 179
- Battle Creek Byway
- Historic Marshall Byway
- U.S. 12 Heritage Trail
- Monroe Byway

Figure 8.1.1-1: Michigan Transportation Networks

Airports

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

- Detroit Metropolitan Airport (DTW) is operated by the Wayne County Airport Authority (DTW, 2015). In 2014, DTW served 32,513,555 passengers, facilitated more than 392,000 aircraft operations, and moved 445,480,024 pounds of cargo (DET, 2014). DET is the 17th busiest airport in the nation, in terms of the number of passengers served (FAA, 2015b).
- Gerald R. Ford International Airport (GRR) serves the City of Grand Rapids, Michigan. It is operated by the Kent County Department of Aeronautics (GRR, 2015). In 2014, GRR facilitated 1,174,821 enplanements, making it the 81st busiest airport in the nation (FAA, 2015b). That same year, GRR moved 238,096,695 pounds of cargo (FAA, 2015c).
- Figure 8.1.1-1 illustrates the major transportation networks, including airports, in the state. Section 8.1.7.5, Airspace, provides greater detail on airports and airspace in Michigan.

Rail Networks

Michigan is connected to a network of passenger rail (Amtrak) and freight rail. Figure 8.1.1-1 illustrates the major transportation networks, including rail lines, in Michigan.

Amtrak runs three lines through Michigan, all of which fall under Amtrak's "Michigan Services" program. The three lines begin in Chicago and provide multiple daily departures to cities in Michigan. In fiscal year 2014, Amtrak served 769,348 passengers at 22 stations in Michigan (MDOT, 2015c). Table 8.1.1-3 provides a complete list of Amtrak lines that run through Michigan.

Table 8.1.1-3: Amtrak Train Routes Serving Michigan

Route	Starting Point	Ending Point	Major Cities Served in Michigan
Pere Marquette	Chicago, IL	Grand Rapids, MI	Grand Rapids
Blue Water	Chicago, IL	Port Huron, MI	Kalamazoo, East Lansing, Flint
Wolverine	Chicago, IL	Pontiac, MI	Kalamazoo, Ann Arbor, Detroit

Source: (Amtrak, 2015)

Michigan's 3,900 miles of freight rail track are owned and operated by 24 freight railroad companies (MDOT, 2011). The Federal Railroad Administration (FRA) classifies railroads as Class I, Class II, or Class III based on corporate revenue thresholds (FRA, 2015a). Four Class I railroads own and operate 2,137 miles of track in the state: Canadian National, Norfolk Southern, CSX Transportation, and Canadian Pacific/Soo Line (MDOT, 2011). In addition, two regional railroads, seven switching/terminal railroads, and 15 short-line railroads operate in Michigan (MDOT, 2011). In 2009, 33 percent of all freight moving within Michigan traveled via rail (MDOT, 2011).

Harbors and Ports

Michigan borders four of the five U.S. Great Lakes, as well Lake Saint Clair and numerous major rivers. The proximity to navigable waterways was important to the development of the state, and today, ports and harbors are integral parts of the local and regional economy. Commercial, recreational, and transportation infrastructure (e.g., ferry terminals) dots every Michigan coast (DNR, 2015b). Three of the state's largest commercial ports are Detroit, Calcite, and Sault Ste. Marie (Figure 8.1.1-1).

The Port of Detroit, on the west bank of the Detroit River,[3] is operated by the Detroit/Wayne County Port Authority. "Covering 35 acres, the Port of Detroit has over 2000 feet of docks and 27 feet of seaway depth. The 128 thousand square foot facility offers covered storage for cargo, and work is underway to restore a four-acre ten-story warehouse (World Port Source, 2016)". The port processes general cargo at the Detroit and Ecorse Terminals, owned by Nicholson Terminal & Dock Company, and bulk cargo processed at several private terminals along the Detroit River and smaller Rouge River the runs west into the city (Port of Detroit, 2015a). The nearest overland interstate connection to the Port of Detroit is I-75, which runs through the City of Detroit (Port of Detroit, 2015b). The port's cargo includes "international and domestic high-grade steel products, coal, iron ore, cement, aggregate and other road building commodities" and it is the third largest steel handling port in the United States (Port of Detroit, 2015a). In 2013, the Port of Detroit imported $758.9 million worth of cargo weighing 2,605,313342 tons, and exported $1,191.6 million of cargo weighing 2,021,859 tons (U.S. Census Bureau, 2015w).

The Port of Calcite is near Rogers City, MI, on the northwest shore of Lake Huron, and is home to the largest open pit limestone quarry in the world (MSU, 2016). Port Calcite is near to mineral mines and processing facilities (Moran Iron Works, 2015). The port's ship channel is 24.5 feet deep, making it a deep water port (Northeast Michigan Collaboration, 2016). Port services include "normal and heavy cargo, logistics, cargo storage, and labor and machinery requirements for specialized cargo services" (Moran Iron Works, 2015). In 2013, the Port of Calcite imported $28.9 million of cargo weighing 32,959 tons, and exported $1.9 million of cargo weighing 17,196 tons (U.S. Census Bureau, 2015w).

The Port of Sault Ste. Marie is a deepwater seaport at the northeast end of Michigan's northern peninsula. Facilities are located the coast of a small island east of I-75 near the Mackinac Bridge. International trade though the port includes iron ore, limestone, coal, grain, cement, salt, and sand. The USACE operates the nearby Soo Locks of Poe and MacArthur, enabling large vessels to pass between Lake Superior in the northwest and Lake Huron (Sault Ste. Marie Economic Development Corporation, 2015a). In 2013, the port imported $7 million in cargo weighing 516,983 tons and exported $107 million of cargo weighing 652,568 tons (U.S. Census Bureau, 2015w).

[3] The Detroit River is actually a strait (i.e., passageway connecting two large waterbodies) between Lake St. Clair and Lake Erie, and is an international border with Canada.

8.1.1.4. Public Safety Services

Michigan public safety services generally consist of public safety infrastructure and first responder personnel aligned with the demographics of the state. Table 8.1.1-4 presents Michigan'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 8.1.9, Socioeconomics.

Table 8.1.1-4: Key Michigan Indicators

Michigan Indicators	
Estimated Population (2014)	9,909,877
Land Area (square miles) (2010)	56,538.90
Population Density (persons per sq. mile) (2010)	174.8
Municipal Governments (2013)	533

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

Table 8.1.1-5 presents Michigan's public safety infrastructure, including fire and police stations. Table 8.1.1-6 identifies first responder personnel including dispatch, fire and rescue, law enforcement, and emergency medical personnel in the state.

Table 8.1.1-5: Public Safety Infrastructure in Michigan by Type

Infrastructure Type	Number
Fire and Rescue Stations [a]	1,476
Law Enforcement Agencies [b]	571
Fire Departments [c]	966

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

[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.

Table 8.1.1-6: First Responder Personnel in Michigan by Type

First Responder Personnel	Number
Police, Fire and Ambulance Dispatchers [a]	2,120
Fire and Rescue Personnel [b]	12,103
Law Enforcement Personnel [c]	26,395
Emergency Medical Technicians and Paramedics [d e]	6,500

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

8.1.1.5. Telecommunications Resources

There is no central repository of information for public safety communications infrastructure and commercial telecommunications infrastructure in Michigan; 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 8.1.1-2 presents a typical wireless configuration including both a narrowband public safety land mobile radio network (traditional radio network) and a commercial broadband access network (wireless technology); backhaul (long-distance wired or wireless connections), core, and commercial networks including a long term evolution (LTE) evolved packet core (modern broadband cellular networks); and network applications (software) delivering voice, data, and video communications.

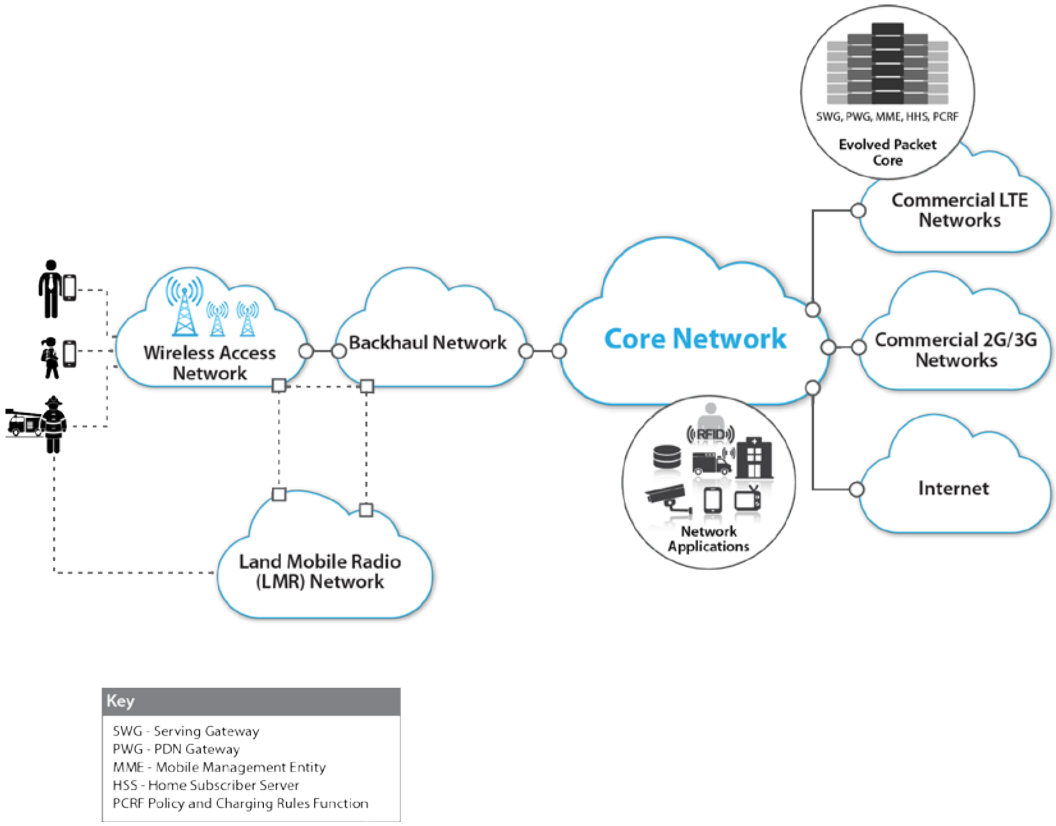

Figure 8.1.1-2: Wireless Network Configuration

Prepared by: Booz Allen Hamilton

Public Safety Communications

In order to protect and best serve the public interest, first responder and law enforcement communities must be able to communicate effectively. The evolution of the communications networks used by public safety stakeholders toward a broadband wireless technology, such as LTE (see Section 8.1.1), 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. Chief among these factors impacting information sharing are: network coverage gaps, land mobile radio system infrastructure diversity, insufficient budgets, and diverse radio frequencies.

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 Michigan. 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 (LMR) networks with a nationwide public safety LTE broadband network, the U.S. Department of Commerce Public Safety Communications Research (PSCR), prepared a locations-based services (LBS) research and development roadmap to examine the current state of location-based technologies, 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 to better inform investment decisions (PSCR, 2015).

Michigan was an early adopter of the standards-based digital P25 technology and currently runs a 244 tower LMR network called the Michigan Public Safety Communications System (MPSCS). This network provides 800 MHz statewide coverage for public safety agencies (APCO International, 2014). Like other states, Michigan faces multiple challenges of maintaining existing legacy investments, upgrading LMR infrastructure and tower sites, increasing requirements for additional interoperability and digital capabilities, and integrating future LMR narrowband network infrastructure with the future deployment of broadband public safety 700 MHz.

Statewide Networks

Michigan was the earliest adopter of all of the states to deploy a standards-based statewide digital P25[4] system in the U.S. Responsibility for the statewide MPSCS network resides within the Department of Technology, Management and Budget. The MPSCS network remains one of the largest footprint P25 systems in the world (APCO International, 2014).

In a 2014 case study on MPSCS done by the Association of Public Safety Communications Officials (APCO) International, it summarized the growth in tower sites and users as well as its key characteristics of this large footprint public safety network. The study stated: "…the system [MPSCS] supports 11 million push to talk (PTTs) conversations per year, and has grown from 180 to 244 tower sites, covering 57,000 square miles of the state of Michigan's land mass. The system has exploded in size and support since its early days as a system dedicated to the Michigan State Police. Since initial deployment, the system has grown from 8000 to 64,400 public safety users, from 180 to 244 tower sites and from 153 to more than 1,413 agencies" (APCO International, 2014).

The MPSCS network supports state public safety agencies including the Michigan State Police, Department of Health, Department of Transportation, regional Community Health Groups, county police and fire departments, and Michigan's National Guard (RadioReference.com,

[4] Project-25 (P25) is a suite of standards for digital radio communications for use by federal, state, and local public safety agencies in North America to enable them to communicate with other agencies and mutual aid response teams in emergencies.

2015a). The statewide digital P25 network, MPSCS is organized around seven regions depicted in Figure 8.1.1-3 (State of Michigan, 2015b).

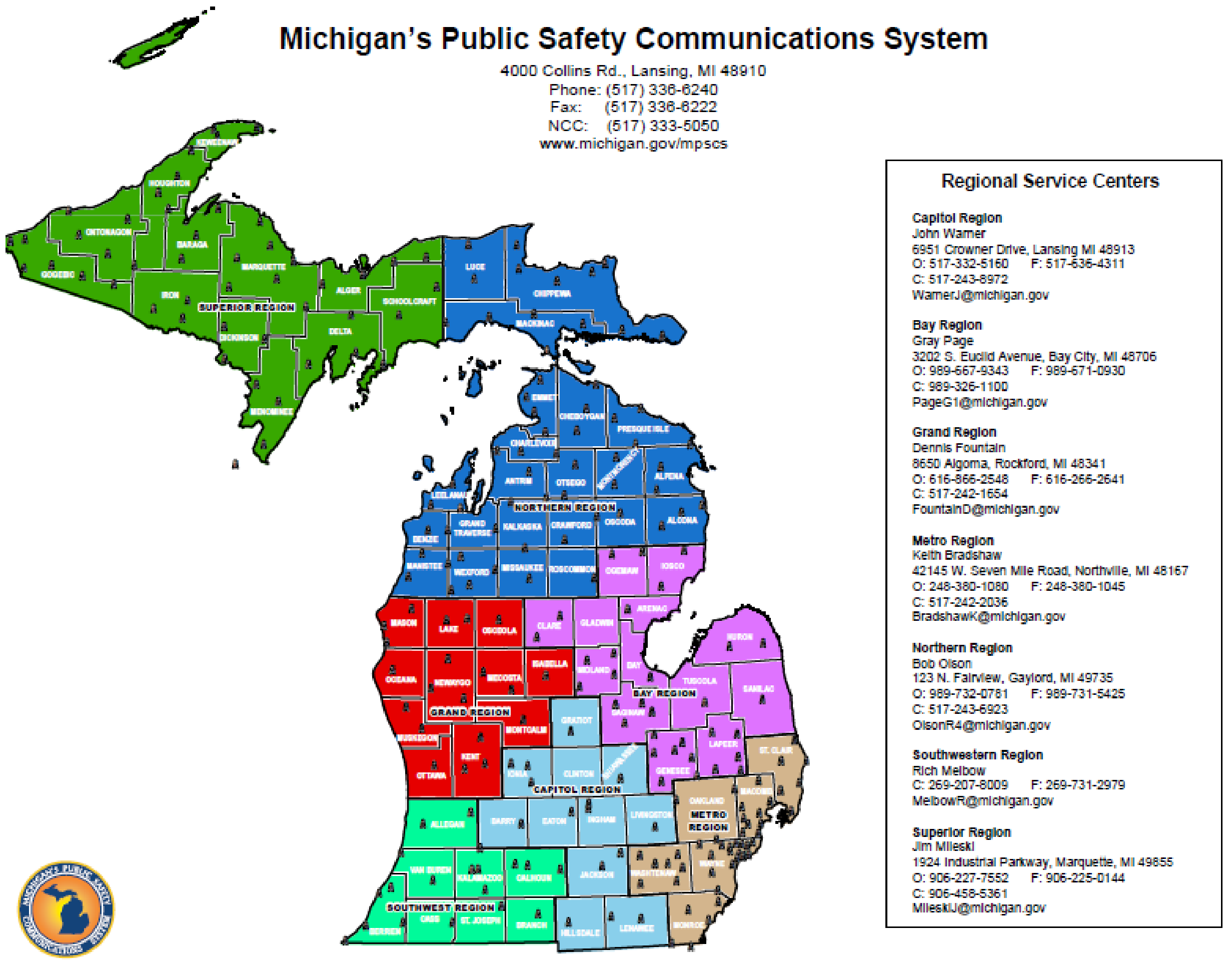

Figure 8.1.1-3: MPSCS Regional Structure

Figure 8.1.1-4 shows the location of the statewide MPSCS tower locations across all of Michigan's 83 counties (Michigan State Police, 2005).

Figure 8.1.1-4: MPSCS Tower Locations

City and County Public Safety Networks

In Michigan, county and local public safety communications have been supported by a diverse set of systems and frequencies including Very High Frequency (VHF),[5] Ultra High Frequency (UHF),[6] and 800 MHz and there continues to be high diversity in the types and frequencies of LMR systems adopted by county and local public safety departments (RadioReference.com, 2015b).

There are four public safety digital P25 systems operational in Michigan using a number of frequencies, with all of the systems operating on 800 MHz and the statewide MPSCS network operating on 700 MHz and 800 MHz. Table 8.1.1-7 below lists these public safety P25 systems which includes three county digital P25 systems and the statewide MPSCS (Project 25.org, 2015a).

Table 8.1.1-7: Michigan Public Safety P25 Networks

Michigan P25 Public Safety Systems	Frequency Band
Downriver Mutual Aid (P25) Radio System	800 MHz
Huron County P25 Public Safety Radio System	800 MHz
Michigan Public Safety Communications System (MPSCS)	700 MHz/800 MHz
Warren Public Safety Project 25 System	800 MHz

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

The Downriver Mutual Aid Radio System is a digital P25 network operating on 800 MHz on four radio sites in the Downriver area (Southeast Warren County) which covers 119 square miles. It supports 2,000 talk groups including mutual aid/intersystem talk groups, area-wide law enforcement, area-wide fire and EMS, and multiple southeast Warren county community police and fire tactical communications and dispatch (RadioReference.com, 2015c).

The Huron County P25 Public Safety Radio system, located in Bad Axe, is a digital P25 800 MHz system providing LMR communications to common and mutual aid talk groups, local community fire and EMS talk groups, unit-to-unit communications, and law enforcement local community/county tactical communications and dispatch (RadioReference.com, 2015d).

The Warren Public Safety P25 System, located in Macomb County, provides 800 MHz LMR communications to the city of Warren, the largest suburb in metro Detroit. The system delivers communications for intersystem/common talk groups including fire and police, police and fire dispatch and tactical communications, in addition to providing individual channels for specialized public safety needs including police special operations and HAZMAT response teams (RadioReference.com, 2015e).

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

Public Safety Answering Points (PSAP)

According to the Federal Communication Commission's (FCC) Master public safety answering points (PSAP) registry there are 200 PSAPs in Michigan serving Michigan's 83 counties (FCC, 2015a).

Commercial Telecommunications Infrastructure

Michigan'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 Michigan'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

Michigan'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 8.1.1-8 presents the number of providers of switched access[7] lines, Internet access[8], and mobile wireless services including coverage.

Table 8.1.1-8: Telecommunications Access Providers and Coverage (2013)

Commercial Telecommunications Access Providers	Number of Service Providers	Coverage of Households
Switched access line	175	97.4% of households
Internet access	106	58% of households
Mobile Wireless	7	100% of population

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

[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 8.1.1.5, Last Mile Fiber Assets.

Table 8.1.1-9 shows the wireless providers in Michigan along with their geographic coverage. The following five maps, Figure 8.1.1-5 to Figure 8.1.1-9, show the combined coverage for the

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

top two providers (Verizon Wireless and AT&T Mobility LLC); Sprint and T-Mobile's coverage; MetroPCS Wireless Inc., SpeedConnect, and miSpot's coverage; Casair Inc., Air Advantage LLC, SkyWeb Networks, and M33 Access's coverage; and the coverage of all other providers with less than 5 percent coverage area, respectively.[9]

Table 8.1.1-9: Wireless Telecommunications Coverage by Providers in Michigan

Wireless Telecommunications Providers	Coverage
AT&T Mobility LLC	95.30%
Verizon Wireless	82.64%
Sprint	49.72%
T-Mobile	21.08%
MetroPCS Wireless, Inc.	16.91%
SpeedConnect	14.78%
miSpot	14.02%
Casair, Inc.	11.18%
Air Advantage, LLC	9.05%
SkyWeb Networks	5.69%
M33 Access	5.60%
Other [a]	44.73%

Source: (NTIA, 2014)

[a]Other: Provider with less than 5% coverage area. Providers include: Thumb Cellular; FreedomNet Solutions; I-2000, Inc.; Agri-Valley Services, Inc.; Cherry Capital Connection, LLC; Michwave Technologies, Inc.; Chain of Lakes Internet; CMSInter.net; Invisalink; ISP Management, Inc.; DMCI Broadband, LLC; ATI Networks, Inc.; West Michigan Broadband; D&P Communications; Lighthouse.Net; ZingMax; Tri-County Wireless, Inc.; Michiana Supernet; Nodin Wifi; Pasty.NET; MetaLINK Technologies, Inc.; Endless Journey Internet; LakeNet, LLC; RACC Enterprises, LLC; U.P. Logon; Summit Digital; West Michigan Wireless ISP; ATIS, Inc.; SyncWave, LLC; VQ Wireless; Message Express Internet; Fast-Air Internet, Inc.; NCATS; QHP Internet, LLC; Banyanol; CSInet Internet Access Corp.; Winn Telecom; Great Lakes High Speed; SonicNet, Inc.; Ogden Telephone Company; RuralReach.com; KPBIZnet LLC; Vergennes Broadband LLC; Gaslight Media; Bitwise Wireless, LLC; Waldron Communication Company; AirNorth; Azulstar, Inc.; Ideal Wireless, Inc.; Fourway.Net; Warp; Cricket Wireless; IronBay.Net; Hidden Lake Wireless, Inc.; Big Bay Broadband, Inc.; Xyotek, LLC; M-22 Internet Project, LLC; LigTel Communications, Inc.; ACD.net.

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

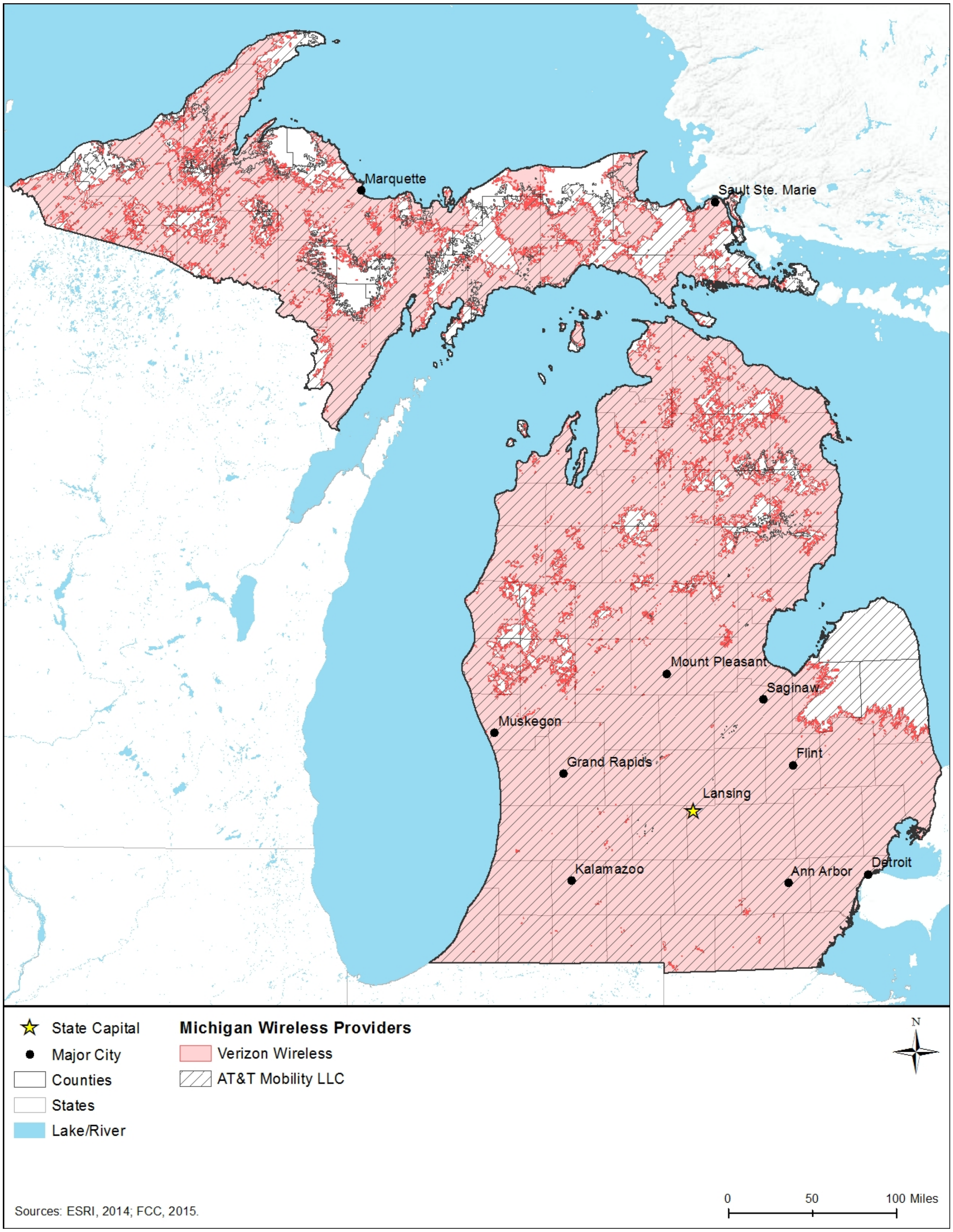

Figure 8.1.1-5: Top Wireless Providers Availability in Michigan

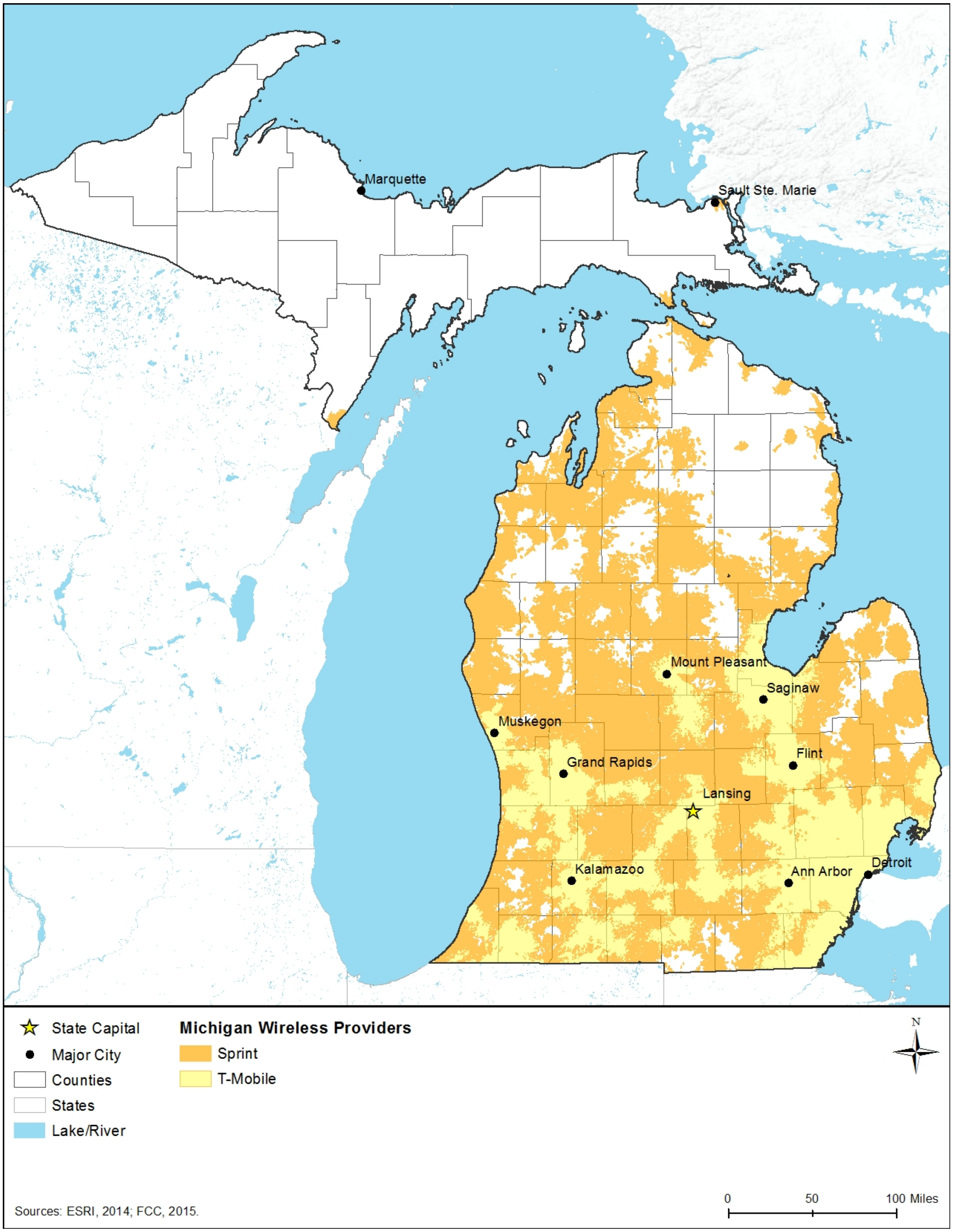

Figure 8.1.1-6: Sprint and T-Mobile Wireless Availability in Michigan

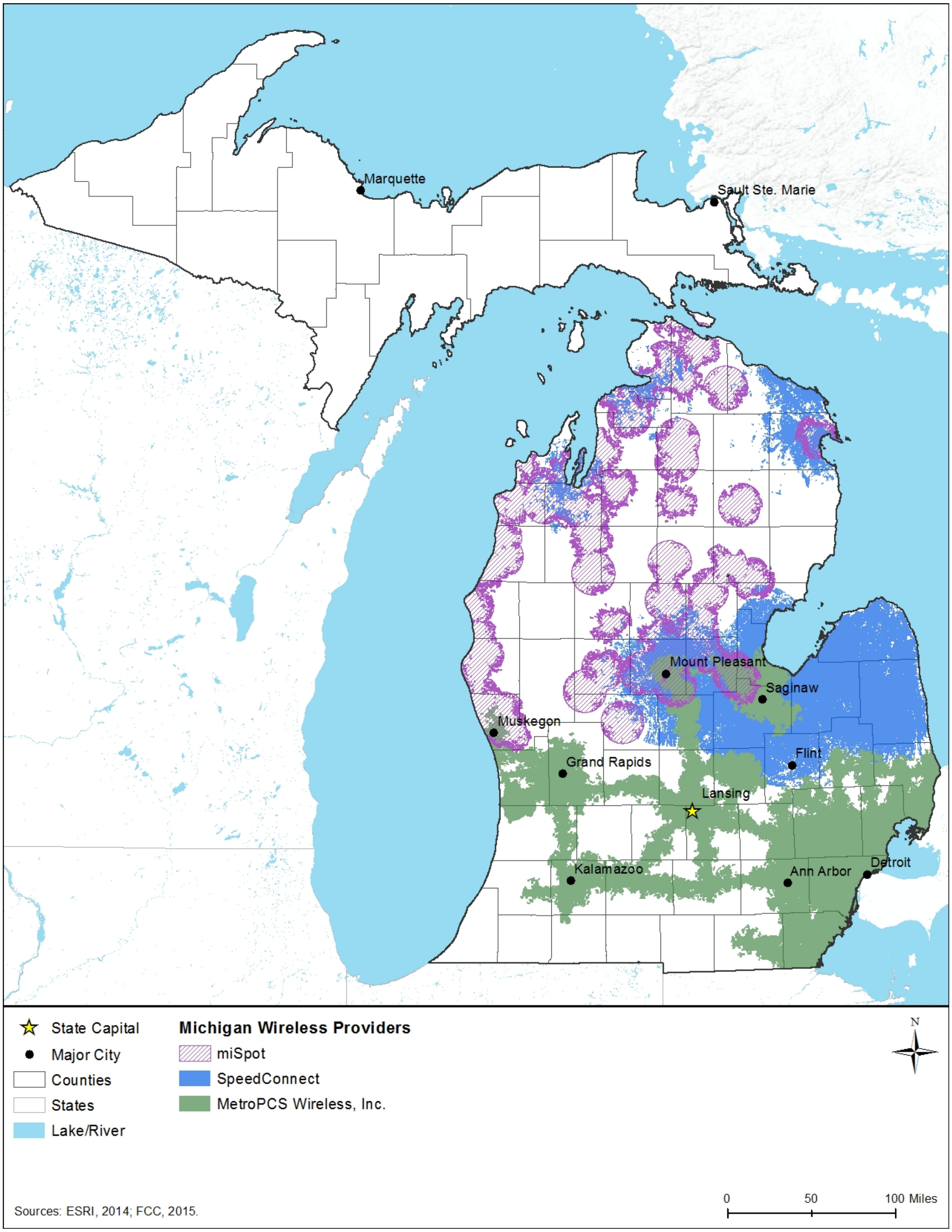

Figure 8.1.1-7: miSpot, SpeedConnect, and MetroPCS Wireless Availability in Michigan

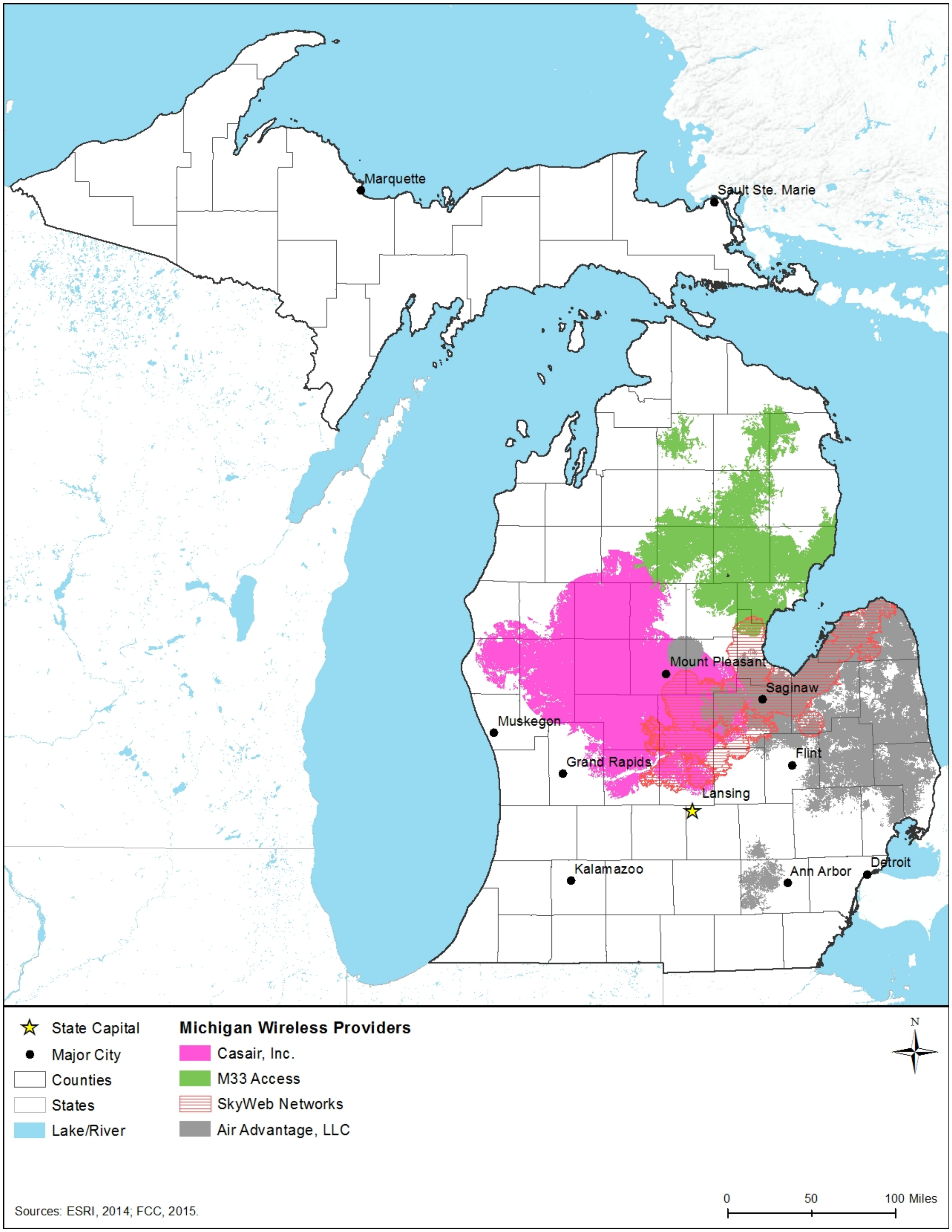

Figure 8.1.1-8: Casair Inc., M33 Access, SkyWeb Networks, and Air Advantage LLC Wireless Availability in Michigan

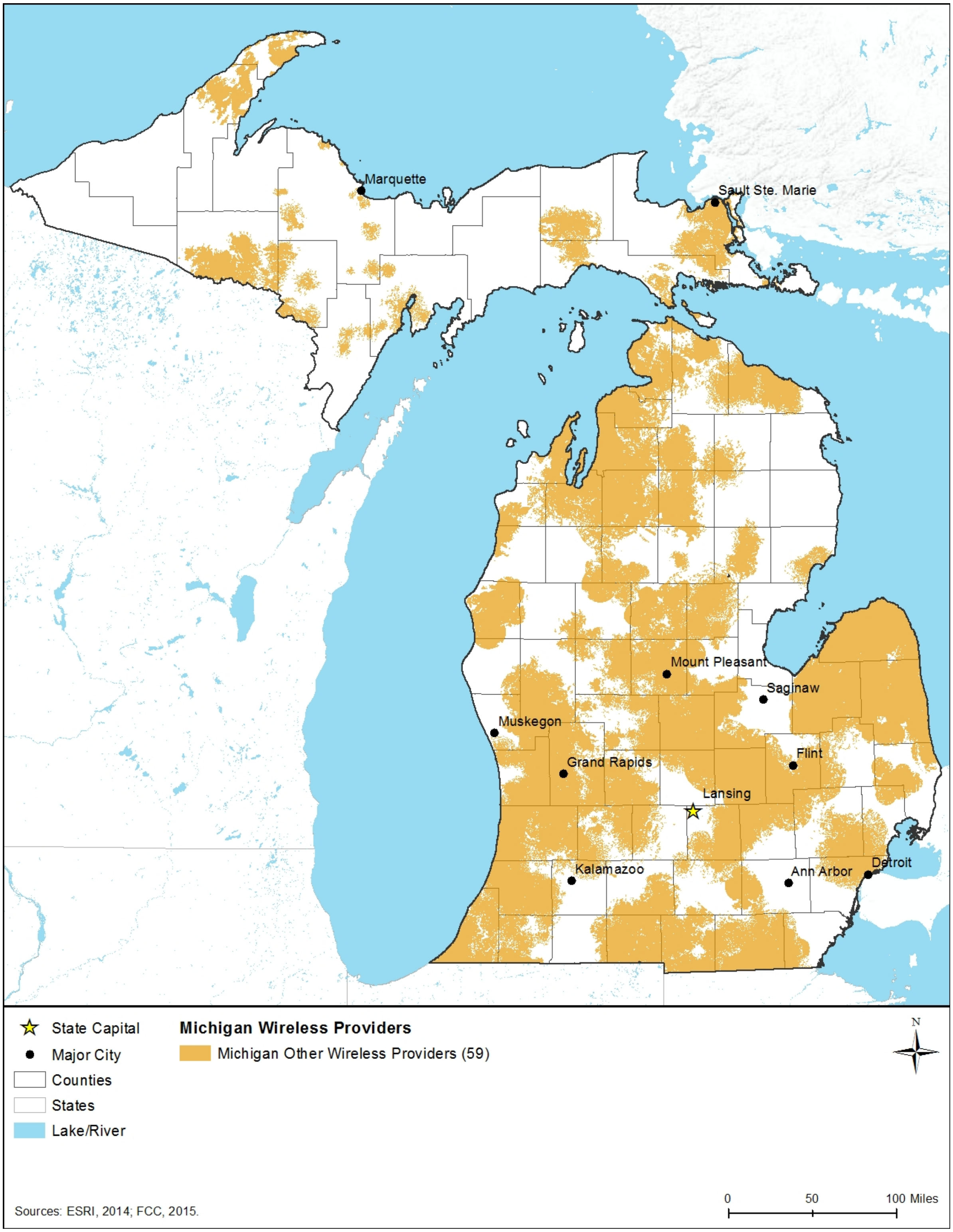

Figure 8.1.1-9: Other Providers Wireless Availability in Michigan

Towers

There are many types of domestic towers employed today by the telecommunications industry, government agencies, and other owners. Towers are designed and used for a variety of purposes, and the height, location, and supporting structures and equipment are all designed, constructed, and operated according to the technical specifications of the spectrum used, the type of equipment mounted on the tower, geographic terrain, need for line-of-sight transmissions to other towers, radio frequency needs, and other technical specifications. There are three general categories of stand-alone towers: monopole, lattice, and guyed. Typically, monopole towers are the smallest, followed by lattice towers at a moderate height, and guyed towers at taller heights (with the guyed wires providing tension support for the taller heights) (CSC, 2007). In general, taller towers can provide communications coverage over larger geographic areas, but require more land for the actual tower site, whereas shorter towers provide less geographic coverage and require less land for the tower site (USFS, 2009a). Figure 8.1.1-10 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 8.1.1-10: Types of Towers

Telecommunications tower infrastructure proliferates throughout Michigan, although tower infrastructure is concentrated in the higher and more densely populated areas of Michigan: Marquette, Sault Ste. Marie, Mount Pleasant, Saginaw, Muskegon, Grand Rapids, Flint, Lansing, Kalamazoo, Ann Arbor, and Detroit. Owners of towers and some types of antennas are required to register those infrastructure assets with the FCC (FCC, 2016a).[10] Table 8.1.1-10 presents the number of towers (including broadcast towers) registered with the FCC in Michigan by tower type, and Figure 8.1.1-11 presents the location of those structures, as of June 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, 2016a).

Table 8.1.1-10: Number of Commercial Towers in Michigan by Type

Constructed[a] Towers[b]		Constructed Monopole Towers	
100ft and over	487	100ft and over	2
75ft – 100ft	824	75ft – 100ft	4
50ft – 75ft	704	50ft – 75ft	82
25ft – 50ft	447	25ft – 50ft	80
25ft and below	61	25ft and below	9
Subtotal	**2,523**	**Subtotal**	**177**
Constructed Guyed Towers		**Buildings with Constructed Towers**	
100ft and over	203	100ft and over	4
75ft – 100ft	76	75ft – 100ft	3
50ft – 75ft	27	50ft – 75ft	9
25ft – 50ft	7	25ft – 50ft	9
25ft and below	2	25ft and below	2
Subtotal	**315**	**Subtotal**	**27**
Constructed Lattice Towers		**Multiple Constructed Structures[c]**	
100ft and over	58	100ft and over	1
75ft – 100ft	115	75ft – 100ft	1
50ft – 75ft	65	50ft – 75ft	3
25ft – 50ft	26	25ft – 50ft	0
25ft and below	5	25ft and below	0
Subtotal	**269**	**Subtotal**	**5**
Constructed Tanks[d]			
Tanks	17		
Subtotal	**17**		
Total All Tower Structures		**3,333**	

Source: (FCC, 2015b)

[a] Planned construction or modification has been completed. Results will return only those antenna structures that the FCC has been notified are physically built or planned modifications/alterations to a structure have been completed (FCC, 2015b).

[b] Self standing or guyed (anchored) structure used for communication purposes (FCC 2012).

[c] Multiple constructed structures per antenna registration (FCC, 2016b).

[d] Any type of tank – water, gas, etc. with a constructed antenna (FCC, 2016b).

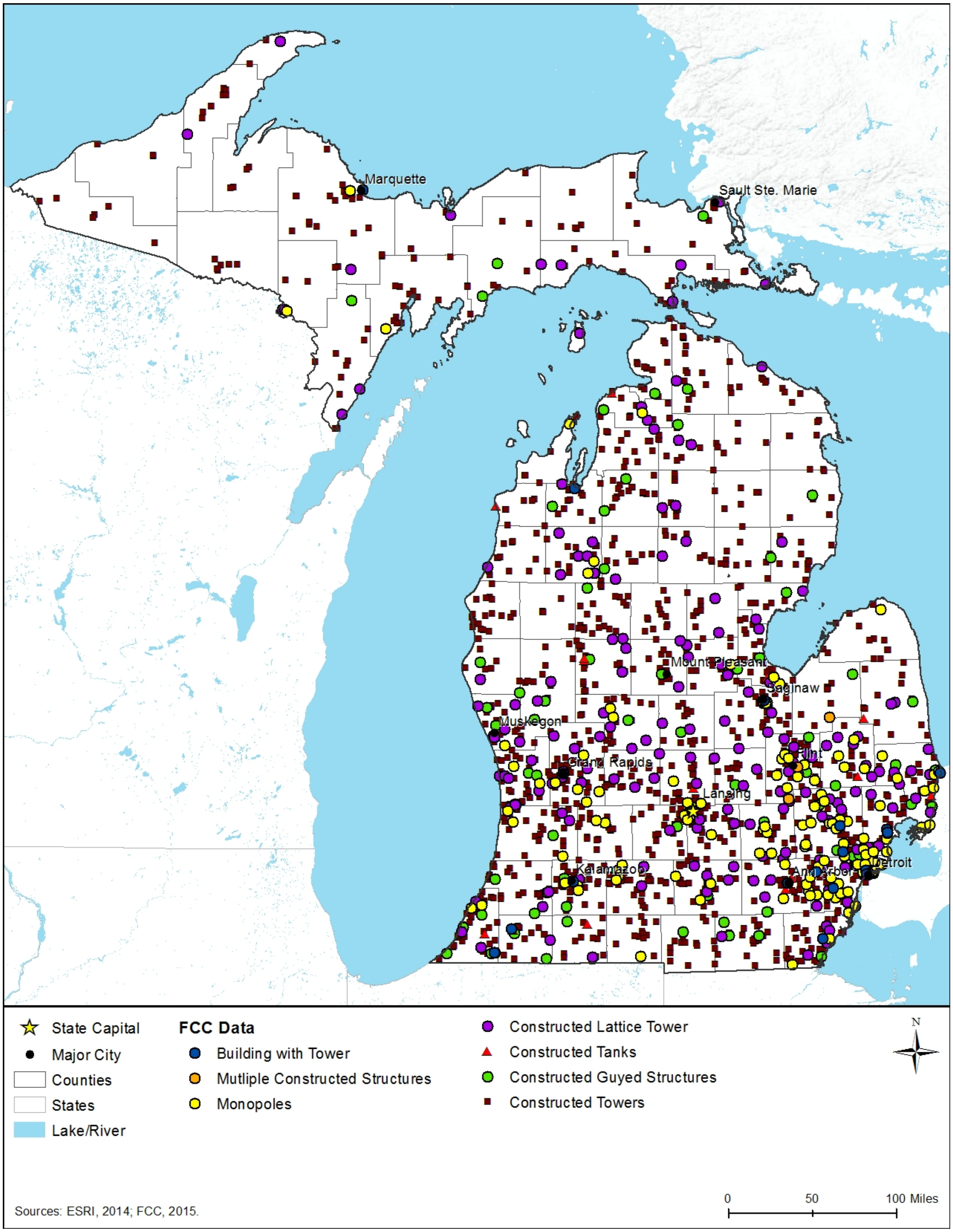

Figure 8.1.1-11: FCC Tower Structure Locations in Michigan

FiberOptic Plant (Cables)

Fiber optic plant, or cables, can be buried directly in the ground; pulled, blown, or floated into ducts, conduits, or innerduct (flexible plastic protective sleeves or tubes); placed under water; or installed aerially between poles, typically on utility rights-of-way. A fiber optic network includes an access network consisting of a central office, distribution and feeder plant (cables of various sizes directly leaving a central office and splitting to connect users to the network), and a user location, as shown in Figure 8.1.1-12. 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).

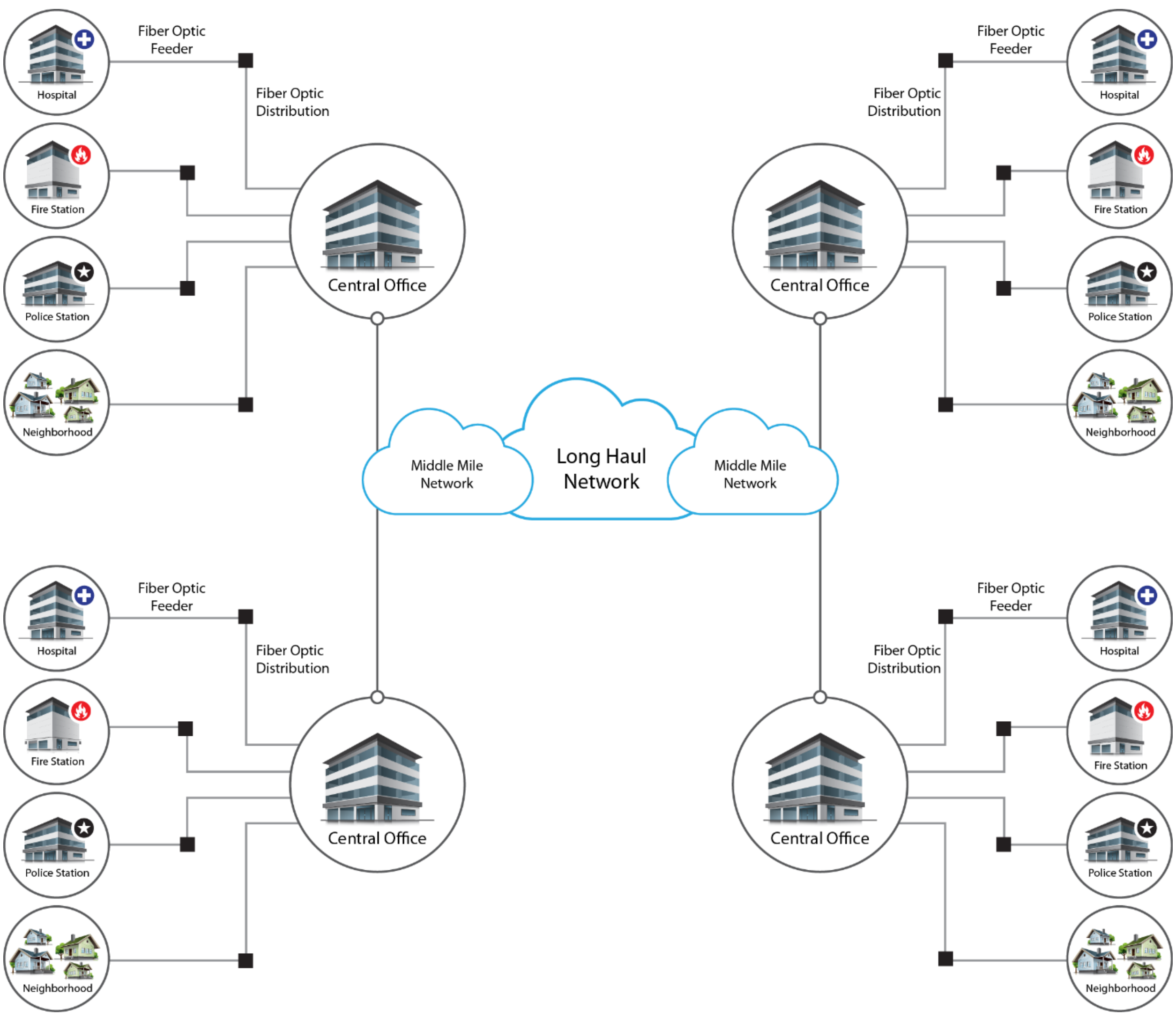

Figure 8.1.1-12: Typical Fiber Optic Network in Michigan

Prepared by: Booz Allen Hamilton

Source: (ITU-T, 2012)

Last Mile Fiber Assets

In Michigan, fiber access networks are concentrated in the highest population centers as shown in the figures below. In Michigan, there are 72 fiber providers that offer service in the state, as listed in Table 8.1.1-11. Figure 8.1.1-13 shows coverage for AT&T, Figure 8.1.1-14 shows coverage for Frontier North Inc. and Charter Communications, Figure 8.1.1-15 shows coverage for Iserv and Comcast, and Figure 8.1.1-16 shows coverage for providers with less than 5 percent coverage area, respectively.

Table 8.1.1-11: Fiber Provider Coverage

Fiber Provider	Coverage
Frontier North, Inc.	16.86%
AT&T Michigan	16.74%
Charter Communications Inc.	16.23%
Iserv	10.21%
Comcast	9.20%
Other[a]	29.90%

Source: (NTIA, 2014)

[a]Other: Provider with less than 5% coverage area. Providers include: CenturyLink; MegaPath Corporation; WOW! Internet, Cable and Phone; Alphacomm.net; Cavalier Telephone; ISP Management, Inc.; I-2000, Inc.; Jamadots; Frontier Midstates, Inc.; TDS Telecom; Frontier Communications of Michigan, Inc.; ACD.net; AcenTek; D&P Communications, Inc.; JAS Networks; Pigeon Telephone Company; up.net; Kaltelnet; MIcom; Allband Communications Cooperative; Barry County Telephone Company; Sunrise Communications, LLC; Carr Telephone Company; Level 3 Communications, LLC; Daystarr Communications, LLC; Parish Communications; Bright House Networks; Michigan Access, Inc.; Springcom, Inc.; Golden Communications; Westphalia Broadband, Inc.; Winn Telephone Company; TVC, Inc.; Blanchard Telephone Company; Buckeye CableSystem; M33 Access; Bloomingdale Communications, Inc.; Sand Creek Internet Company; RACC Enterprises, LLC; Vogtmann Engineering, Inc.; CTS Telecom; Chapin Telephone Company; Midwest Connections; Ogden Telephone Company; Southwest Michigan Communications, Inc.; Summit Digital; Waldron Telephone Company; Lennon Telephone Company; Casair, Inc.; Time Warner Cable; Cable America; Packerland Broadband; Lewiston Communications; Iron River Cable; ATI Networks, Inc.; City of Norway; Hi-Tech SMR Communications; Coldwater Board of Public Utilities; Sister Lakes Cable; Negaunee Cable Company; Sebewaing Light and Water; Martell Cable Services, Inc.; Wyandotte Municipal Services; upnorthcable.com; Lighthouse.Net; Borderland Communications, LLC; Cogent Communications, Inc.

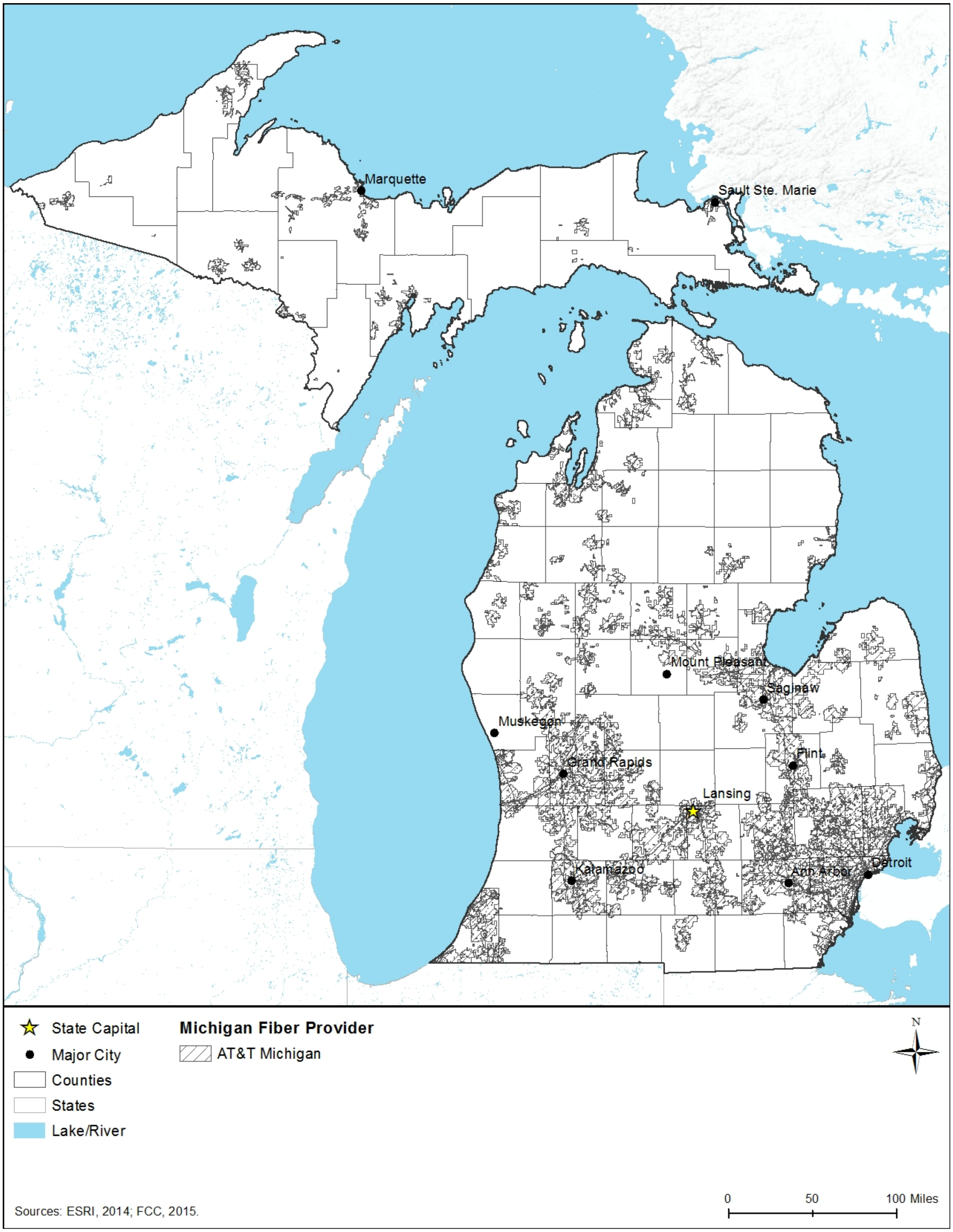

Figure 8.1.1-13: Fiber Availability in Michigan for AT&T

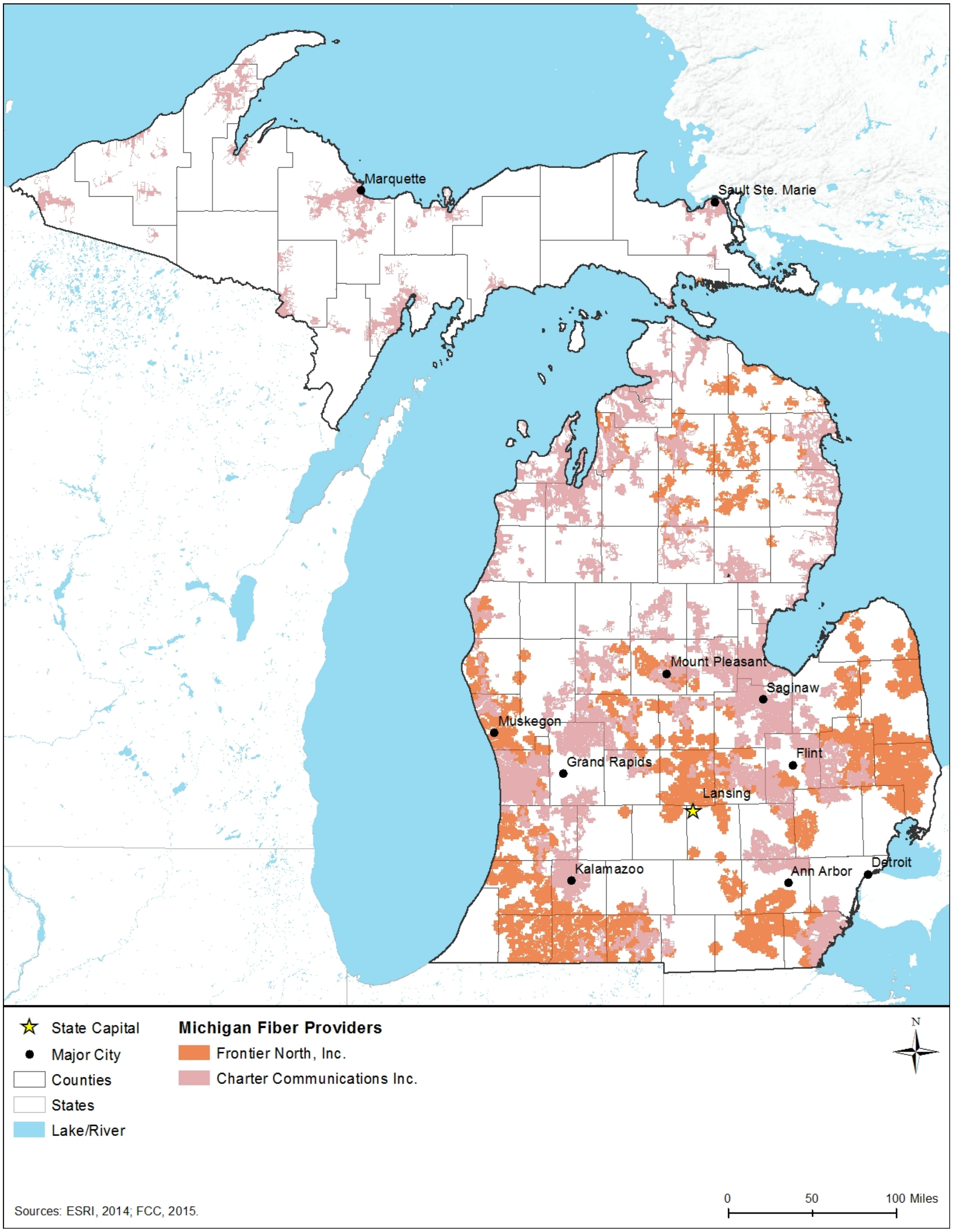

Figure 8.1.1-14: Frontier North Inc. and Charter Communications Inc.'s Fiber Availability in Michigan

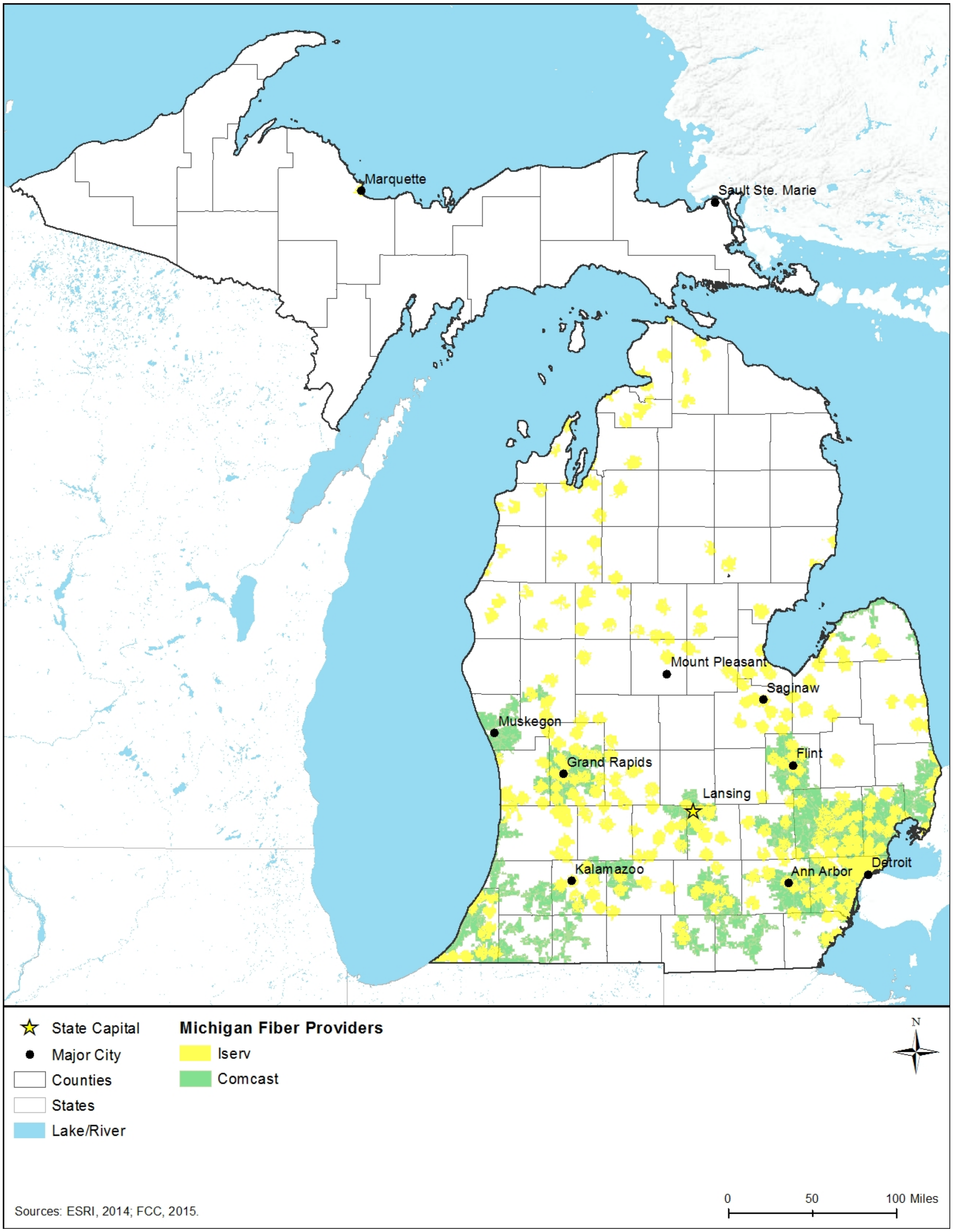

Figure 8.1.1-15: Iserv and Comcast's Fiber Availability in Michigan

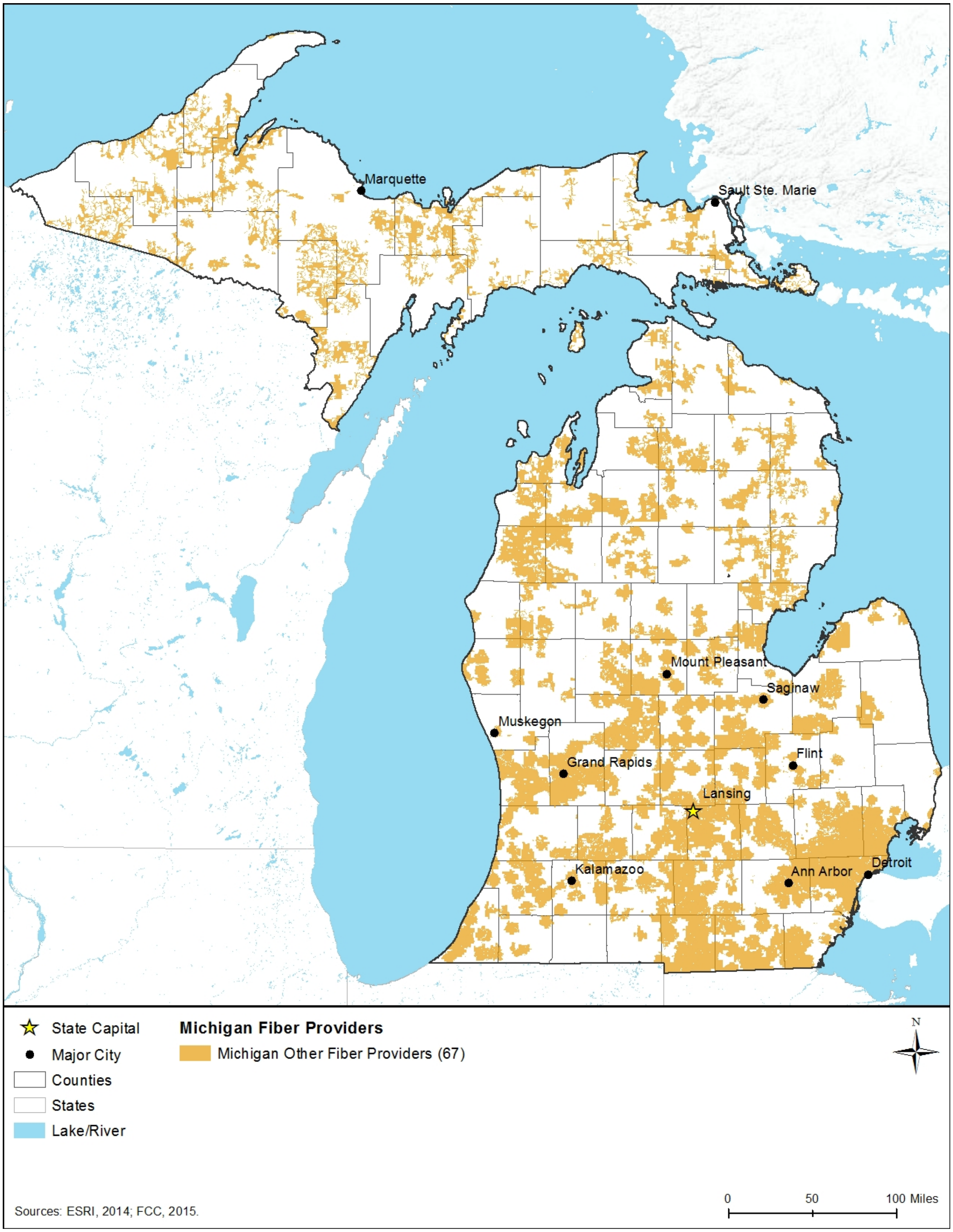

Figure 8.1.1-16: Other Provider's Fiber Availability in Michigan

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.

8.1.1.6. 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 8.1.4, Water Resources, describes the potable water sources in the state.

Electricity

Many utilities in the state of Michigan have aspects of their service regulated by the Michigan Public Service Commission (MPSC) including ensuring that utilities charge reasonable rates for their services and the quality of the service provided by these utilities (MPSC, 2015a). In the case of electric utilities, the MPSC regulates both investor owned utilities and electric cooperatives, but does not regulate municipal electric providers. A total of 20 utilities fall under the MPSC's jurisdiction: 9 investor owned companies and 11 collectives (MPSC, 2015b). The majority of the electricity produced in Michigan comes from generation facilities using either coal, nuclear power, or natural gas as a fuel source (EIA 2015a). In 2014, the state produced 106,816,991 megawatthours[11] of electricity; 52,899,844 megawatt-hours (50 percent) came from coal fueled facilities, and 12,522,837 megawatt-hours (11 percent) from natural gas powered plants. Much of the coal used in these facilities is brought into the state from Wyoming or Montana (EIA, 2015b). The state's 3 nuclear power plants have a total of 4 reactor units and produced 31,246,848 megawatt-hours (29.5 percent) in 2014 (EIA 2015a) (EIA, 2015b). Additional significant sources of power included wind power, biomass, and conventional hydroelectric facilities (EIA 2015a). The electricity use is shared largely between the residential sectors (27.2 percent), industrial sector (25.9 percent) and transportation sector (25.8 percent), with the commercial sector using the smallest portion of the state's electricity (21.1 percent) (EIA, 2015b).

Water

The quality of Michigan's drinking water is regulated by both the Federal Safe Drinking Water Act (SDWA) and the Michigan SDWA. Both of these programs use the state Department of

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

Environmental Quality (DEQ) as the primary enforcement body. The regulations set forth by this legislation regulate public drinking water supplies, a grouping that includes both community water systems and non-community water systems (MDEQ, 2015a). Water Supplies are broken into four groups: community, non-transient non-community, transient non-community, and "Type III Public Water Supply." Community water supplies include those that service the same year round residents, such as apartments or nursing homes. Non-transient non-community supplies serve the same people over at least six months a year, while transient non-community supplies serve an ever changing group of people at least sixty days a year. Non-transient non-community water supplies include schools, hospitals, or places of employment while transient non-community water supplies would include restaurants or campgrounds. "Type III Public Water Supply" includes water supplies that do not fit the above description and serve less than 25 people or operate less than sixty days a year (MDEQ, 2015b). In total, Michigan is home to about 1,500 community water supplies and 10,000 non community supplies, including both transient and non-transient suppliers. Additionally, there approximately 1.12 million residences served by private wells (MDEQ, 2015a).

All community water supplies are required to produce an annual report to give customers information on their drinking water. These Consumer Confidence Reports (CCR) include information to report on "the quality of the drinking water and the sources of that water, and to characterize the risks (if any) from exposure to contaminants detected in the water" (MDEQ, 2015c). The state also operates a Source Water Assessment Program through the Department of Environmental Quality that identifies the source of the water, assesses how susceptible it may be to contamination (and what the possible contaminants are) and informs the public of their findings. These assessments have been completed for all community and non-community public water supplies (DEQ, 2015).

Wastewater

Michigan's wastewater is managed largely through two means: The National Pollutant Discharge Elimination System (NPDES) and the certification of operators. The NPDES uses permits to authorize the discharge of wastewater and the certification of wastewater facility operators (MDEQ, 2015e). The NPDES is a program mandated by the Federal Water Pollution Control Act, though authority to operate it was given to the MDEQ by the USEPA in 1973. NPDES permits allow discharge into public waters, which must be protected. Using public resources for waste disposal requires a permit, which also limits the amount of discharged pollutants (MDEQ, 2015f). Waste or wastewater discharge activities into surface waters, and the proposal of these activities, require a permit (MDEQ, 2015g). Michigan's NPDES permits are broken into three categories: individual, general, and permit-by-rule. Individual permits are used to allow specific discharges at specific sites. "The limitations and requirements in an individual permit are based on the permittee's discharge type, the amount of discharge, facility operations (if applicable), and receiving stream characteristics" (MDEQ, 2015h). General permits cover numerous operations that have similar attributes, such as size or type of discharge. These are used to protect most surface waters in the state, as they have similar needs. "Permit-by-rule" denotes that permit requirements are stated in a formally promulgated administrative rule. A facility requiring coverage under a "permit-by-rule" must abide by the provisions written in the rule—instead of applying for an NPDES permit, the facility submits a form called a Notice of Coverage (NOC) (MDEQ, 2015h).

MDEQ also requires that the operators of wastewater facilities by certified by the state. Specific certifications are available for the operators of municipal wastewater facilities, industrial wastewater facilities, and stormwater operations. Certification exams are now offered twice a year. MDEQ also offers training courses and materials useful for those seeking to become wastewater treatment facility operators (MDEQ, 2015i).

Solid Waste

Michigan's solid waste is also managed by the MDEQ, through the use of several programs, including composting, scrap tire, landfill, and electronic waste takeback programs (MDEQ, 2015j). During the fiscal year 2014, the state generated 36,394,323 cubic yards of waste and imported an additional 10,649,135 cubic yards of waste material. "A simple conversion of 3 cubic yards equals 1 ton of waste" was used in the Report of Solid Waste Landfilled in Michigan to help with comparisons to other state's waste (MDEQ, 2015k). The largest source of this imported waste is Canada, which contributed 7,677,835 cubic yards in FY14. Ohio, Wisconsin, West Virginia, Maryland, Indiana, Illinois, and Florida also dispose of waste in Michigan. In total the state disposed of 47,043,458 cubic yards of waste material in its 70 landfills; 30,824,475 cubic yards was municipal waste, 10,740,145 cubic yards came from industrial sources, and 5,478,838 cubic yards were produced from construction and demolition (MDEQ, 2015k). As of the end of FY14, 19,013,960 cubic yards of capacity was used to dispose of waste material, leaving 495,809,471 cubic yards of capacity remaining in the state's landfills. The Report of Solid Waste Landfilled in Michigan estimates that there are 26 years of disposal capacity left (MDEQ, 2015k).

Michigan strives to increase its recycling rates across the state. Currently, it has one of the lowest residential recycling rates in the country at 14.5 percent. Overall, recycling of bottles and cans is high, about 90 percent. However, bottles and cans only comprise 2 percent of the state's waste. MDEQ estimates that they landfill about $435 million worth of reusable materials each year; efforts exist to increase access to recycling programs. Michigan's governor appointed a council to advice MDEQ in matters of recycling with the result of the MDEQ now seeking to increase their residential recycling rate to 30 percent by 2016 (MDEQ, 2015l).

8.1.2. Soils

8.1.2.1. 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.

8.1.2.2. Specific Regulatory Considerations

The Proposed Action must meet the requirements of the National Environmental Policy Act (NEPA) and other applicable laws and regulations. Applicable federal laws and regulations that apply for Soils, such as the Farmland Protection Policy Act of 1981, are in Section 1.8, Overview of the Relevant Federal Laws and Executive Orders. A list of applicable state laws and regulations is included in Table 8.1.2-1.

Table 8.1.2-1: Relevant Michigan Soil Statutes and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Natural Resources and Environmental Protection Act (Excerpt) Act 451 of 1994, Part 91 Soil Erosion and Sedimentation Control (SESC)[a]	Local Agencies (Trained by MDEQ)	An SESC permit is required generally when a project involves a human-made change in the natural cover or topography of land within 500 feet of a lake or stream, or if a project will disturb an area larger than one acre in size. Check local SESC permitting agencies[b] for additional guidance.

[a] (State of Michigan, 2015c)

[b] (MDEQ, 2015m)

8.1.2.3. Environmental Setting

Michigan is composed of three Land Resource Region (LRR),[12] as defined by the NRCS (NRCS, 2006):

- Central Feed Grains and Livestock Region;

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

- Lake State Fruit, Truck Crop, and Dairy Region; and
- Northern Lake States Forest and Forage Region.

Within and among Michigan's three LRRs are 14 Major Land Resource Areas (MLRA),[13] which are characterized by patterns of soils, climate, water resources, land uses, and type of farming. The locations and characteristics of Michigan's MLRAs are presented in Table 8.1.2-1 and Table 8.1.2-2.

[13] 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)

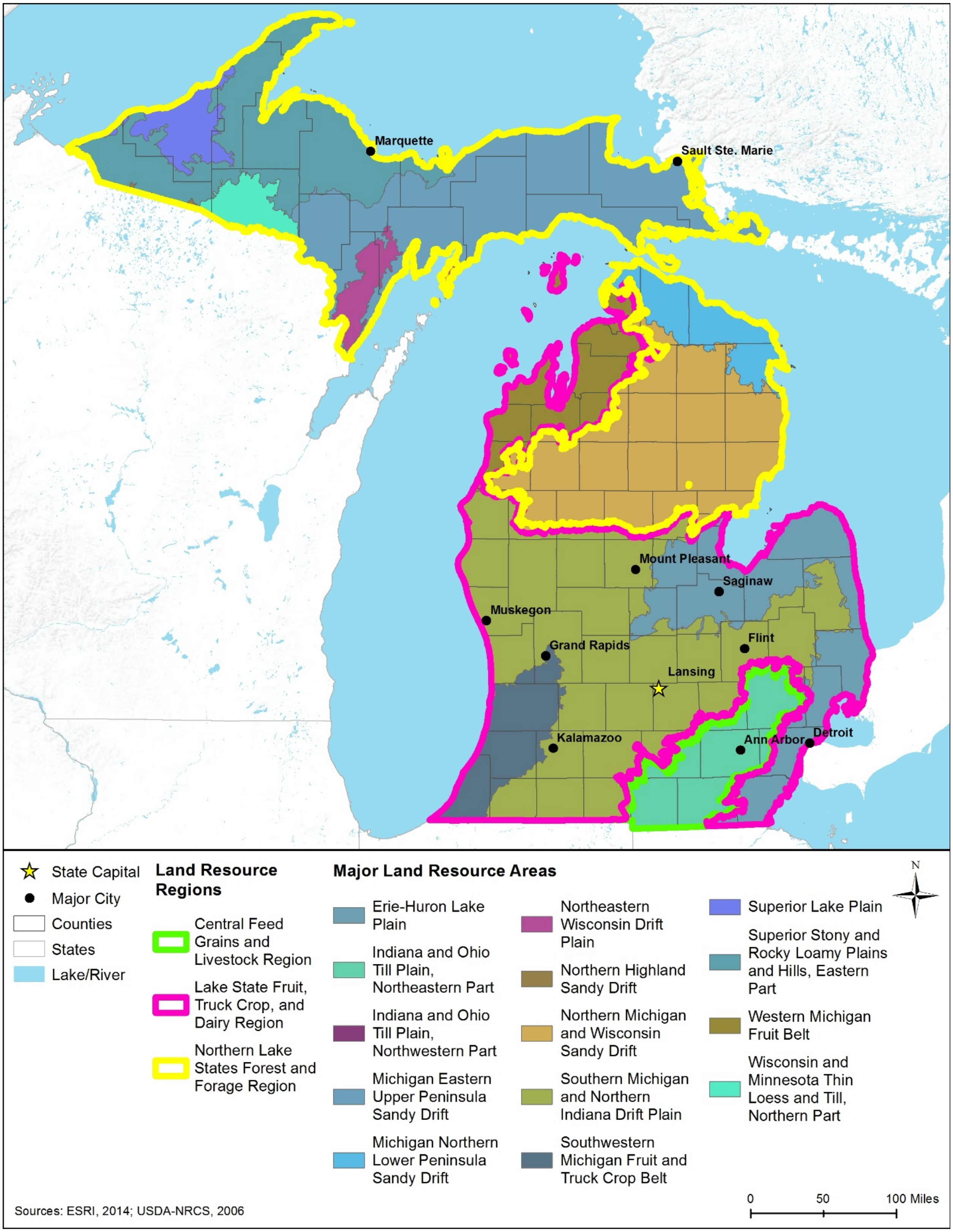

Figure 8.1.2-1: Locations of Major Land Resource Areas in Michigan

Table 8.1.2-2: Characteristics of Major Land Resource Areas in Michigan

MLRA Name	Region of State	Soil Characteristics
Erie-Huron Lake Plain	Eastern Michigan	Alfisols,[a] Inceptisols,[b] Mollisols,[c] and Spodosols[d] are the dominant soil orders. These clayey or loamy[e] soils are typically poorly drained to somewhat poorly drained, and are very deep.
Indiana and Ohio Till Plain, Northeastern Part	Southeastern Michigan	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	Southwestern Michigan	Alfisols, Entisols,[f] Histosols,[g] Inceptisols, and Mollisols are the dominant soil orders. These typically deep and clayey or loamy soils range from very poorly drained to well drained.
Michigan Eastern Upper Peninsula Sandy Drift	Northwestern Michigan	Alfisols, Entisols, Histosols, and Spodosols are the dominant soil orders. These clayey to sandy soils range from very poorly drained to excessively drained. They range from shallow to very deep.
Michigan Northern Lower Peninsula Sandy Drift	Northeastern Michigan	Alfisols, Entisols, Histosols, and Spodosols are the dominant soil orders. These very deep and sandy soils range from poorly drained to excessively drained.
Northeastern Wisconsin Drift Plain	Northwestern Michigan	Alfisols, Histosols, and Spodosols are the dominant soil orders. These clayey to sandy soils range from very poorly drained to excessively drained, and are very deep.
Northern Highland Sandy Drift	Northwestern Michigan	Histosols and Spodosols are the dominant soil orders. These mucky, sandy, or loamy soils range from very poorly drained to excessively drained, and are very deep.
Northern Michigan and Wisconsin Sandy Drift	Central Michigan	Alfisols, Entisols, Histosols, and Spodosols are the dominant soil orders. These sandy and very deep soils range from poorly drained to excessively drained.
Southern Michigan and Northern Indiana Drift Plain	Southern Michigan	Alfisols, Histosols, and Mollisols are the dominant soil orders. These loamy or sandy soils range from very poorly drained to well drained and are very deep.
Southwestern Michigan Fruit and Truck Crop Belt	Southwestern Michigan	Alfisols, Entisols, Histosols, and Spodosols are the dominant soil orders. These soils typically range from very poorly drained to excessively drained. They are loamy or sandy, and are very deep.
Superior Lake Plain	Northwestern Michigan	Alfisols, Entisols, Inceptisols, and Spodosols are the dominant soil orders. These clayey, sandy, silty, or loamy soils are very deep.
Superior Stony and Rocky Loamy Plains and Hills, Eastern Part	Northwestern Michigan	Histosols and Spodosols are the dominant soil orders. These soils range from very poorly drained to excessively drained, and range from shallow to very deep. They are clayey to sandy.
Western Michigan Fruit Belt	Northern Michigan	Alfisols, Entisols, Histosols, and Spodosols are the dominant soil orders. These loamy and sandy soils are very deep, and range from very poorly drained to excessively drained.
Wisconsin and Minnesota Thin Loess and Till, Northern Part	Northwestern Michigan	Alfisols, Entisols, Histosols, and Spodosols are the dominant soil orders. These soils are silty, sandy, or loamy.

Source: (NRCS, 2006)

[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% of the world's ice-free land surface." (NRCS, 2015d)
[b] Inceptisols: "Soils found in semiarid to humid environments that exhibit only moderate degrees of soil weathering and development. They have a wide range of characteristics, can occur in a wide variety of climates, and make up nearly 17% of the world's ice-free land surface." (NRCS, 2015d)
[c] 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)

[d] Spodosols: "Spodosols formed from weathering processes that strip organic matter combined with aluminum from the surface layer and deposit them in the subsoil. They commonly occur in areas of course-textured deposits under coniferous forests of humid regions, tend to be acid and infertile, and make up about 4% of the world's ice-free land surface." (NRCS, 2015d)
[e] Loamy Soil: "[A soil] that combines [sand, silt, and clay] in relatively equal amounts." (Purdue University Consumer Horticulture, 2006)
[f] Entisols: "Soils that show little to no pedogenic horizon development. They occur in areas of recently deposited parent materials or in dunes, steep slopes, or flood plains where erosion or deposition rates are faster than rate of soil development. They make up nearly 16% of the world's ice-free land surface." (NRCS, 2015d)
[g] 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% of the world's ice-free land surface." (NRCS, 2015d)

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[14] such as bacteria, fungi, biological crusts, vegetation, animals, and climatic variables such as precipitation and temperature. For example, expansive soils[15] 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[16] (discussed further in the subsections below).

8.1.2.4. Soil Suborders

Soil suborders are part of the soil taxonomy[17]. Soil orders are the highest level in the taxonomy[18]; there are 12 soil orders in the world and they are characterized by both observed and inferred[19] 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[20] soil database identifies 13 different soil suborders in Michigan (NRCS, 2015a). Figure 8.1.2-2 depicts the distribution of the soil suborders, and Table 8.1.2-3 provides a summary of the major physical-chemical characteristics of the various soil suborders found.

[14] The flora and fauna of a region.
[15] 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).
[16] Rutting is indentations in soil from operating equipment in moist conditions or soils with lower bearing strength (USFS, 2009b).
[17] Taxonomy: "A formal representation of relationships between items in a hierarchical structure" (USEPA, 2015r).
[18] Science of naming and classifying organisms or specimens.
[19] "Soil properties inferred from the combined data of soil science and other disciplines (e.g., soil temperature and moisture regimes inferred from soil science and meteorology)" (NRCS, 2015e).
[20] 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.

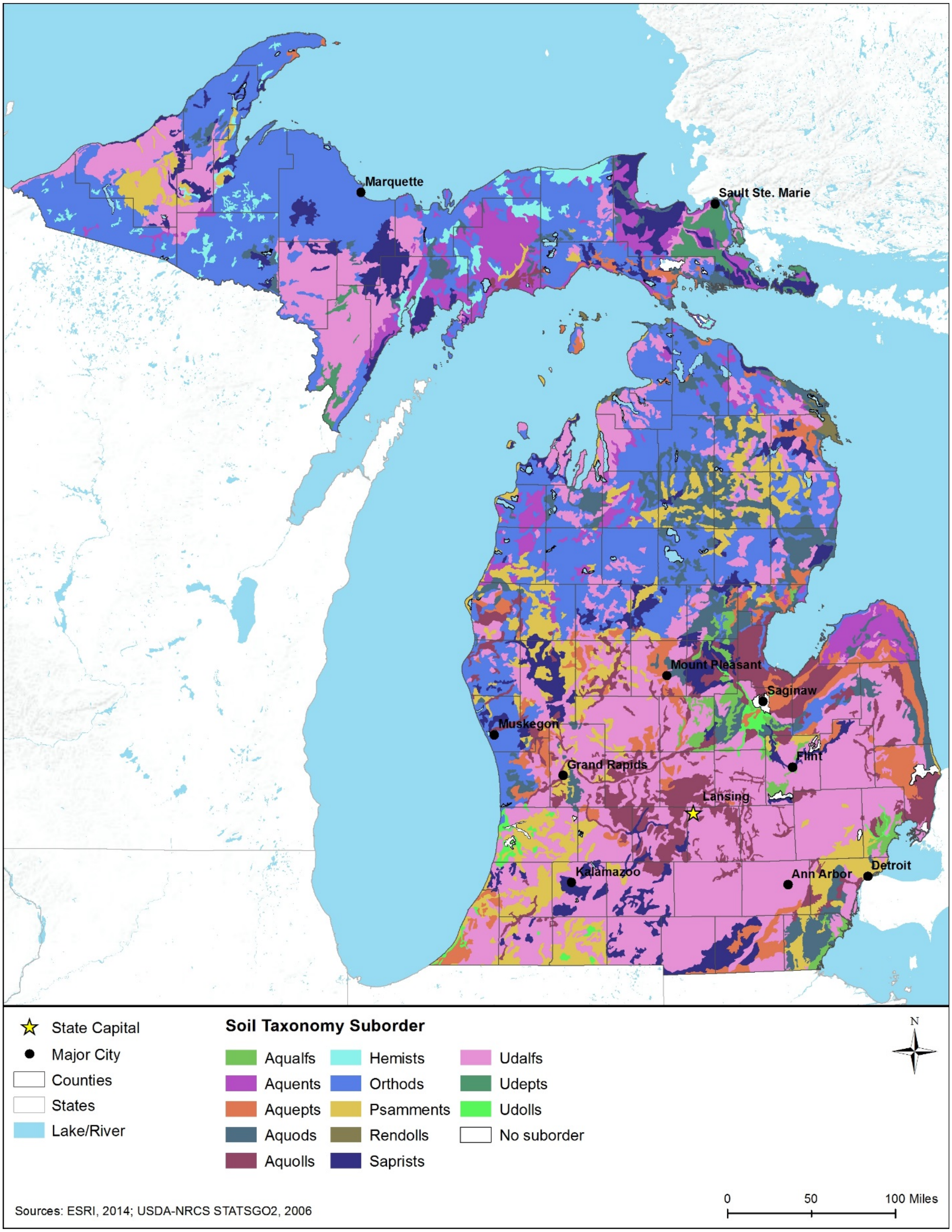

Figure 8.1.2-2: Michigan Soil Taxonomy Suborders

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Table 8.1.2-3: Major Characteristics of Soil Suborders[21] Found in Michigan, as depicted in Figure 8.1.2-2

Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (%)	Drainage Class	Hydric Soil[a]	Hydrologic Group	Runoff Potential	Permeability[b]	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	0-6	Somewhat poorly drained	No	C	Medium	Low	Medium	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.	Fine sandy loam, Gravelly sand, Loamy sand, Mucky sand, Sand, Variable	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
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.	Clay loam, Fine sandy loam, Loam, Sandy loam, Silt loam	0-3	Very poorly drained to somewhat poorly drained	No, Yes	B, C, D	Medium, High	Moderate, Low, Very Low	Medium to High, depending on slope	High, due to hydric soil and poor drainage conditions	Erosion and Compaction
Spodosols	Aquods	Aquods are characterized by a shallow fluctuating water table, with water-loving vegetation, ranging from moss, shrubs, and trees in cold areas to mixed forests and palms in the warmest areas. Although some Aquods have been cleared and are used as cropland or pasture, most are used as forest or wildlife habitat, as they are naturally infertile (but they can be highly responsive to good management).	Loam, Loamy coarse sand, Loamy fine sand, Loamy sand, Sand, Sandy loam, Very fine sandy loam	0-6	Somewhat poorly drained	No	B, C	Medium	Moderate, Low	Medium	Low	Erosion
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, Silt loam, Silty clay loam, Stratified gravelly sandy loam to silty clay loam, Unweathered bedrock	0-2	Very poorly drained to poorly drained	Yes	A, B, C, D	Low, Medium, High	High, Moderate, Low, Very Low	Low to High, depending on slope	High, due to hydric soil and poor drainage conditions	Erosion and Compaction
Histosols	Hemists	Hemists are usually found in broad, flat areas, such as coastal plains and outwash plains as well as closed depressions. They are typically under natural vegetation and uses for rangeland, woodlands, and/or wildlife habitat, although some large areas have been cleared and drained, and utilized for cropland.	Mucky peat, Peat	0-2	Very 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

[21] 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.

Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (%)	Drainage Class	Hydric Soil[a]	Hydrologic Group	Runoff Potential	Permeability[b]	Erosion Potential	Compaction and Rutting Potential	Limitation for Construction
Spodosols	Orthods	Orthods have a moderate accumulation of organic carbon, and are relatively freely drained. Most of these soils are either used as forest or have been cleared and are used as cropland or pasture. Although they are naturally infertile, they can be highly responsive to good management.	Clay loam, Cobbly sandy clay loam, Cobbly silt loam, Fine sand, Fine sandy loam, Gravelly sand, Loamy fine sand, Loamy sand, Loamy very fine sand, Sand, Sandy loam, Silt loam, Stratified cobbly coarse sand to sand, Stratified fine sand to silt loam, Stratified sand to sandy clay loam, Unweathered bedrock, Very fine sandy loam	0-70	Somewhat poorly drained to excessively drained	No	A, B, C	Low, Medium	High, Moderate, Low	Low to Medium, depending on slope	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.	Fine sand, Loamy sand, Loamy very fine 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
Mollisols	Rendolls	Rendolls are found in more humid areas. They are formed under grass and shrubs or forest vegetation in highly calcareous parent materials. Most of these soils are used for pasture or cropland, although some are used for forest or rangeland.	Sandy loam	2-6	Well drained	No	D	High	Very Low	High	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.	Clay, Fine sand, Marl, Muck, Mucky peat	0-2	Very 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
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, Cobbly loam, Fine sandy loam, Gravelly sandy clay, loam, Loam, Loamy fine sand, Loamy sand, Sand, Sandy loam, Silt loam, Silty clay, Silty clay loam, Stratified very gravelly coarse sand to sand, Unweathered bedrock	0-50	Somewhat poorly drained to well 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.	Fine sandy loam	0-15	Well drained	No	B, D	Medium, High	Moderate, Very Low	Medium to High, depending on slope	Low	Erosion

Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (%)	Drainage Class	Hydric Soil[a]	Hydrologic Group	Runoff Potential	Permeability[b]	Erosion Potential	Compaction and Rutting Potential	Limitation for Construction
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.	Fine sandy loam, Sandy loam	0-5	Somewhat poorly drained to well drained	No	B	Medium	Moderate	Medium	Low	Erosion

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

[a] 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.

[b] Based on Runoff Potential, described in Section 8.1.2.5.

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8.1.2.5. Runoff Potential

The NRCS uses four Hydrologic Soil Groups (A, B, C, and D) that are based on a soil's runoff potential.[22] Group A generally has the smaller runoff potential, whereas Group D generally has the greatest (Purdue University, 2015). Table 8.1.2-3 provides a summary of the runoff potential for each soil suborder in Michigan.

Group A. **Sand, loamy sand or sandy loam soils.** This group of soils has "low runoff potential and high infiltration rates[23] 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). Aquents, Aquolls, Hemists, Orthods, Psamments, Saprists, and Udalfs fall into this category in Michigan.

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. Aquents, Aquepts, Aquods, Aquolls, Hemists, Orthods, Psamments, Saprists, Udalfs, Udepts, and Udolls fall into this category in Michigan.

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

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 clay pan or clay layer at or near the surface and shallow soils over nearly impervious material" (Purdue University, 2015). Aquents, Aquepts, Aquolls, Hemists, Rendolls, Saprists, Udalfs, and Udepts fall into this category in Michigan.

8.1.2.6. 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 8.1.2-3 provides a summary of the erosion potential

[22] 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.
[23] Infiltration Rate: "The rate at which a soil under specified conditions absorbs falling rain, melting snow, or surface water expressed in depth of water per unit time" (FEMA, 2010).

for each soil suborder in Michigan. Soils with medium to high erosion potential in Michigan include those in the Aqualfs, Aquents, Aquepts, Aquods, Aquolls, Hemists, Orthods, Psamments, Rendolls, Saprists, Udalfs, Udepts, and Udolls suborders, which are found throughout the state Table 8.1.2-3.

8.1.2.7. Soil Compaction and Rutting

Soil compaction and rutting occurs when soil layers are compressed by machinery or animals, which decreases both open spaces in the soil, as well as water infiltration rates (NRCS, 1996b). Moist soils with high soil water content are most susceptible to compaction and rutting, as they lack the strength to resist deformation caused by pressure. When rutting occurs, channels form and result in downslope erosion (USFWS, 2009a). 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 8.1.2-3 provides a summary of the compaction and rutting potential for each soil suborder in Michigan. Soils with the highest potential for compaction and rutting in Michigan include those in the Aquents, Aquepts, Aquolls, Hemists, and Saprists suborders, which are found primarily in southern areas of the state (Figure 8.1.2-2).

8.1.3. Geology

8.1.3.1. Definition of the Resource

The 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 8.1.4), Human Health and Safety (Section 8.1.15), and Climate Change (Section 8.1.14).

This section covers the six aspects of geology most relevant to the proposed action and Alternatives:

- Section 8.1.3.3, Environmental Setting: Physiographic Regions and Provinces[24, 25]
- Section 8.1.3.4, Surface Geology
- Section 8.1.3.5, Bedrock Geology[26]

[24] Physiographic regions: Areas of the United States that share commonalities based on topography, geography, and geology (Fenneman, 1916).
[25] Physiographic provinces: Subsets within physiographic regions (Fenneman, 1916).
[26] Bedrock: Solid rock beneath the soil and superficial rock (USGS, 2015e).

- Section 8.1.3.6, Paleontological Resources[27]
- Section 8.1.3.7, Fossil Fuel and Mineral Resources
- Section 8.1.3.8, Geologic Hazards[28]

8.1.3.2. Specific Regulatory Considerations

The proposed action must meet the requirements of NEPA and other applicable laws and regulations. A list of applicable state laws and regulations is included in Table 8.1.3-1 below.

Table 8.1.3-1: Relevant Michigan Geology Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
2012 Michigan Building Code (Michigan Department of Licensing and Regulatory Affairs, 2015b)	Michigan Department of Licensing and Regulatory Affairs	Provides seismic guidelines for construction.
Parks and Recreation Areas – State Land Rules, General Rule 299.922hh (2001 Annual Admin Code Supplement (AACS); 2014 Michigan Register (MR2), (DNR, 2014)	Michigan Department of Natural Resources (MDNR)	It is against the law to remove any invertebrate fossil for individual or non-commercial use.

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

Michigan has two physiographic regions: Interior Plains (Central Lowland Province) and Laurentian Upland (Superior Upland Province). The locations of these regions are shown in Figure 8.1.3-1 and their general characteristics summarized in the following subsections.

[27] Paleontology: "Study of life in past geologic time based on fossil plants and animals" (USGS, 2015f).
[28] Geologic Hazards: Any geological or hydrological process that poses a threat to people and/or their property, which includes but is not limited to volcanic eruptions, earthquakes, landslides, sinkholes, mudflows, flooding, and shoreline movements (NPS, 2013).

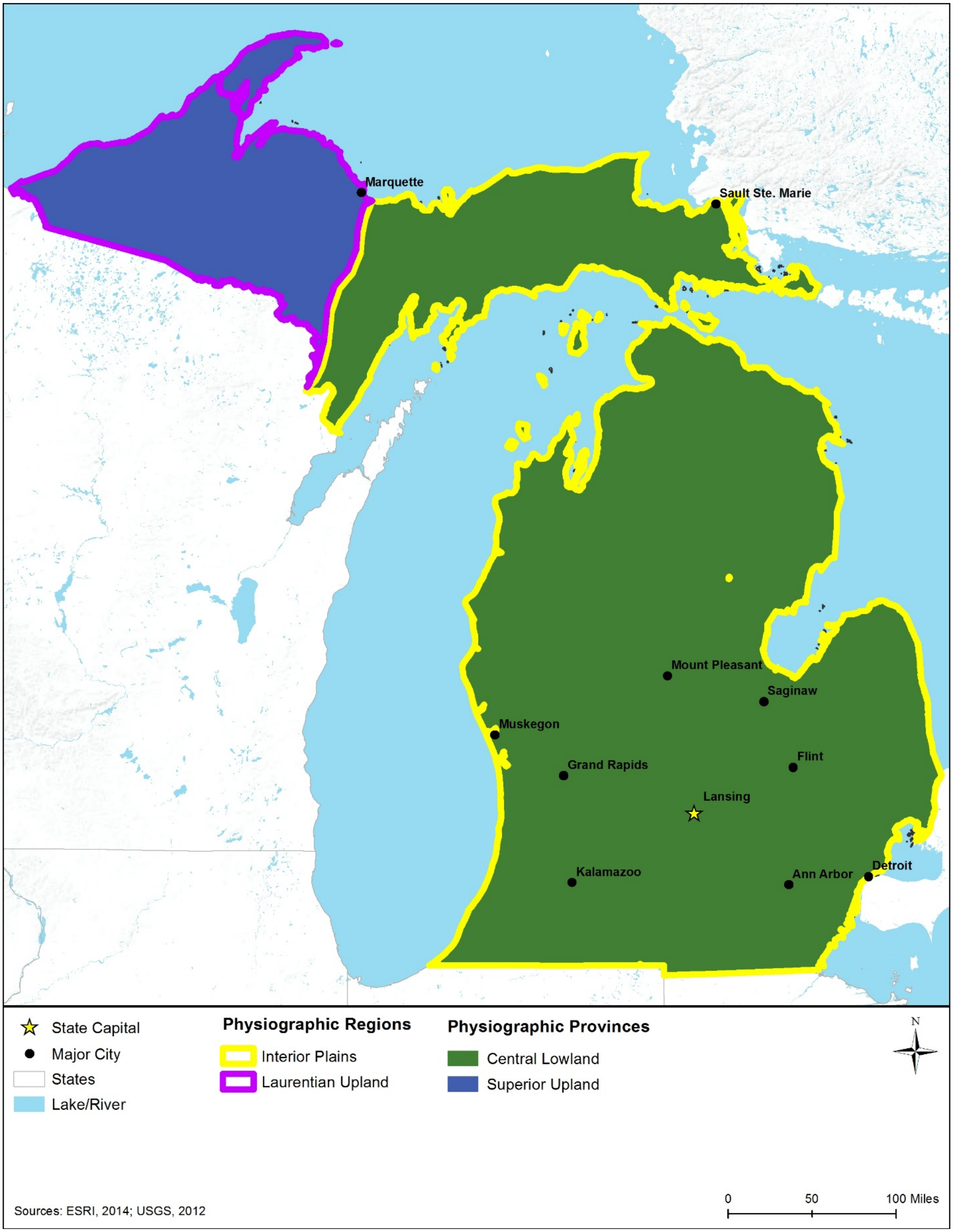

Figure 8.1.3-1: Physiographic Regions and Provinces of Michigan

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[29] and igneous[30] rocks dating to the Precambrian Era (older than 542 million years ago [MYA]) underlie the entire region.[31] 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[32] 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,[33] mudstone,[34] and clay (USGS, 2014a).

Central Lowland Province – As the largest physiographic province in the United States, the Central Lowland Province includes more than 580,000 square miles and encompasses the eastern portion of the Interior Plains Region. The Central Lowland Province is comprised of the lower peninsula of Michigan, and the eastern half of the upper peninsula of Michigan. Bedrock consists of sedimentary deposits, overlain by glacial till.[35] The topography of the Central Lowland Province is generally flat, with gently rolling hills, and is about 2,000 feet above sea level (ASL) (NPS, 2014a), (USGS, 1991).

Laurentian Upland Region

The Laurentian Upland Region extends from northwestern Michigan, through northern Wisconsin, and into northeastern Minnesota. The metamorphic rocks that comprise the basement of the Laurentian Upland are the oldest on the continent and are often referred to as the "Canadian Shield;" these rocks have been dated to 2.5 billion years old. Topographic relief is minimal throughout the region. "Hills rise just a few hundred feet above the surrounding countryside. The highest of these, such as Rib Hill, Wisconsin, are made up mostly of resistant quartzite or granite." (USGS, 2014b)

Superior Upland Province – The Superior Upland Province is comprised of the western half of the upper peninsula of Michigan. "The rocks of the Superior Upland are mostly Precambrian metamorphic rocks and overlying Paleozoic rocks (Cambrian [542 to 488 MYA])." The terrain

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[29] 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, 2015i).
[30] Igneous Rocks: "Rock formed when molten rock (magma) that has cooled and solidified (crystallized)" (USGS, 2015i).
[31] 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.
[32] 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, 2014g).
[33] Sandstone: "Sedimentary rock made mostly of sand-sized grains" (USGS, 2015i).
[34] Mudstone: "A very fine-grained sedimentary rock formed from mud" (USGS, 2015i).
[35] Till: "An unsorted and unstratified accumulation of glacial sediment, deposited directly by glacier ice. Till is a heterogeneous mixture of different sized material deposited by moving ice (lodgement till) or by the melting in-place of stagnant ice (ablation till). After deposition, some tills are reworked by water." (USGS, 2013b)

is hilly and rugged, with ridges, composed of more resistant rock, and valleys, composed of relatively weaker rock, trend in a northeast-southwest direction throughout the province. The majority of the Superior Upland Province is covered in glacial till that dates to the Pleistocene glaciation roughly 10,000 years ago. However, Michigan's Isle Royale and Keweenaw Peninsula are areas where ancient lava flows, some of which are more than 1,200 feet thick, are exposed at the surface. These lava flows resulted from rifting of the North American continent, which produced eruptions of more than 400 lava flows (NPS, 2014b) (USGS, 1991).

8.1.3.4. Surface Geology

Surficial geology is characterized by materials such as till,[36] 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,[37] subsidence,[38] and erosion (Thompson, 2015).

Glacial deposits, including unconsolidated stratified sand, gravel, and clay, cover most of Michigan. Nearly all of Michigan's topographic and geographic features, particularly in the Lower Peninsula, were formed from glaciation. During the Pleistocene Epoch (2.6 MYA to 11,700 years ago), glaciers repeatedly advanced and retreated over Michigan. This activity pulverized rocks as glaciers moved across the land, and sediments were deposited as the glaciers melted. Four major glacial periods occurred during the Pleistocene Epoch, but only deposits from the most recent glaciation, the Wisconsinan (85,000 to 11,700 years ago), remain as surface deposits in Michigan. (MDEQ, 2003) (MDEQ, 2015s)

Figure 8.1.3-2 depicts the main surficial composition of Michigan.

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

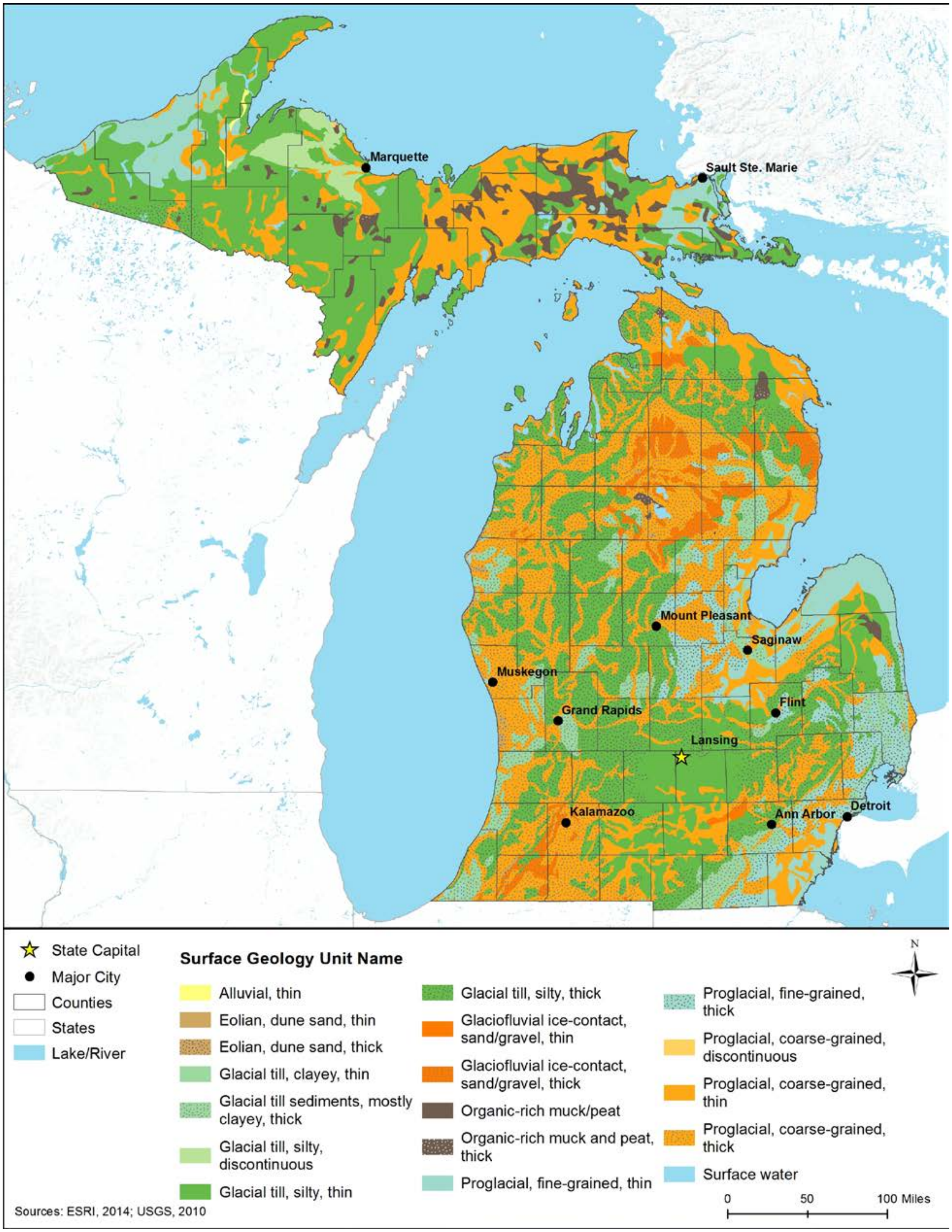

Figure 8.1.3-2: Generalized Surface Geology for Michigan

8.1.3.5. Bedrock Geology

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

Bedrock in Michigan varies across the western Upper Peninsula, eastern Upper Peninsula, and Lower Peninsula. Precambrian (older than 542 MYA) rocks compose the bedrock of the western Upper Peninsula. This area includes the southern end of the Canadian Shield, a geologic unit that also covers northern Minnesota, Wisconsin, and part of central Canada. Paleozoic (542 to 251 MYA) and Mesozoic (251 to 66 MYA) sedimentary rock is found throughout the rest of the state. These sedimentary layers are about 14,000 feet thick, and form the Michigan Basin, a large regional bedrock structure. Outcrops of bedrock are rare in the Lower Peninsula, due to the deposition of glacial materials (MDEQ, 2003) (MDEQ, 2015s).

Figure 8.1.3-3 shows the general bedrock geology for Michigan.

[39] Dip: "A measure of the angle between the flat horizon and the slope of a sedimentary layer, fault plane, metamorphic foliation, or other geologic structure" (NPS, 2000).

[40] Tectonism: "Structure forces affecting the deformation, uplift, and movement of the earth's crust" (USGS, 2016a).

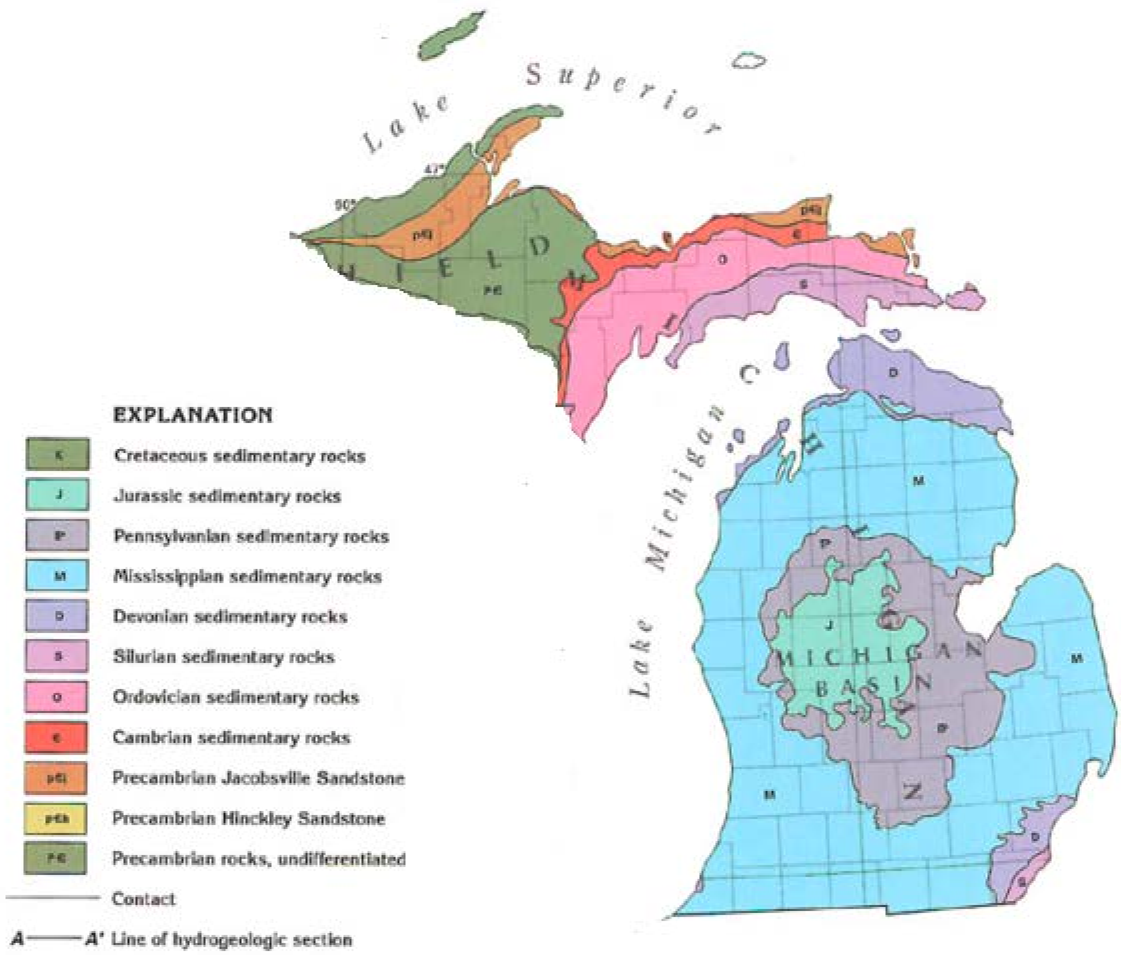

Figure 8.1.3-3: Generalized Bedrock Geology for Michigan

Source: (USGS, 1992)

8.1.3.6. Paleontological Resources

Michigan State Fossil
Mastodon

Source: (The Paleontology Portal, 2015)

Michigan's Precambrian (older than 542 MYA) metamorphic rocks have been found to contain fossils of *Grypania spiralis*, one of the oldest eukaryotes.[41] During the Cambrian (542 to 488 MYA) and Ordovician (488 to 444 MYA) Periods, tropical water covered the state. Organisms preserved from these timeframes include trilobites,[42]

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[41] Eukaryote: "Cells of the higher organisms, containing a true nucleus bounded by a nuclear membrane" (USGS, 2015i).

[42] Trilobite: "Any member of Trilobita, an extinct class of marine arthropods. Trilobites are known from the Cambrian to the Permian. They had segmented, oval-shaped bodies and were the first animals to have complex eyes (similar to the compound eyes in modern insects)." (Smithsonian Institution, 2016)

brachiopods,[43] crinoids,[44] and corals. Corals, bryozoans,[45] crinoids, trilobites, brachiopods, clams, snails, and cephalopods[46] were recorded Silurian (444 to 416 MYA) fossils. The seas that covered Michigan throughout the early Paleozoic Era began to retreat in the Carboniferous Period (359 to 299 MYA). Crinoid, blastoid, clam, and coral fossils have been recorded. The late Carboniferous had nearshore coal-forming swamps, and plants dominated the fossil record. Fossilized plant spores have been discovered from the Jurassic Period (200 to 151 MYA), indicating a hot dry climate in Michigan. Cenozoic (66 MYA to present) fossils in Michigan include pine and spruce remains, freshwater clams, snails, fish, amphibians, birds, mammoths, mastodons, musk oxen, and giant beavers (The Paleontology Portal, 2015). The mastodon, present in the Quaternary Period (2.6 MYA to present), is Michigan's state fossil; it was similar to a wooly mammoth in size and appearance (Michigan Legislature, 2002).

8.1.3.7. Fossil Fuel and Mineral Resources

Oil and Gas

In 2014, Michigan produced nearly 7.3M barrels of oil. This level of production accounted for less than one percent of total nationwide production. In August 2015, Michigan was ranked 19th nationwide in crude oil production (EIA, 2015c).

In 2014, Michigan produced 114,946 million cubic feet of natural gas from 10,500 natural gas wells. This level of production accounted for 0.4 percent of total nationwide production and ranked 18th among gas producing states. The Lower Peninsula's Antrim Field is among the top 100 natural gas producing fields in the country (EIA, 2015c).

Minerals

In 2015, Michigan's total nonfuel mineral production (including iron ore, portland cement, sand and gravel, stone, and salt) value was $2.19B. This level of production ranked 11th nationwide (in terms of dollar value) and accounted for 2.95 percent of total nationwide production. As of 2011, Michigan was the nation's leading producer of magnesium compounds and second leading producer of iron ore. Other minerals produced in the state are common clay and shale,

[43] Brachiopod: "Any member of a phylum of marine invertebrate animals called Brachiopoda. Brachiopods are sessile, bivalved 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)

[44] 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." Echinoderm: "Common name for members of the phylum Echinodermata. These organisms are characterized by bodies showing radial symmetry (usually in fives) and the presence of tube feet in most forms." (Smithsonian Institution, 2016)

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

[46] Cephalopod: "Any mollusk of the class Cephalopoda, which includes squids, octopus, and ammonites. They are characterized by the tentacles attached to their heads." (Smithsonian Institution, 2016)

dimension stone,[47] gypsum, peat, perlite, potash, sulfur, copper, ferroalloys, industrial sand, lime, steel, and titanium metal (USGS, 2015c).

8.1.3.8. Geologic Hazards

The three major geologic hazards of concern in Michigan are earthquakes, landslides, and subsidence. Volcanoes were considered but not analyzed further for Michigan because they do not occur in Michigan and therefore do not present a hazard to the state (USGS, 2015g). A discussion of each geologic hazard is included below.

Earthquakes

While Michigan is at low risk of experiencing a significant earthquake event, the southern portion of the state is more susceptible to earthquakes than the remainder of the state. Between 1973 and March 2012, there were two earthquakes of a magnitude 2.5 (on the Richter scale[48]) or greater in Michigan (USGS, 2014c). 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 earthquakes, the most common in Michigan, 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[49] collide. "When tectonic plates collide, one plate slides 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, 2014f). 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). Michigan is located far from any convergence boundaries.

Figure 8.1.3-4 depicts the seismic risk throughout Michigan; 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

Spotlight: Michigan's Largest Earthquake

The largest earthquake ever recorded in Michigan was a magnitude 4.6 quake that occurred in 1947 southeast of the city of Kalamazoo. The earthquake's impacts covered the area Indiana, Illinois, Ohio, Wisconsin, and Ontario, Canada. (USGS, 2012c).

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[47] 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).

[48] 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, 2014d)

[49] Tectonic Plate: "A massive, irregularly shaped slab of solid rock, generally composed of both continental and oceanic rock material" (USGS, 1999b).

chance of being exceeded in a 50-year period. Units on the map are measured in terms of acceleration due to gravity (% g). Most pre-1965 buildings are likely to experience damage with exceedances of 10 % g (USGS, 2010). Post-1985 buildings (in California) have experienced only minor damage with shaking of 60 % g (USGS, 2010).

"No severely destructive earthquake has ever been documented in Michigan… according to the USGS, although Michigan is in an area in which there is a low probability of earthquake occurrences, the area may be affected by distant earthquakes that occur in the New Madrid Seismic Zone and upstate New York." It is estimated that southern Michigan will experience one magnitude 3.0 to 4.0 earthquake roughly once every 50 years (Michigan Emergency Management and Homeland Security Division, 2014).

Landslides

While Figure 8.1.3-5 indicates that most of Michigan is at low risk to experiencing landslide events, portions of the state, particularly along the Great Lakes are at moderate to high risk of landslides (Radbruch-Hall, et al., 1982). "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, 2003). 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, 2003).

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, 2003).

According to the USGS, the highest potential for landslides in Michigan is found in areas "where Cambrian sandstone or Ordovician and Silurian limestone form cliffs along the shores of [Lake Michigan and Lake Superior]." Glacial deposits adjacent to both lakes also have demonstrated susceptibility to landslide events. "The Grand Marais sand dunes area along the south shore of Lake Superior and along the east and south sides of Lake Michigan are moderately susceptible to sand flows" (Radbruch-Hall, et al., 1982). Portions of the Grand Sable Dunes (near Grand Marais, MI), within the Michigan National Lakeshore, closed in July 2014 due to erosion and risk of total collapse.

Figure 8.1.3-5 shows landslide incidence and susceptibility throughout Michigan.

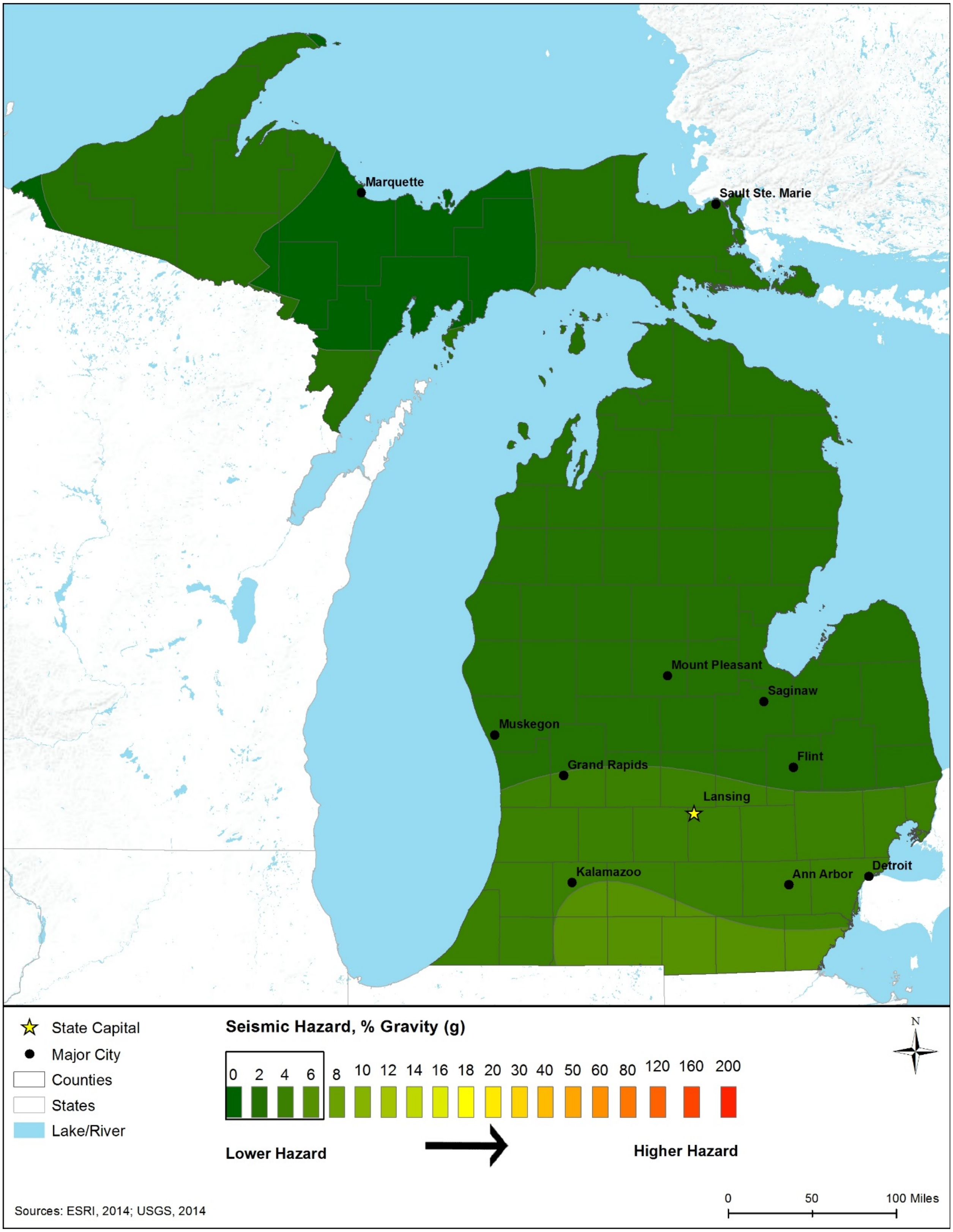

Figure 8.1.3-4: Michigan 2014 Seismic Hazard Map

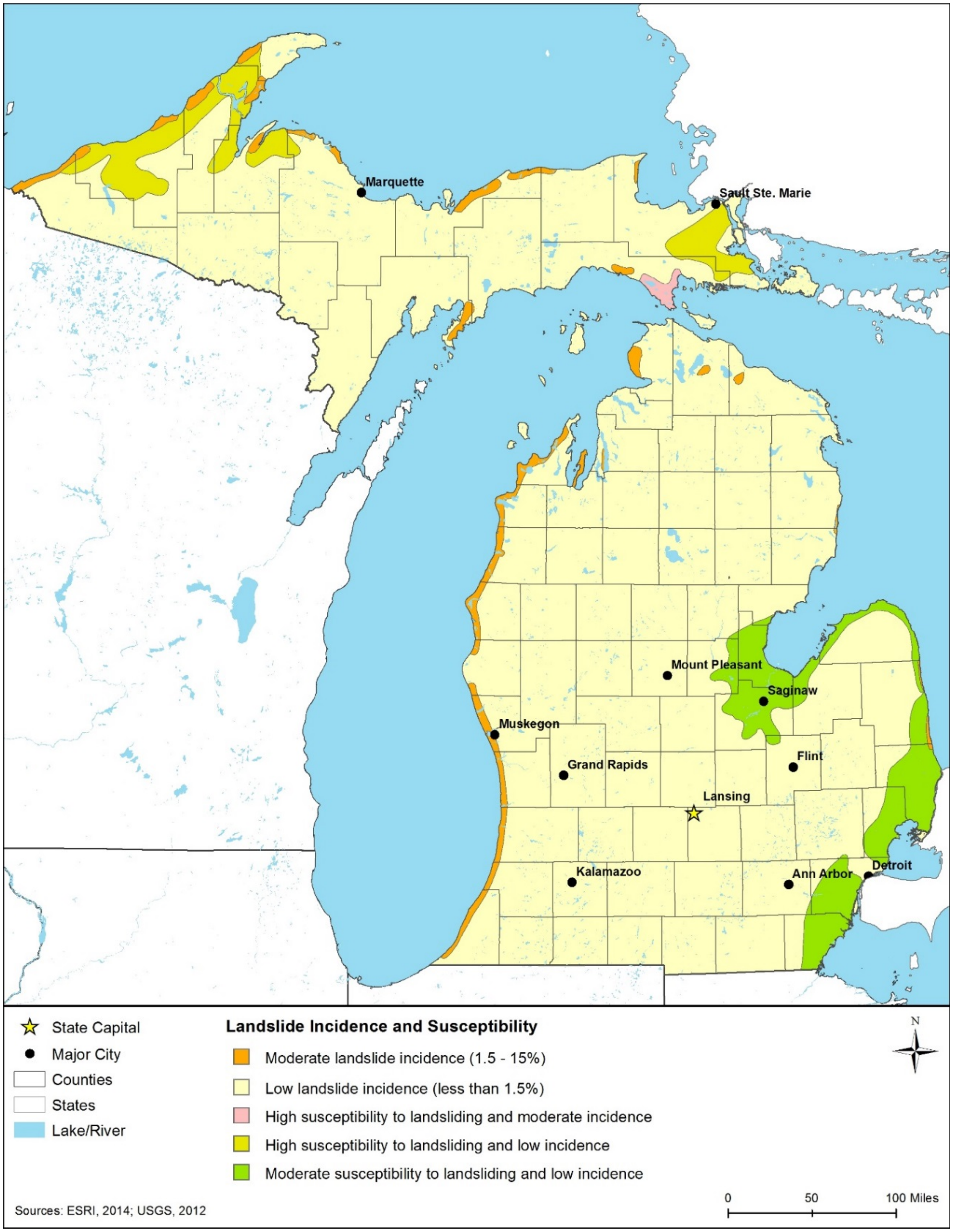

Figure 8.1.3-5: Michigan Landslide Incidence and Susceptibility Hazard Map[50]

[50] Susceptibility hazards not indicated in Figure 8.1.3-5 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). "Michigan's geology and history tends to make it more prone to land subsidence instead [of landslides]" (Michigan Emergency Management and Homeland Security Division, 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, 2013a).

In Michigan, a significant cause of land subsidence is collapse of underground mines or improper stabilization of mine openings. Michigan contains mines for salt, coal, gypsum, and copper. During the 1980s, over mining of pillars within copper mines in Ontonagon, Houghton, and Keweenaw Counties (in the far northwestern portion of the state) resulted in mine-induced subsidence. Groundwater dissolution of shallow areas where gypsum has been mined has contributed to land subsidence in Iosco County in the east-central portion of the state along Lake Huron. (Michigan Emergency Management and Homeland Security Division, 2014)

Another cause of land subsidence in Michigan is the collapse of karst,[51] which can result in the formation of underground cavities or sinkholes. Areas of Michigan that are particularly susceptible to subsidence due to the dissolution of gypsum[52] include Kent, Barry, Eaton, Calhoun, and Jackson Counties (Michigan Emergency Management and Homeland Security Division, 2014). Figure 8.1.3-6 shows the location of areas in Michigan that are susceptible to land subsidence due to karst topography.

[51] Karst: "A distinctive landscape (topography) that can develop where the underlying bedrock, often limestone or marble, is partially dissolved by surface or groundwater" (USGS, 2015i).
[52] Gypsum: Calcium sulfate dihydrate (NRCS, 2016).

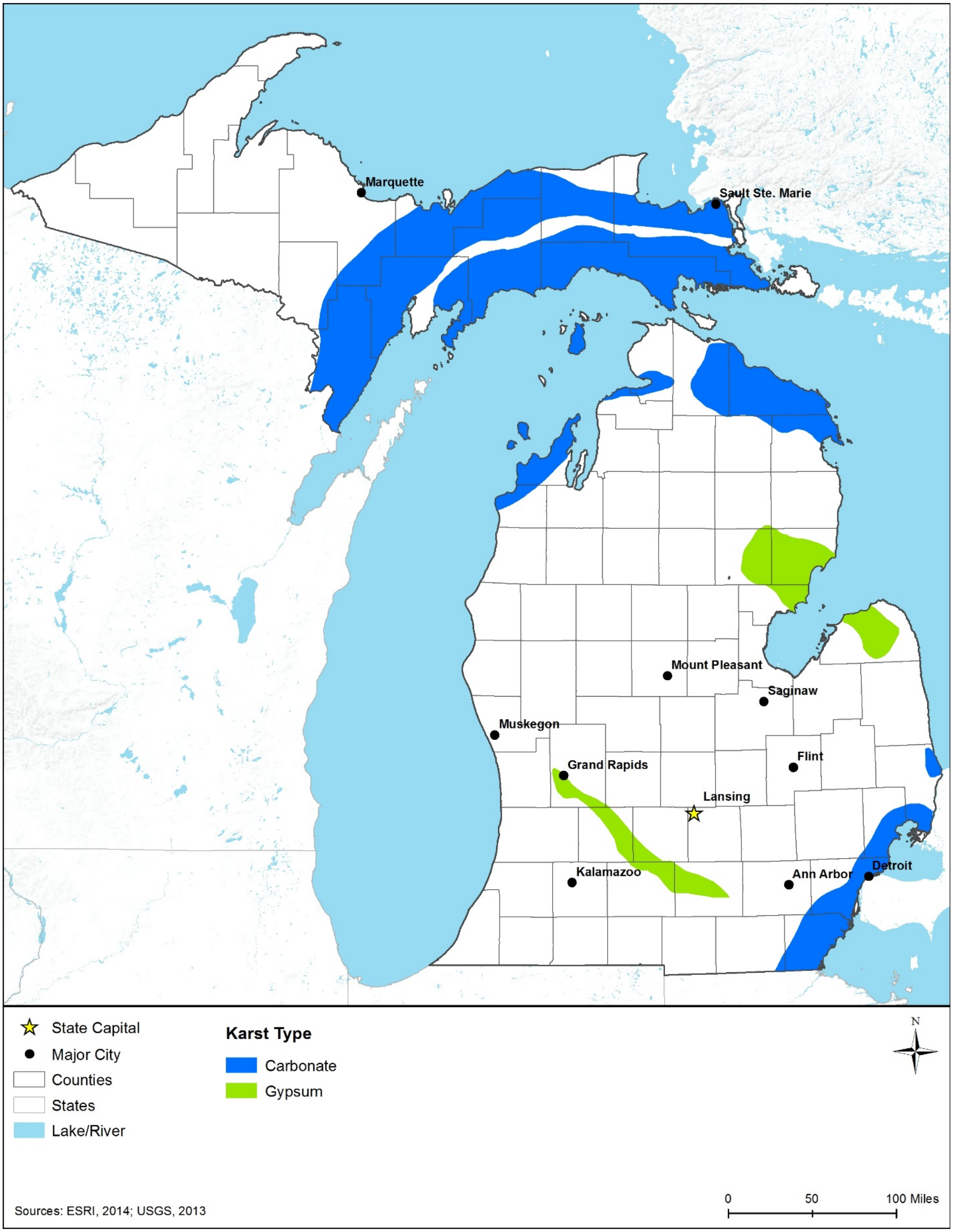

Figure 8.1.3-6: Areas Susceptible to Subsidence due to Karst Topography in Michigan

8.1.4. Water Resources

8.1.4.1. Definition of the Resource

Water resources are defined as all surface water bodies and groundwater systems including streams, rivers, lakes, canals, ditches, estuarine waters, floodplains, aquifers, and other aquatic habitats (wetlands are discussed separately in Section 8.1.5). 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, 2014h)

8.1.4.2. Specific Regulatory Considerations

Federal laws relevant to protecting the quality and use of water resources are summarized in Appendix C, Environmental Laws and Regulations. Multiple Michigan laws and regulations pertain to the state's public utility and transportation infrastructure and its public safety community. Table 8.1.4-1 identifies the relevant laws and regulations for water resources in Michigan.

Table 8.1.4-1: Relevant Michigan Water Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
DEQ Water Resources Policies	DEQ	Drinking water, wastewater treatment, surface water management, groundwater protection, and other topics (DEQ, 2016).
Joint Application includes: • Authorization under Section 404 of the CWA • Water Quality Certification under Section 401 of the CWA	MDEQ/USACE	Michigan has the authority to administer the federal wetlands program. As such, the Joint Application is required to cover state and federal rules and regulations for construction activities where the land meets the water, including wetlands (MDEQ, 2015n).
National Pollutant Discharge Elimination System (NPDES) Program	MDEQ	Regulates the discharge of pollutants in stormwater discharges associated with municipal separate storm sewer systems, construction activities, and industrial operations (MDEQ, 2015o).

8.1.4.3. Environmental Setting: Surface Water

Surface water resources are lakes, ponds, rivers, and streams. Michigan has approximately 76,439 miles of rivers and streams (including connecting channels), 42,167 square miles of waters from the Great Lakes, associated bays, and Lake St. Clair, and 46,000 inland lakes, reservoirs, and ponds with a surface area at least one-tenth of an acre or greater (MDEQ, 2014a).

Surface waters uses include public supply, industrial, irrigation, thermoelectric power, and domestic (MSU, 2011).

Watersheds

Watersheds, or drainage areas, consist of surface water and underlying groundwater, and encompass an area of land that drains streams and rainfall to a common outlet (e.g., reservoir, bay). Michigan's waters are divided into 12 major watersheds, or drainage basins (Figure 8.1.4-1). The Southern Lake Superior-Lake Superior watershed extends from the western end of the Michigan Upper Peninsula to the eastern end along the northern border. The Western Lake Superior and Wisconsin watersheds drain small areas in the far western and southwestern portion of the Upper Peninsula. The Northwestern Lake Michigan watershed covers a large portion of the western and central Upper Peninsula. The Northeastern Lake Michigan-Lake Michigan watershed covers a portion of the eastern Upper Peninsula and extends south to the west-central portion of the Lower Peninsula, including the islands in northeast Lake Michigan. The Northwestern Lake Huron watershed drains the remaining portion of the eastern Upper Peninsula and extends south to cover the northernmost area of the Lower Peninsula of Michigan. Southwestern Lake Huron-Lake Huron and St. Clair-Detroit watersheds drain the eastern half of the Lower Peninsula, while the Lake Erie watershed drains a the far southeastern area in the Lower Peninsula. The Southeastern Lake Michigan and Southwestern Lake Michigan drain the remaining southwest portion of the Lower Peninsula. (USGS, 2015d)

Freshwater

There are eight major rivers in Michigan: Saginaw, Grand, Kalamazoo, St. Joseph, Detroit, Clinton, Huron, and St. Mary's. The Grand River originates in the southern Lower Peninsula of Michigan and flows north to Lansing, before turning west to empty into Lake Michigan. Many boating access sites can be found along the river, providing recreational opportunities for the public (MRBIS, 2015). The Clinton River is in the southeastern Lower Peninsula of Michigan, and drains into Lake St. Clair. The St. Mary's River is in the far eastern Upper Peninsula of Michigan. The river forms the international border between Michigan's Upper Peninsula and Canada's Province of Ontario, connecting Lake Superior to Lake Huron (MDEQ, 2015p).

Michigan has approximately 730 inland "public access lakes" each with a public boat launch and a surface area of 50 acres or greater (MDEQ, 2014b). Major lakes within Michigan include Houghton and Torch Lakes. Houghton Lake is the largest inland lake in the state, occupying more than 20,000 acres in the central Lower Peninsula of Michigan (DNR, 2015c). Torch Lake, located in the northern Lower Peninsula, is the second largest inland lake at about 18,770 acres in size (DNR, 2015c). These lakes are popular for recreationa1 activities, such as fishing.

The Great Lakes form the largest surface freshwater system on the planet spanning over 94,000 square miles of surface area (NOAA, 2015a). According to the MDEQ, Michigan maintains jurisdiction over approximately 45 percent of the bordering Great Lakes (Lakes Superior, Michigan, Huron, and Erie). Approximately 16,400 square miles of Lake Superior, 13,250 square miles of Lake Michigan, 9,100 square miles of Lake Huron, and 115 square miles of Lake Erie are located within Michigan. Waters of Lakes Superior, Michigan, and Huron generally have excellent water quality. A few impaired areas exist in nearshore zones where pollutants are discharged from heavily industrialized areas (MDEQ, 2014a).

8.1.4.4. Sensitive or Protected Waterbodies

Wild and Scenic Rivers

As shown in Figure 8.1.4-1, there are 16 river segments federally designated as National Wild and Scenic Rivers (NWSR) in Michigan (see Appendix C, Environmental Laws and Regulations, for more information about the Wild and Scenic Rivers Act). Within Michigan, approximately 656 miles of river are designated as wild and scenic (NWSR System, 2015a). Rivers with this designation "possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural or other similar values." Therefore, the free-flowing condition of the rivers is preserved "to protect the water quality of such rivers and to fulfill other vital national conservation purposes" (NWSR System, 2015b). For a complete list and additional information regarding these designated rivers, visit www.rivers.gov/michigan.php (NWSR System, 2015a).

State Designated Natural Rivers

Michigan developed the Natural Rivers Program "to preserve, protect and enhance" the "state's finest river systems" for the use and enjoyment of current and future generations by allowing property owners their right to reasonable development, while protecting Michigan's unique river resources." Michigan has designated approximately 2,091 miles of sixteen rivers or segments of rivers into the Natural River System, as shown in Figure 8.1.4-1. For a complete list and maps of these rivers, visit www.michigan.gov/dnr/ (DNR, 2015d).

Figure 8.1.4-1: Major Michigan Watersheds and Surface Waterbodies

8.1.4.5. 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,[53] the causes of impairment, and probable sources. Table 8.1.4-2 summarizes the water quality of Michigan's assessed major waterbodies by category, percent impaired, designated use,[54] cause, and probable sources. Figure 8.1.4-2 shows the Section 303(d) waters in Michigan as of 2014.

As shown in Table 8.1.4-2, various sources affect Michigan's waterbodies, causing impairments. For example, the presence of mercury or organic chemicals have resulted in fish consumption advisories in waterbodies throughout the state. However, generally Michigan's assessed lakes, reservoirs, and bays have good water quality. Designated uses of the impaired lakes, reservoirs, and bays include fishing, and primary and secondary contact recreation. Atmospheric deposition of PCBs and mercury have resulted in fish consumption advisories for many species in Michigan's Great Lakes, inland lakes, reservoirs, and impoundments. (USEPA, 2015a) (MDEQ, 2014b)

MDEQ works closely with federal and state agencies to ensure designated uses of Michigan waterbodies are preserved. For example, water quality monitoring is conducted by DEQ to provide efficient water quality data collection across the state. Programs, such as the Clean Michigan Initiative, were established in Michigan "to clean up, protect, and enhance Michigan's environmental quality, natural resources, and infrastructure" (MDEQ, 2015t). Additionally, MDEQ is proposing a Total Maximum Daily Load (TMDL) for inland water bodies affected by atmospheric deposition of mercury and PCBs to determine sources and established goals to prevent further pollution of the state's waters and restore the designated uses to the waterbodies (MDEQ, 2015x).

[53] 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, 2015c).
[54] 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, 2015c)

Table 8.1.4-2: Section 303(d) Impaired Waters of Michigan, 2010

Water Type[a]	Amount of Waters Assessed[b] (Percent)	Amount Impaired (Percent)	Designated Uses of Impaired Waters	Top Causes of Impairment	Top Probable Sources for Impairment
Rivers and Streams	100%	70%	fish consumption, industrial water supply, and recreation	polychlorinated biphenyls (PCBs) and mercury	atmospheric deposition[c] and channelization (creating channels in rivers and streams)
Lakes, Reservoirs, and Ponds	98%	36%	fish consumption and recreation	PCBs, mercury, and pesticides	atmospheric deposition and contaminated sediments (historical pollutants)
Estuaries and Bays	3,136 square miles (total size not available)	100%	fish consumption, and water supply	PCBs, dioxins, mercury, and pesticides	atmospheric deposition and contaminated sediments (historical pollutants)
Great Lakes shoreline	97%	97.5%	fish consumption	PCBs, dioxins, mercury, pesticides, and pathogens	atmospheric deposition and agriculture
Great Lakes open water	39,031 square miles (total size not available)	100%	fish consumption	PCBs, dioxins, mercury, and pesticides	atmospheric deposition and agriculture
Great Lakes connecting channel	112 miles (total size not available)	100%	fish consumption, aquatic life, and primary and secondary contact recreation	no causes of impairment reported	no probable sources of impairment reported
Inland Lake shoreline	87 miles (total size not available)	5.5%	primary and secondary contact recreation	no causes of impairment reported	no probable sources of impairment reported

Source: (USEPA, 2010a)

[a] Some waters may be considered for more than one water type.

[b] Michigan has not assessed all waterbodies within the state.

c Atmospheric deposition: the process by which airborne pollutants settle onto to the earth's surface and pollutants travel from the air into the water through rain and snow ("wet deposition"), falling particles ("dry deposition"), and absorption of the gas form of the pollutants into the water (USEPA, 2015c).

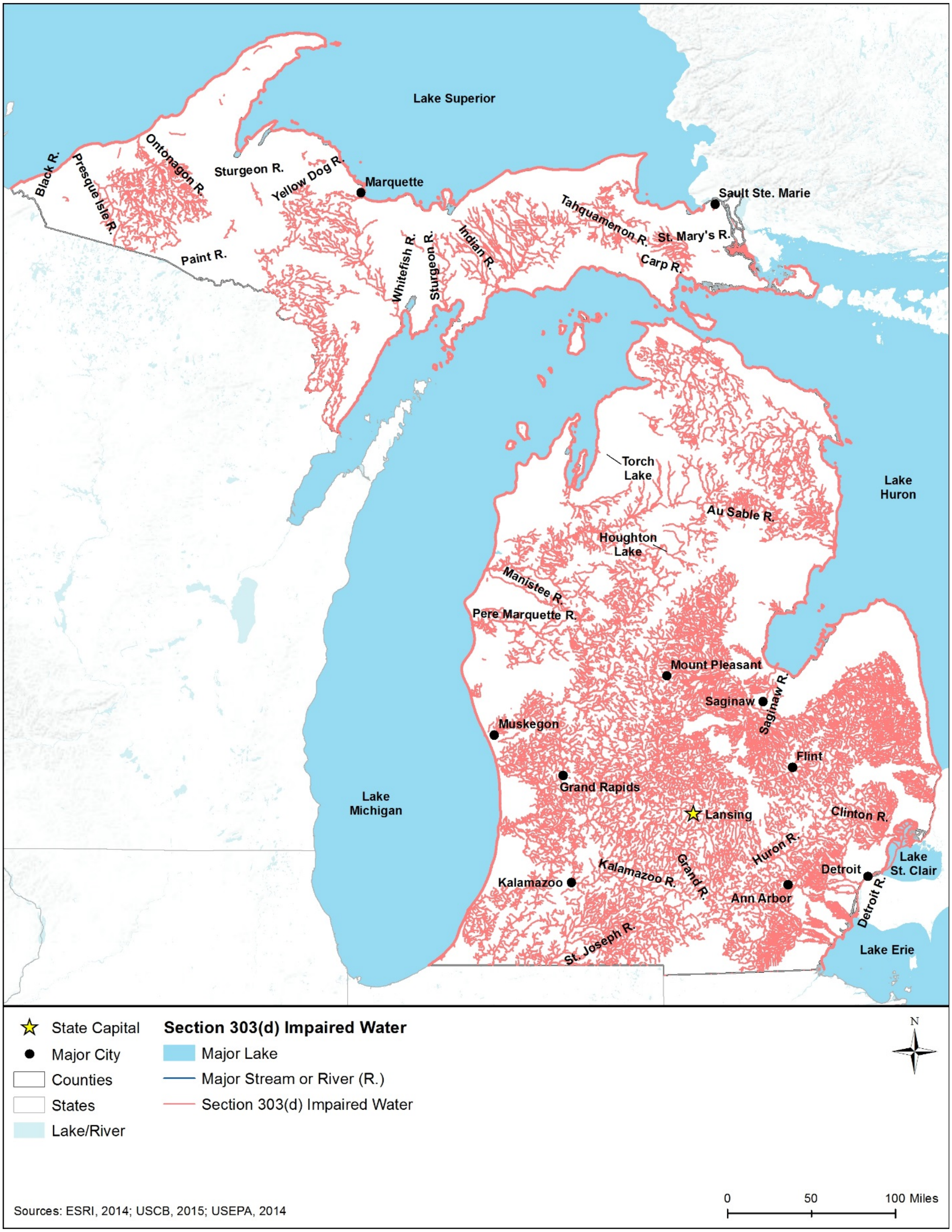

Figure 8.1.4-2: Section 303(d) Impaired Waters of Michigan, 2014

8.1.4.6. 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, 2014c).

There are two primary types of floodplains in Michigan.

- **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 Michigan border the shorelines of Lake Superior, Lake Michigan, Lake Huron, and Lake Erie. Coastal flooding can occur when strong wind and storms increase water levels on the adjacent shorelines (FEMA, 2013).

Flooding is the leading cause for disaster declaration by the President in the U.S. and results in significant damage throughout the state annually (NOAA, 2015c). There are several causes of flooding in Michigan, often resulting in loss of life and damage to property, infrastructure, agriculture, and the environment. These include severe rain events, rapid snowmelt, debris and ice jams, storm surges, and dam/levee failure (NOAA, 2015d). Since 1972, Michigan has had 16 major disaster declarations that resulted in severe flooding; three of which have occurred since 2008 (FEMA, 2015a).

Great Lakes Coastal Floodplains

FEMA is conducting a coastal flood hazard study for the coastal counties around the Great Lakes. The goal of this study is to "update the coast storm surge elevations for all of the U.S. shoreline of the Great Lakes" (MDEQ, 2015aa). The results of the study will enable FEMA and state agencies to provide more accurate estimates of coastal flood hazards and associated risks for the communities along the Great Lakes. This study will affect the residents of Michigan that live along the 3,126 miles of shoreline along Lake Superior, Lake Michigan, Lake Huron, and Lake Erie (MichiganFilmOffice.org, 2016).

Source: (MDEQ, 2015aa)

Flooding typically occurs in Michigan during late winter or early spring when rain events combined with snowmelt and frozen soils lead to large quantities of runoff. However, major flood events do not normally occur in Michigan, and only 6 percent of the state is considered to be at risk for flooding, primarily in the southern two-thirds of the Lower Peninsula. "Flood damage in Michigan is estimated to range from $60 to $100 million annually." (Blumer, Nurnberger, Hamilton, & Sorrell, 1991)

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 995 communities in Michigan through the National Flood Insurance Program (NFIP) (FEMA, 2014b). Established to reduce the economic and social cost of flood damage by subsidizing insurance payments, the NFIP encourages communities "to adopt and enforce floodplain management regulations and to implement broader floodplain management programs" and allows property owners in participating communities to purchase insurance protection against losses from flooding (FEMA, 2015b). As an incentive, communities can voluntarily participate in the NFIP Community Rating System (CRS), which is a program that rewards communities by reducing flood insurance premiums in exchange for doing more than the minimum NFIP requirements for floodplain management. As of May 2014, Michigan had 24 communities participating in the CRS (FEMA, 2014e).[55]

8.1.4.7. Groundwater

Groundwater systems are sources of water that result from precipitation infiltrating the ground surface, and includes underground water that occupies pore spaces between sand, clay, or rock particles. An aquifer is a permeable geological formation that stores or transmits water to wells and springs. Groundwater is contained in either confined (bound by clays or nonporous bedrock) or unconfined (no layer to restrict the vertical movement of groundwater) aquifers (USGS, 1999a). 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.

Michigan's principal aquifers consist of sandstone aquifers,[56] sandstone and carbonate-rock,[57] and sand and gravel aquifers of alluvial and glacial origin.[58] Groundwater resources account for approximately 45 percent of public drinking water supply in Michigan (MDEQ, 2013). According to MDEQ, "for many communities, groundwater is the only possible source of fresh water for drinking" (Hillsdale County Community Center, 2015). Generally, the water quality of Michigan's aquifers is suitable for drinking and daily water needs. Statewide, the most serious threats to groundwater quality include leaking or improperly located septic systems, and other direct sources of contamination, such as industrial operations which may use hazardous chemicals, landfills, and gasoline filling stations (Hillsdale County Community Center, 2015).

Table 8.1.4-3 provides details on aquifer characteristics in the state; Figure 8.1.4-3 shows Michigan's principal aquifers. There are no sole source aquifers in Michigan.

Table 8.1.4-3: Description of Michigan's Principal Aquifers

Aquifer Type and Name	Location in State	Groundwater Quality
Aquifers of Alluvial and Glacial Origin consist mainly of the sand, gravel, and bedrock eroded by the glaciers.	Spread throughout the state	Most water is very hard. Suitable for most uses. Water from the surficial aquifer system slightly basic (chalky) because the aquifers contain fragments of carbonate rocks. Primary use is for public supply and agricultural withdrawals. Other uses include: domestic and commercial; industrial; mining; and thermoelectric-power withdrawals.

[55] A list of the 24 CRS communities can be found in the most recent FEMA CRS report dated May 1, 2014 (FEMA, 2014d) and additional program information is available from FEMA's NFIP CRS website (www.fema.gov/national-flood-insurance-program-community-rating-system).

[56] 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 P. G., 1995b).

[57] 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 P. G., 1995a).

[58] 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, 2015h).

Aquifer Type and Name	Location in State	Groundwater Quality
Cambrian-Ordovician aquifer system consists of sandstone.	Central and eastern parts of the Upper Peninsula and underlie the entire Lower Peninsula	Suitable for most uses. Water is hard as concentrations of dissolved solids ranges from median to high. Primary use of water is for public supply. Other uses include: domestic and commercial purposes; agriculture; industrial; mining and thermoelectric-power.
Jacobsville aquifer consists of sandstone and shale.	Very northwestern part of the state, running along the coast of Lake Superior	Generally unproductive since aquifer allows little water through (low permeability). Low levels of dissolved solids concentrations and primary use is domestic supply.
Marshall aquifer consists of sandstone, shale, limestone, and coal.	Forms a ring around the central part of the state, running Lake Huron north of Mount Pleasant, through Muskegon, south of Grand Rapids, east – northeast of Lansing	Generally, the water is suitable for most uses. Low to median level of dissolved solid concentrations. The central part of the aquifer is extremely briny and has very high levels of dissolved solids concentrations. Primary uses are for industrial, mining, and thermoelectric-power purposes. Public supply is a secondary use.
Pennsylvanian aquifer consists of sandstone and shale.	Central part of the Lower Peninsula	Water is generally very salty with high levels of dissolved solids concentrations. The aquifer is a major source of water for municipal, industrial, and domestic supply.
Silurian-Denovian aquifers consists of limestone and dolomite.	Extreme southeast corner near the coast of Lake Erie and north central, near the coast of Lake Huron and Lake Michigan	Least hard of principal aquifers as contains the smallest median dissolved-solids concentrations. Readily available source of water for most uses. Where overlain by younger bedrock units, water from the aquifer may not be suitable for drinking because of undesirable concentrations of naturally occurring sulfate and dissolved solids.

Sources: (Moody, Carr, Chase, & Paulson, 1986) (Olcott P. G., 1992)

Figure 8.1.4-3: Principal Aquifers of Michigan

8.1.5. Wetlands

8.1.5.1. 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)

8.1.5.2. Specific Regulatory Considerations

Appendix C, Environmental Laws and Regulations, explains the pertinent federal laws protecting wetlands in detail. Table 8.1.5-1 summarizes the major Michigan state laws and permitting requirements relevant to the state's wetlands.

Table 8.1.5-1: Relevant Michigan Wetland Laws and Regulations

<table>
<tr><th>State Law/Regulation</th><th>Regulatory Authority</th><th>Applicability</th></tr>
<tr><td>Joint Application includes:
Authorization under Section 404 of the CWA
Water Quality Certification under Section 401 of the CWA</td><td>MDEQ/ USACE</td><td>Michigan has the authority to administer the federal wetlands program. As such, the Joint Application is required to cover state and federal rules and regulations for construction activities where the land meets the water, including wetlands. (MDEQ, 2015q)</td></tr>
<tr><td>Natural Resources Environmental Protection Act 451 of 1994
Part 303:
Wetland Protection</td><td>MDEQ</td><td>A permit is required for any activities in regulated wetlands. A wetland is regulated if it is:
Connected to one of the Great Lakes or Lake St. Clair.
Located within 1,000 feet of one of the Great Lakes or Lake St. Clair.
Connected to an inland lake, pond, river, or stream.
Located within 500 feet of an inland lake, pond, river, or stream.
Not connected to one of the Great Lakes or Lake St. Clair, or an inland lake, pond, stream, or river, but are more than 5 acres in size.
Not connected to one of the Great Lakes or Lake St. Clair, or an inland lake, pond, stream, or river, and less than 5 acres in size, but the MDEQ has determined that these wetlands are essential to the preservation of the state's natural resources and has notified the property owner (MDEQ, 2015y).</td></tr>
</table>

8.1.5.3. Environmental Setting: Wetland Types and Functions

The U.S. Fish and Wildlife Service's (USFWS) National Wetlands Inventory (NWI) mapping adopted a national Wetlands Classification Standard (WCS) that classifies wetlands according to shared environmental factors, such as vegetation, soils, and hydrology, as defined in Cowardin et al (1979). The WCS includes five major wetland systems: Marine, Estuarine, Riverine, Lacustrine, and Palustrine. Three of these are present in Michigan, as detailed in Table 8.1.5-2. 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 or greater."

- Lacustrine System includes inland water bodies that are situated in topographic depressions, lack emergent trees and shrubs, have less than 30 percent vegetation cover, and occupy greater than20 acres. Includes lakes, larger ponds, sloughs, lochs, bayous, etc.
- "Palustrine includes all nontidal wetlands dominated by trees, shrubs, persistent emergents plants, or emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 5 percent." The System is characterized based on the type and duration of flooding, water chemistry, vegetation, or substrate characteristics (soil types). (Cowardin, Carter, Golet, & LaRoe, 1979) (FGDC, 2013).

In Michigan, the main type of wetlands is palustrine (freshwater) wetlands found on river and lake floodplains across the state. Riverine and lacustrine wetlands, as defined in Table 8.1.5-2, comprise less than one percent of the wetlands in the state. Therefore, they are not discussed in this PEIS.

Figure 8.1.5-1 uses 2014 NWI data to characterize and map Michigan wetlands on a broad-scale. The data are not intended for site-specific analyses and are not a substitute for field-level wetland surveys, delineations, or jurisdictional determinations which may be conducted, as appropriate, at the site-specific level once those locations are known. As shown in Table 8.1.5-2, palustrine wetlands are found across the state, although more abundant in northern Michigan, particularly the Upper Peninsula. The map codes and colorings in Figure 8.1.5-1 correspond to the wetland types in the figures.

Table 8.1.5-2: Michigan Wetland Types, Descriptions, Location, and Amount, 2014

Wetland Type	Map Code and Color	Description	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.	Throughout the state, more concentrated on the Upper Peninsula	5,793,506
Palustrine scrub-shrub wetland	PSS	Woody vegetation less than 20 feet tall dominates PSS wetlands. Thickets and shrub swamps are examples of PSS wetlands.		
Palustrine emergent wetlands	PEM	PEM wetlands have erect, rooted, green-stemmed, annual, water-loving plants, excluding mosses and lichens, present for most of the growing season in most years. PEM wetlands include freshwater marshes, wet meadows, fens, prairie potholes, and sloughs.	Throughout the state	618,390
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	153,785
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[59], and other miscellaneous wetlands are included in this group.	Throughout the state	21,485
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	773
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 less than 8.2 feet deep.	Throughout the state	59,769
			TOTAL	**6,647,708**

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

[a] The wetlands descriptions are based on information from the Federal Geographic Data Committee (FGDC)'s Classification of Wetland and Deepwater Habitats of the United States. Based on Cowardin, et.al, 1979, some data has been revised based on the latest scientific advances. The USFWS uses these standards as the minimum guidelines for wetlands mapping efforts (FGDC, 2013).

[59] 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).

[b] All acreages are rounded to the nearest whole number. The maps are prepared from the analysis of high altitude imagery. A margin of error is inherent in the use of imagery. The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted (USFWS, 2015b).

Palustrine Wetlands

In Michigan, palustrine wetlands include the majority of vegetated freshwater wetlands (freshwater marshes, swamps, and bogs). Marshes in Michigan are found along rivers, streams, ponds, inland lakes, and the Great Lakes, and are characterized by cattails (*Typha sp)*, sedges *(Cyperaceae sp)*, and grasses. One special type of marsh is found along the Great Lakes shoreline in small bays, swales between beach ridges, and in wind-blown depressions. These marshes are called interdunal swale wetlands, and their water sources is the Great Lakes. These wetlands exists nowhere else on earth, and support many threatened and endangered species. Wet meadows are another type of marsh that are found in southeast Michigan and the Saginaw Bay watershed, within the former lake-plain of the Great Lakes. They have saturated soils and grass-like vegetation, but rarely have standing water. The majority of these wet meadows have been extremely degraded or lost to agricultural and development activities. (Cwikiel, 2003)

Swamps found in Michigan include hardwood swamps, shrub-scrub swamps, and conifer swamps. They are found along streams, rivers, and lakes, as well as in areas where groundwater is near the surface. Vernal pools are also swamps that occur in Michigan; these are isolated wetlands that hold water for only a short time period in the spring. (Cwikiel, 2003)

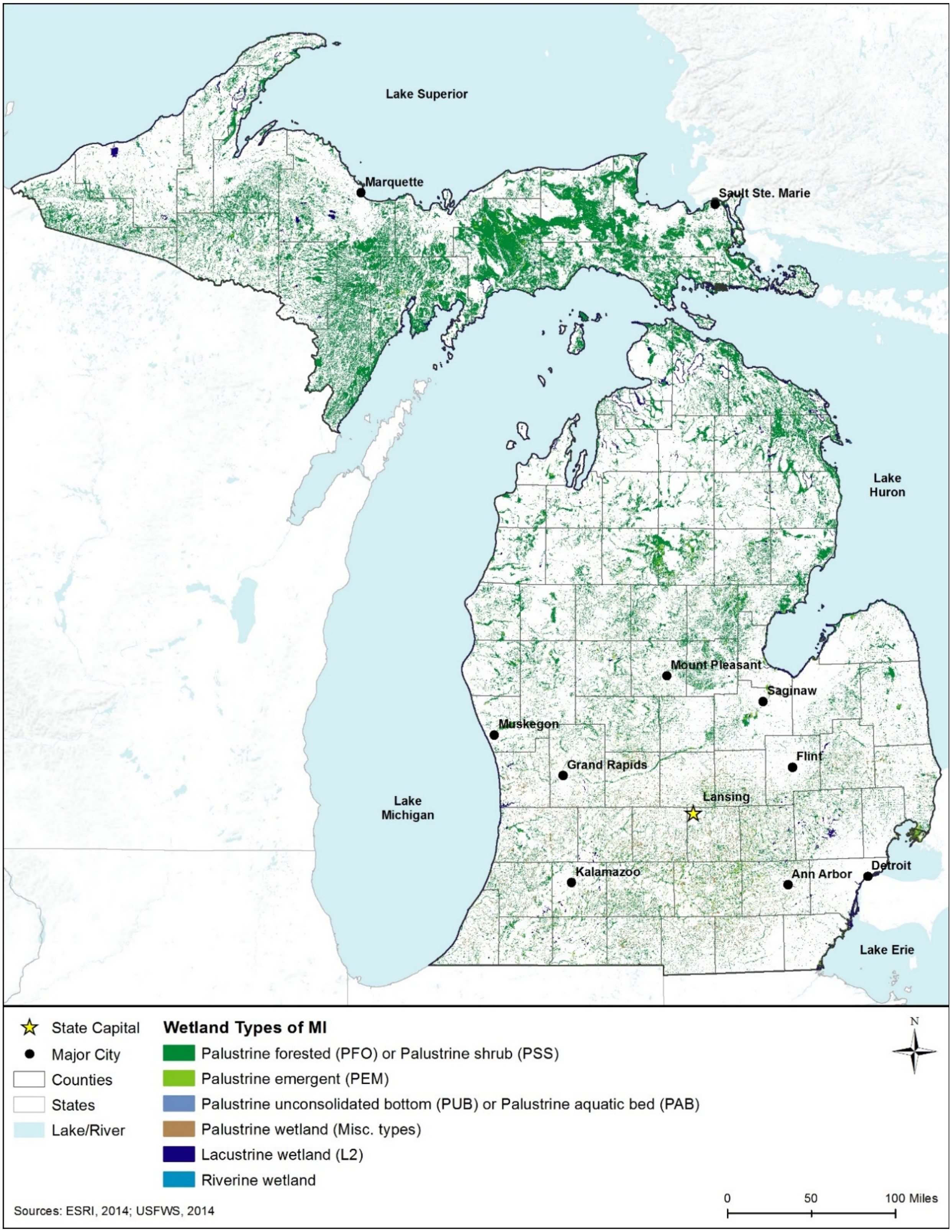

Figure 8.1.5-1: Wetlands by Type, in Michigan, 2014

Bogs, or northern peatlands, and fens are found in Michigan as well. Bogs are fed by rainwater, and the most common type in Michigan is a quaking bog, formed by the accumulation of organic matter over thousands of years that creates a floating mat of peat that "quakes" when one walks on it. Calcareous fens are found where groundwater has passed through soils rich in limestone, and are dominated by grasses and sedges (*Cyperaceae sp).* (Cwikiel, 2003)

Based on the USFWS NWI 2014 analysis, PFO/PSS is the dominant wetland type (87 percent), followed by PEM (9 percent), PUB/PAB (2 percent), and other palustrine wetlands (less than 1 percent). There are currently about 6.6 million acres of palustrine (freshwater) wetlands in the state (USFWS, 2014a). It is estimated approximately 50 percent of Michigan's original wetlands have been drained, or have been filled (MDEQ, 2015u).

Figure 8.1.5-2: Michigan Wetland Management District NWR

Source: (USFWS, 2012g)

In 1979, the Michigan State Legislature passed the Geomare-Anderson Wetlands Protection Act, 1979, PA 203. This is now known as Part 303, Wetlands Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. This act defines and regulates all wetlands in the state (MDEQ, 2015y).

8.1.5.4. Wetlands of Special Concern or Value

Special wetlands in Michigan include Michigan's wildlife management areas, National Natural Landmarks, conservation programs, and easements (see below for information about these wetlands). Michigan does not contain any regulated high-quality wetlands.

Important Wetland Sites in Michigan

- The Michigan Wetland Management District is a National Wildlife Refuge, managed by the USFWS, encompassing 13 counties in southern Michigan, and providing wetland and grassland habitats for waterfowl and wildlife habitat (USFWS, 2012a). To learn more about the Michigan Wetland Management District,[60] visit http://www.fws.gov/refuge/michigan_wmd/.
- National Natural Landmarks range in size from 24 acres to over 11,600 acres, and are owned by MDNR, Michigan State University, USFWS, USFS, and other private individuals (NPS, 2014c). Section 8.1.8, Visual Resources, describes Michigan's National Natural Landmarks.
- Other 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, the state of Michigan, MDEQ, and easements managed by natural resource conservation groups such as Little Traverse Conservancy. According to the National Conservation Easement

[60] A Wetland Management District is an administrative organization that manages all the waterfowl production areas in a multi-county area (USFWS, 2014d).

Database, a national electronic repository of government and privately held conservation easements (http://conservationeasement.us/), NRCS holds more than 42,000 acres in conservation easements in Michigan (NCED, 2015).

- For more information on Michigan's wildlife management areas, National Natural Landmarks, conservation programs, and easements, see Section 8.1.8, Visual Resources, and Section 8.1.7, Land Use, Recreation, and Airspace.

8.1.6. Biological Resources

8.1.6.1. Introduction

This section describes the biological resources of Michigan. Biological resources include terrestrial[61] vegetation, wildlife, fisheries and aquatic[62] habitats, and threatened[63] and endangered[64] species as well as species of conservation concern. Wildlife habitat and associated biological ecosystems are also important components of biological resources. Michigan supports a wide diversity[65] of biological resources ranging from coniferous and northern hardwood forests, undulating plains and hills, and wetlands and lakes and cropland agriculture in the north region of the state to rolling plains, lakes and marshes, and cleared lands for agriculture in the central and southern portion of the state (Bryce, 2003). Beginning in the late 1800's, much of the conifer forest in the north was logged, and the land in the south was settled and converted to farmland. Each of these topics is discussed in more detail below.

8.1.6.2. Specific Regulatory Considerations

The federal laws relevant to the protection and management of biological resources in Michigan are summarized in detail in Appendix C, Environmental Laws and Regulations. Table 8.1.6-1 summarizes major state laws relevant to Michigan's biological resources.

[61] Terrestrial: "Pertaining to land" (USEPA, 2015m).
[62] Aquatic: "Pertaining to water" (USEPA, 2015m).
[63] 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*)).
[64] 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*)).
[65] Diversity: "An ecological measure of the variety of organisms present in a habitat" (USEPA, 2015m).

Table 8.1.6-1: Relevant Michigan Biological Resources Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Michigan Natural Resources and Environmental Protection Act (Act 451 of 1994, Part 413, Section 324.41301 through 314.41325)	MDNR	Requires the state of Michigan to manage a list of prohibited species or restricted species, and to consult and set conditions for harvesting, possessing, and transporting restricted species. The law also outlines the process for adding new species to the permitted species list.
Michigan Noxious Weeds (Michigan Seed Law, Act 329 of 1965 and Regulations 715, under Act 329)	Michigan Department of Agriculture and Rural Development (Michigan DARD)	Lists the noxious weeds prohibited to be sold or distributed in the state of Michigan; the list includes seeds of the prohibited species.
Michigan Natural Resources and Environmental Protection Act (Act 451 of 1994, Part 365 Endangered Species Protection, Sections 324.36501 through 324.36507)	MDNR	Protects the environment and natural resources of the state. It also codifies, revises, consolidates, and classifies laws relating to the environment and natural resources of the state. Specific environmental laws regulate the discharge of certain substances into the environment; regulate the use of certain lands, waters, and other natural resources; protect people's right to hunt and fish; prescribe the powers and duties of certain state and local agencies and officials; provide for charges, fees, and assessments; prescribe penalties; and repeal acts or parts of acts of the law.

8.1.6.3. Terrestrial Vegetation

The distribution of flora within the state is a function of the characteristic geology,[66] soils, climate,[67] and water of a given geographic area and correlates with distinct areas identified as ecoregions.[68] Ecoregions are broadly defined areas that share similar characteristics, such as climate, geology, soils, and other environmental conditions and represent ecosystems of regional extent. The boundaries of an ecoregion are not fixed, but rather depict a general area with similar ecosystem types, functions, and qualities (National Wildlife Federation, 2015) (USDA, 2015a) (WWF Global, 2015). Ecoregion boundaries often coincide with geographic regions of a state. Based on the state of Michigan's location between Lake Michigan, Lake Superior, Lake Huron, and Lake Erie, Michigan contains two distinct geographic regions, which include two separate peninsulas: the upper and lower peninsulas. The Upper Peninsula consists of swamp and wetlands and flat lowlands in the eastern portion and forests, higher elevations, and the

[66] "Geology is the study of the planet earth- the materials it is made of, the processes that act on those materials, the products formed, and the history of the planet and its life forms since its origin" (USEPA, 2015m).
[67] 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, 2015m)
[68] Ecoregion: "A relatively homogeneous ecological area defined by similarity of climate, landform, soil, potential natural vegetation, hydrology, or other ecologically relevant variables" (USEPA, 2015m).

rugged terrain of the Porcupine and Huron Mountains in the northwestern portion of the state (Omernik & Gallant, 2010).

The ecoregions mapped by the USEPA are the most commonly referenced, although individual states and organizations have also developed ecoregions that may differ slightly from those designated by the USEPA. The USEPA 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 Michigan at USEPA Level III (USEPA, 2016a).

As shown in Figure 8.1.6-2, the USEPA divides Michigan into five Level III ecoregions. The five ecoregions include two forested regions in the north: the Northern Lakes and Forests and North Central Hardwood Forests, and three plain regions in the south: the Southern Michigan/Northern Indiana Drift Plains, Eastern Corn Belt Plains, and the Huron/Erie Lake Plains (Bryce, 2003). The five ecoregions support a variety of different plant communities, all predicated on their general location within the state. Two of the forested regions occur on the Upper Peninsula and in the northern portion of the state that is heavily forested and contain higher elevations. The three plain and lowland regions occur in the central and southern portion of the state bordered by the southern half of Lake Michigan, Lake Huron, Lake Erie, and the states of Indiana and Ohio. Table 8.1.6-2 provides a summary of the general abiotic[69] characteristics, vegetative communities, and the typical vegetation found within each of the five Michigan ecoregions.

Communities of Concern

Michigan 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[70] that could result from implementation of an action.

The Michigan Natural Features Inventory (MNFI) program conducts field surveys to locate and identify threatened and endangered species and communities throughout the state. The program maintains a database of all relevant species and community locations, provides data and summaries and analysis in support of environmental review processes, and provides biological expertise to the MDNR. Documenting field occurrences for threatened and endangered species and natural communities is important for assessing previously undocumented occurrences or re-

[69] Abiotic: "Characterized by absence of life; abiotic materials include non-living environmental media (e.g., water, soils, sediments); abiotic characteristics include such factors as light, temperature, pH, humidity, and other physical and chemical influences" (USEPA, 2015q).
[70] 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, 2015m).

occurrences of previously documented species. The Nature Conservancy originally developed the concept for the state natural heritage program adopted and implemented by the state of Michigan, and it has been run by the Conservancy since the late 1990s. In 2000, the MNFI program became administered by MSUE. The transition occurred to ensure the program was more accessible to land use decision makers; it also increased contact with university researchers, faculty, and students to create collaborative opportunities for biodiversity conservation (DNR, 2015e).

Each natural community is assigned a rank based on its rarity and vulnerability. As with most state heritage programs, the Michigan MNFI ranking system assesses rarity using a state rank (S1, S2, S3, S4, S5) that indicates its rarity within Michigan. Communities ranked as an S1 by the Michigan MNFI program are 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. The MNFI inventory list is meant to be dynamic. As new data become available, ranks are revised as necessary to reflect the most current information (MNFI, 2015).

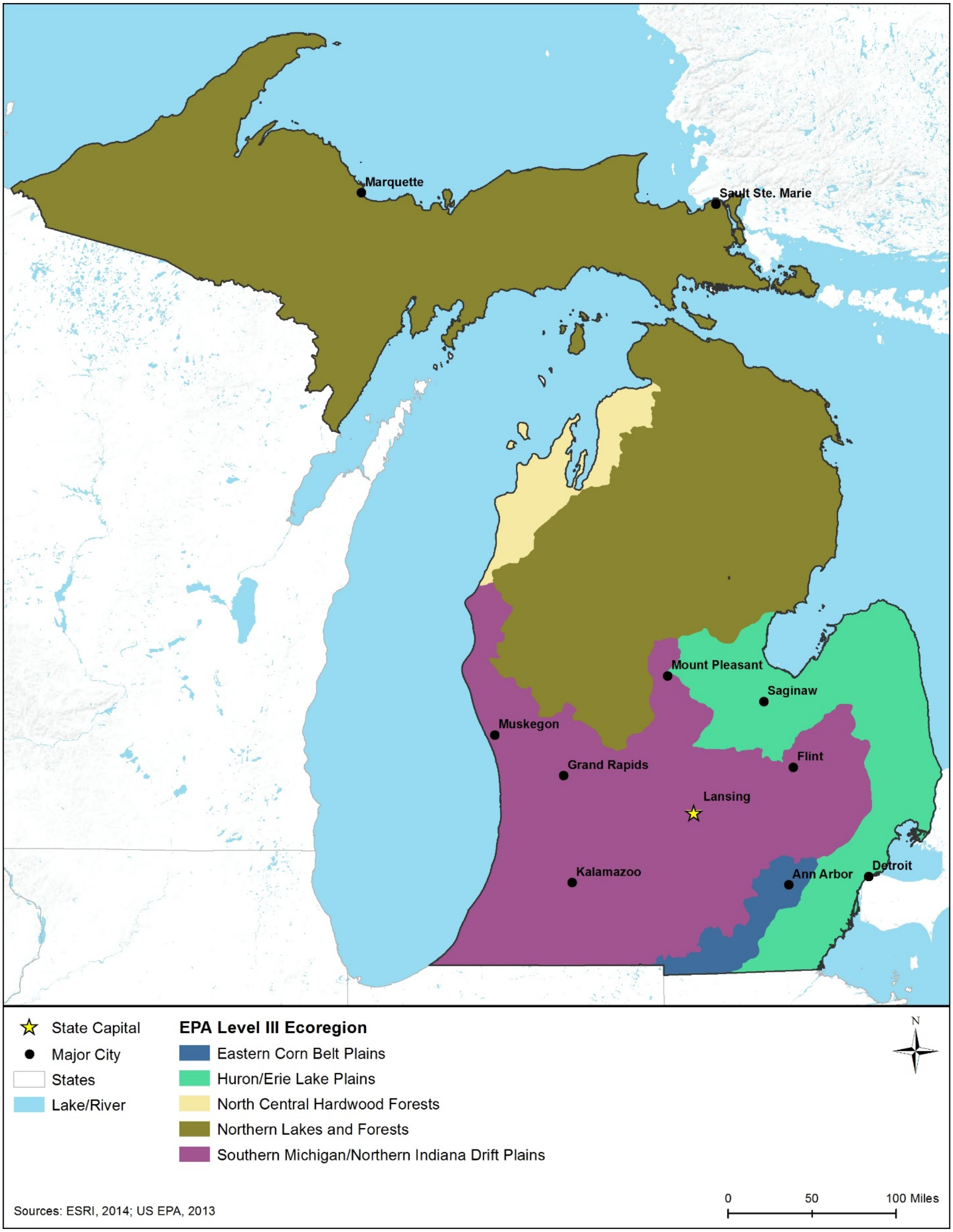

Figure 8.1.6-1: USEPA Level III Ecoregions in Michigan

Table 8.1.6-2. USEPA Level III Ecoregions of Michigan

Ecoregion Number	Ecoregion Name	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
Geographic Region: Upper Peninsula				
50	Northern Lake and Forests	A region consisting of nutrient poor glacial soils, coniferous and northern hardwood forests, undulating till plains, morainal hills, lacustrine basins, and sandy outwash plains. The soils in the region are thicker than those to the north and lack arability compared to soils in the adjacent regions to the south. The lakes in this region are clearer and less productive than those in the regions to the south.	Coniferous Forests, Northern Hardwood Forests, White and Red Pine Forests, Pine Barrens, Jack Pine, Sugar-Maple/Basswood Forest, Hemlock/Sugar-Maple Forest, Boreal Forest	**Conifer Trees –** Jack pines (*Pinus banksiana*), red pine (*Pinus resinosa*), white pine (*Pinus strobus*), eastern hemlock (*Tsuga canadensis*) **Hardwood Trees –** yellow birch (*Betulla allegheniensis*), white birch (*Betula papyrifera*), sugar-maple (*Acer saccharum*), basswood (*Tilia americana*), Hill's oak (*Quercus ellipsoidalis*), bur oak (*Querus macrocarpa*), red oak (*Quercus borealis*)
Geographic Region: Lower Peninsula				
51	North Central Hardwood Forests	Primarily a transitional area between the predominantly forested Northern Lakes and Forests region to the north and the agricultural regions to the south, this region consists of mosaic forests, wetlands and lakes, cropland agriculture, pasture, and dairy operations.	Hardwood Forest, Aspen/Birch/Pine Forest, Oak-maple Forests, Sugar-Maple/Birch/Pine Forests, Basswood/Oak Forests	**Conifer Trees –** red pine, white pine, eastern hemlock **Hardwood Trees –** quaking aspen (*Populus tremuloides*), yellow birch, white birch, red maple (*Acer rubrum*), sugar maple, Hill's oak, bur oak, red oak, basswood, black ash (*Fraxinus nigra*), black oak (*Quercus velutina*), beech (*Fabus grandifolia*)
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
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, green ash (*Fraxinus species),* American elm (*Ulmus americana*)

Ecoregion Number	Ecoregion Name	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
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

Sources: (Bryce, 2003) (USEPA, 2015d)

In Michigan, there are 76 natural communities, as recognized by the MNFI (Kost, 2010). Eighteen of these vegetative communities are ranked as S1 communities[71] in Michigan; these communities represent the rarest terrestrial habitat in the state. These communities occur throughout the state, with the majority of the communities located within northern and southern portions of the lower peninsula of Michigan, with more unique communities located along the Great Lake shorelines and dune fields within the upper peninsula of the state (Albert, Cohen, Kost, & Slaughter, 2008). Michigan Appendix A, Table A-1, provides a description of the 18 S1 ranked terrestrial vegetation communities of conservation concern in Michigan along with their state rank, distribution, abundance, and the associated USEPA Level III ecoregions.

Michigan also implements the 2005 Wildlife Action Plan (WAP). The WAP is a comprehensive document that helps guide wildlife conservation decision making for the MDNR. Michigan developed the WAP as a comprehensive strategy to serve as a coordinated plan of action for federal, state, and partner organizations that will help shape conservation efforts across the state. The first version of the Michigan WAP was completed in 2005, and revised in November 2006 (DNR, 2005). Since 2005, the MDNR has published three biannual reports regarding the status of implementation activities outlined in the WAP. Each report provides a summary of projects that have been fully or partially funded by State Wildlife Grants. The 2015 Michigan WAP is currently under revision; the Draft WAP was made available in September 2015 for public review (DNR, 2015f).

One of the focus areas of the conservation efforts outlined in the 2005 WAP is the need to preserve Michigan's wildlife diversity. As a result, a key step of the plan is to conserve species of greatest conservation need (SGCN), which are species of wildlife with small or declining populations or other characteristics that make them vulnerable. Therefore, the conservation of SGCN is a key component in monitoring the effectiveness of conservation actions and the success of the 2005 WAP. Michigan catalogs species summaries for 404 SGCN; each summary describes the general abundance, distribution, landscape feature associations, and known threats, as well as issues of important to the individual species (DNR, 2005).

Nuisance and Invasive Plants

There are a large number of undesirable plant species that are considered nuisance and invasive[72] plants. 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 (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 are terrestrial, 19 aquatic, and 5 parasitic (USDA, 2015b).

[71] S1 – Communities "critically imperiled in the state because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state" (MNFI, 2015).
[72] 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, 2015m)

Noxious weeds are a threat to Michigan's range of forests, savannas, moraine, pine and oak barrens, and tall-grass prairie habitat types. Noxious weeds can have adverse ecological and economic impacts to these habitats by displacing native species, degrading wildlife habitat, and increasing soil erosion.[73] Under the Michigan Natural Resources and Environmental Protection Act (NREPA;Act 451 of 1994), it is illegal to possess prohibited or restricted species, except under specific circumstances, such as for research purposes with a public or private institution (MDARD, 2015).

In 2009, the MDNR Wildlife Division contracted with MNFI to assess the status of invasive plants in Michigan and develop a strategy to address their negative impacts to wildlife, as there are numerous invasive plant species that are well established in the state, spreading rapidly, and there is little information on their distribution and abundance. Also, at the time, there was not an official list of species that pose the greatest threat. The strategy between the MDNR and MNFI sought to identify those species that pose the greatest threat to wildlife and direct actions towards prevention, early detection-rapid response, and control at prioritized sites. A publication released in 2009, *Meeting the Challenge of Invasive Plants: A Framework for Action* outlines the six strategic goals and associated objectives of the strategy including prevention, early detection-rapid response, long-term control at prioritized sites, leadership to set direction and empower staff, assessment and research, and education and outreach (Higman, 2009).

Today, the MDNR regulates invasive species using the regulations listed under the NREPA and by maintaining a statewide working list of invasive species list of plants, aquatic invertebrates, terrestrial and aquatic vertebrates, fungus, algae and cyanobacteria, fish and crayfish, and terrestrial invertebrates. The statewide list of invasive plant species includes prohibited and restricted plant species and restricted and prohibited noxious weeds and seeds. There are 13 prohibited plant species on the list, including species, such as fanwort (*Cambomba caroliniana*), hydrilla (*Hydrilla verticillata*), and giant salvinia (*Salvinia molesta*). There are five restricted plant species on the list, including species such as flowering rush (*Butomus umbellatus*), curly leaf pondweed (*Potamogeton crispus*), and purple loosestrife (*Lythrum salicaria*). There are 19 prohibited noxious weeds and 23 restricted noxious weed species in the state of Michigan (MDARD, 2015).

Short lists of other priority species on the statewide working list are organized by Michigan's two main geographic areas further broken down into two subareas: Southern Lower Peninsula, Northern Lower Peninsula, Eastern Upper Peninsula, and Western Upper Peninsula. The current distribution and level of threat for each species is based on formal risk assessments completed by the Michigan Invasive Plant Council (MIPC), other national and regional risk assessments, and from information obtained from land managers across the state. The priority species are then grouped into four categories of recommended actions including A list species, which have medium to high threat and mostly isolated occurrences; B list species, which have medium to high threat and occur locally in some areas, but not others; C list species, which have medium to

[73] 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, 2015m).

high threat and are widespread; and D list species, which require more information for specific management control (Higman, 2009).

The MDNR is responsible for updates to the statewide list, as necessary, and as managers become more familiar with species of concern and treatment options. As of 2015, there were a total of 76 regulated plant species on the watch list (Higman, 2009). Of the plant species, there are 18 prohibited and restricted species in the state. Of these prohibited and restricted plant species, three species are also identified as a Federal Noxious Weeds, including giant hogweed (*Heracleum mantegazzianum*), hydrilla (*Hydrilla verticillata),* and giant salvinia (*Salvinia molesta*). With the exception of isolated occurrences of giant hogweed, none of the other noxious weed species have been identified in the state (Higman, 2009). Table 8.1.6-3 lists the plant species regulated in Michigan organized by ecoregion and by action category.

Table 8.1.6-3. Regulated Invasive Plant Species in Michigan

Common Name	Scientific Name
Southern Lower Peninsula	
A List Species	
Amur-cork-tree	*Phellodendron amurense*
Black jetbead	*Rhodotypos scandens*
European frog-bit	*Hydrocharis morsus-ranae*
Giant hogweed	*Heracleum mantegazzianum*
Giant knotweed	*Polygonum sachalinesis*
Hydrilla	*Hydrilla verticillata*
Japanese stilt grass	*Microstegium vimineum*
Kudzu	*Pueraria lobata*
Norway maple	*Acer platanoides*
Pale swallowwort	*Vincetoxicum rossicum*
Black swallowwort	*Vincetoxicum nigrum*
Reed mannagrass	*Glyceria maxima*
Water-hyacinth	*Eichhornia crassipes*
B List Species	
Baby's Breath	*Gypsophila panicula*
Flowering Rush	*Butomus umbellatus*
Japanese knotweed	*Polygonum cuspidatum*
Leafy spurge	*Euphorbia esula*
Russian olive	*Elaeagnus angustifolia*
Scotch pine	*Pinus sylvestris*
C List Species	
Amur honeysuckle	*Lonicera maackii*
Autumn olive	*Elaeagnus umbellate*
Japanese barberry	*Berberis thunbergii*
Bell's honeysuckle	*Lonicera Xbella*
Black Locust	*Robinia pseudoacacia*
Canada thistle	*Cirsium arvense*
Common buckthorn	*Rhamnus cathartica*
Curly pondweed	*Potamogeton crispus*
Eurasian water milfoil	*Myriophyllum spicatum*
European fly honeysuckle	*Lonicera xylosteum*
Garlic mustard	*Alliaria petiolota*
Glossy buckthorn	*Rhamnus frangula*
Japanese honeysuckle	*Lonicera japonica*

Common Name	Scientific Name
Morrow's honeysuckle	*Lonicera morrowii*
Multiflora rose	*Rosa multiflora*
Oriental bittersweet	*Celastrus orbiculata*
Purple loosestrife	*Lythrum salicaria*
Reed canary grass	*Phalaris arundinacea*
Phragmites	*Phragmites australis*
Scotch pine	*Pinus sylvestris*
Spotted knapweed	*Centaurea maculosa*
Tartarian honeysuckle	*Lonicera tatarica*
Tree-of-heaven	*Ailanthus altissima*
Variable-leaf watermilfoil	*Myriophyllum heterophyllum*
D List Species	
Black alder	*Alnus glutinosa*
European highbush cranberry	*Viburnum opulus*
Lesser naiad	*Najas minor*
Northern Lower Peninsula	
A List Species	
Amur honeysuckle	*Lonicera maackii*
Black jetbead	*Rhodotypos scandens*
Black swallowwort	*Vincetoxicum nigrum*
Common buckthorn	*Rhamnus cathartica*
European frog-bit	*Hydrocharis morsus-ranae*
Flowering rush	*Butomus umbellatus*
Garlic mustard	*Alliaria petiolota*
Giant hogweed	*Heracleum mantegazzianum*
Giant knotweed	*Polygonum sachalinensis*
Japanese barberry	*Berberis thunbergii*
Japanese knotweed	*Polygonum cuspidatum*
Japanese stilt grass	*Microstegium vimineum*
Leafy spurge	*Euphorbia esula*
Multiflora rose	*Rosa multiflora*
Norway maple	*Acer platanoides*
Oriental bittersweet	*Celastrus orbiculata*
Pale swallowwort	*Vincetoxicum rossicum*
Phragmites	*Phrgmites australis*
Privet	*Ligustrum obtusifolium*
Reed mannagrass	*Glyceria maxima*
Russian olive	*Elaeagnus angustifolia*
Swamp thistle	*Cirsium palustre*
Tree-of-heaven	*Ailanthus altissima*
Wild parsnip	*Pastinaca sativa*
B List Species	
Autumn olive	*Elaeagnus umbellate*
Baby's breath	*Gypsophila paniculatus*
Bell's honeysuckle	*Lonicera Xbella*
Black locust	*Robinia pseudocacia*
Canada thistle	*Cirsium arvense*
Glossy buckthorn	*Rhamnus frangula*
Morrow's honeysuckle	*Lonicera morrowii*
Reed grass	*Phragmites australis*
Scotch pine	*Pinus sylvestris*
Tartarian honeysuckle	*Lonicera tatarica*

Common Name	Scientific Name
C List Species	
Common St. John's-wort	*Hypericum perforatum*
Curly pondweed	*Potamogeton crispus*
Eurasian watermilifoil	*Myriophyllum spicatum*
Reed canary grass	*Phalaris arundinacea*
Spotted knapweed	*Centaurea maculosa*
Variable-leaf watermilfoil	*Myriophyllum heterophyllum*
D List Species	
European highbush cranberry	*Viburnum poulus*
European water-clover	*Marsilea quadrifolia*
Japanese hedge-parsley	*Torilis japonica*
Money-wort	*Lysimachia nummularia*
Purple loosestrife	*Lythrum salicaria*
Eastern Upper Peninsula	
A List Species	
Baby's breath	*Gypsophila paniculata*
Black locust	*Robinia pseudoacacia*
Common buckthorn	*Rhamnus cathartica*
Garlic mustard	*Alliaria petiolota*
Giant knotweed	*Polygonum sachalinensis*
Glossy buckthorn	*Rhamnus frangula*
Japanese barberry	*Berberis thunbergii*
Japanese knotweed	*Polygonum cuspidatum*
Leafy spurge	*Euphorbia esula*
Multiflora rose	*Rosa multiflora*
Privet	*Ligustrum obtusifolium*
Purple loosestrife	*Lythrum salicaria*
Phragmites	*Phragmites australis*
Wild parsnip	*Pasinace sativa*
B List Species	
Amur honeysuckle	*Lonicera maackii*
Autumn olive	*Elaeagnus umbellate*
European fly honeysuckle	*Lonicera xylosteum*
Morrow's honeysuckle	*Lonicera morrowii*
Scotch pine	*Pinus sylvestris*
Swamp thistle	*Cirsium palustre*
Tartarian honeysuckle	*Lonicera tatarica*
C List Species	
Canada thistle	*Cirsium arvense*
Common St. John's wort	*Hypericum perforatum*
Curly pondweed	*Potamgeton crispus*
Eurasian water milfoil	*Myriophyllum spicatum*
Reed canary grass	*Phalaris arundinacea*
Spotted knapweed	*Centaurea maculosa*
Variable-leaf water milfoil	*Myriophyllum heterophyllum*
D List Species	
Japanese hedge-parsley	*Torillis japonica*
European highbush cranberry	*Viburnum opulus*
Moneywort	*Lysimachia nummularia*
Western Upper Peninsula	
A List Species	
Amur honeysuckle	*Lonicera maackii*

Common Name	Scientific Name
Baby's breath	*Gypsophila paniculata*
Black locust	*Robinia pseudoacacia*
Common buckthorn	*Rhamnus cathartica*
Flowering rush	*Butomus umbellatus*
Common valerian	*Valeriana officianalis*
Garlic mustard	*Alliaria petiolota*
Giant hogweed	*Heracleum mantegazzianum*
Giant knotweed	*Polygonum sachalinensis*
Glossy buckthorn	*Rhamnus frangula*
Japanese barberry	*Berberis thunbergii*
Japanese knotweed	*Polygonum cuspidatum*
Leafy spurge	*Euphorbia esula*
Morrow's honeysuckle	*Lonicera morrowii*
Multiflora rose	*Rosa multiflora*
Norway maple	*Acer platanoides*
Purple loosestrife	*Lythrum salicaria*
Phragmites	*Phragmites australis*
Scotch pine	*Pinus sylvestris*
Tartarian honeysuckle	*Lonicera tatarica*
B List Species	
Autumn olive	*Elaeagnus umbellate*
Swamp thistle	*Cirsium palustre*
C List Species	
Canada thistle	*Cirsium arvense*
Common St. John's wort	*Herpericum perforatum*
Curly pondweed	*Potamogeton crispus*
Eurasian water milfoil	*Myriophyllum spicatum*
Reed canary grass	*Phalaris arundinacea*
Spotted knapweed	*Centaurea maculosa*
Variable-leaf watermilfoil	*Myriophyllum heterophyllum*
D List Species	
Common tansy	*Tanacetum vulgaris*
Japanese hedge-parsley	*Torillis japonicas*
Moneywort	*Lysimachia nummularia*
European highbush cranberry	*Viburnnum opulus*

Source: (Higman, 2009)

8.1.6.4. Terrestrial Wildlife

This section discusses the terrestrial wildlife species in Michigan, divided among mammals,[74] birds,[75] reptiles and amphibians,[76] and invertebrates.[77] Terrestrial wildlife consists of those species, and their habitats, that live predominantly on land. Terrestrial wildlife includes common big game species, small game animals, furbearers, nongame animals, game birds, waterfowl, and

[74] 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, 2015m).
[75] Birds: "Warm-blooded vertebrates possessing feathers and belonging to the class Aves" (USEPA, 2015m).
[76] 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, 2015m).
[77] Invertebrates: "Animals without backbones: e.g. insects, spiders, crayfish, worms, snails, mussels, clams, etc" (USEPA, 2015m).

migratory birds as well as their habitats within Michigan. 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 MDNR, the state is home to 636 vertebrate species, including 115 game species. Of the 636 vertebrate species, there are 66 mammal species, 28 reptile species (17 snakes, 10 turtles, and one lizard), 22 amphibian species (12 frogs and 10 salamanders), 150 fish species, and over 370 bird species, including 232 bird species that are known to have bred in the state (DNR, 2015g).

Mammals

Common and widespread large mammal species in Michigan include the black bear (*Ursus americanus*), wolf (*Canis lupus*), elk (*Cervus elaphus*), moose (*Alces alces*), cougar (*Puma concolor*), red fox (*Vulpes vulpes fulva*), coyote (*Canis latrans*), and white-tailed deer (*Odocoileus virginianus*). Common smaller mammal species include the water shrew (*Sorex palustris*), badger (*Taxidea taxus*), meadow vole (*Microtus pennsylvanicus*), flying squirrel (*Glaucomys sabrinus* and *G. volans*), American marten (*Martes americana*), and eastern mole (*Scalopus aquaticus*). Most mammals are widely distributed in the state. Common flying mammals, such as bats, include the little brown bat (*Myotis lucifigus*), Indiana bat (*Myotis solidalis*), and silver-haired bat (*Lasionycteris noctivagans*) (DNR, 2015h). A number of threatened and endangered mammals are located in Michigan. Section 8.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, identifies these protected species.

In Michigan, black bear, elk, white-tailed deer, and wild turkey (*Meleagris gallopavo*) are classified as big game species, whereas small game species include small mammals (e.g., squirrels and rabbits), furbearers, and upland and migratory game birds (DNR, 2015i). The following small game species may be legally hunted in Michigan: coyote, cottontail rabbit (*Sylvilagus floridanus*), snowshoe hare (*Lepus americanus*), red and eastern gray squirrels (*Tamiasciurus hudsonicus* and *Sciurus carolinensis*), crow (*Corvus brachyrhynchos*), ring-necked pheasant (*Phasianus colchicus*), northern bobwhite quail (*Colinus virginianus*), ruffed grouse (*Bonasa umbellus*), sharp-tailed grouse (*Tympanuchus phasianellus*), woodcock (*Scolopax minor*), and waterfowl species, such as geese and swans (DNR, 2015i).

Michigan has identified 27 mammals as Species of Greatest Conservation Need (SGCN) (DNR, 2005). The SGCN list consists of at-risk species that are rare or declining, and State Wildlife Grants can provide funding for efforts to reduce their potential to be listed as endangered. Although these species have been targeted for conservation, they are not currently under legal protection. The SGCN list is updated periodically and is used by the state of Michigan to focus their conservation efforts and as a basis for implementing their State WAP.

Birds

The number of native bird species documented in Michigan varies according to the timing of the data collection effort, changes in bird taxonomy,[78] and the reporting organization's method for

[78] Taxonomy: "A formal representation of relationships between items in a hierarchical structure" (USEPA, 2015m).

categorizing occurrence and determining native versus non-native status. Further, the diverse ecological communities (i.e., hardwood forests, savannas, lakes and ponds, plains, etc.) found in Michigan support a large variety of bird species.

According to the Distributional Checklist of the Birds of Michigan, a total of 370 bird species of resident and migratory birds have been documented and are known to occur in Michigan, with 232 of those species known to have breeding populations[79] in the state of Michigan (Payne 1983). Among the 370 extant[80] bird species in Michigan, 99 SGCN have been identified (DNR, 2005).

Michigan is located within the Mississippi Flyway. The Mississippi Flyway covers the entire state of Michigan and spans from the coast of the Gulf of Mexico in the south to the Canadian border to the north. 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).

Bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*) are protected under the Bald and Golden Eagle Protection Act. Bald eagles are generally found near large rivers and lakes year round within the state and have summer breeding range in northern Michigan (eBird, 2015a). Golden eagles are generally found in a variety of habitat types anywhere they occur, but they generally nest in mountains and cliffs. Golden eagles are found throughout the state during the winter season (eBird, 2015b).

A number of Important Bird Areas (IBAs) have also been identified in Michigan, as can be seen in Figure 8.1.6-2. The IBA program is an international bird conservation initiative with a goal of identifying the most important places for birds and to conserve these areas. These IBAs are identified according to standardized, scientific criteria through a collaborative effort among state, national, and international conservation-oriented non-governmental organizations (NGOs), state and federal government agencies, local conservation groups, academics, grassroots environmentalists, and birders. These IBAs link global and continental bird conservation priorities to local sites that provide critical habitat for native bird populations. IBA priority areas are based on a number of specific criteria. Generally, global IBAs are sites determined important for globally rare species or support bird populations at a global scale. Continental IBAs are sites determined important for continentally rare species or support bird populations at a continental

[79] Population: "Aggregate of individuals of a biological species that are geographically isolated from other members of the species and are actually or potentially interbreeding" (USEPA, 2015m).
[80] Extant: "A species that is currently in existence (the opposite of extinct)" (USEPA, 2015m).

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 National Audubon Society (NAS), a total of 103 IBAs are located in Michigan, including breeding range[81], migratory stop-over, feeding, over-wintering areas, and a variety of habitats such as hardwood forests; peatlands; swamp, pond, bog, and wetland areas; native prairie grasslands; shorelines; grasslands, sage brush, and wetland/riparian[82] areas (National Audubon Society, 2014). These IBAs, which cover approximately 5.3 million acres, are widely distributed throughout the state, although the largest concentration of IBAs are located in the central and north central regions of the state, near Saginaw Bay, at Gladwin Lake, and along the Lake Michigan and Lake Huron shorelines. These IBAs occur in national wildlife refuges, state parks and forests, wildlife sanctuaries, along known river corridors and along major lake shorelines. The largest IBAs in the state include the Saginaw Bay IBA, which occurs in central Michigan along the Lake Huron shoreline and covers 374,945 acres; Gladwin Lake Plain IBA, which occurs in central Michigan within 645,070 acres; and Grand Traverse Bay Basin IBA, which occurs in the northwestern portion of the Lower Peninsula within approximately 479,166 acres (National Audubon Society, 2014). A number of threatened and endangered birds are located in Michigan. Section 8.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, identifies these protected species.

Reptiles and Amphibians

A total of 50 native reptile and amphibian species occur in the state of Michigan, including 10 salamanders, 12 frogs, 10 turtles, one lizard, and 17 snakes (DNR, 2015j). These species occur in a wide variety of habitats from the central plains in the south to moist hardwood forests in the north. Amphibian and reptile species prefer habitats with cover provided by long grass, pockets of shrubby vegetation, and near the riparian areas adjacent to river, lake, and stream banks. Very few species are widespread throughout the state, and are instead more commonly found in areas near bodies of water, along sandy banks or open sandy soils, and within ponds and wetland areas, as turtles, frogs including the wood frog (*Lithobates sylvaticus*), and salamanders including the common mole salamander (*Ambystoma spp.*), are attracted to these types of habitats. Of the 50 native reptile and amphibian species, 30 SGCN have been identified (DNR, 2005). Section 8.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, identifies the federally listed protected reptile species occurring in Michigan.

Michigan's reptile and amphibian species are classified as nongame species. Hunting and trapping is not allowed for most reptile and amphibian species that do not have an open season, and take or possession of several species is prohibited, including the following: blanding's turtle (*Amys blandingi*), spotted turtle (*Clemmys guttata*), wood turtle (*Glyptemys insculpta*), eastern box turtle (*Terrapene carolina carolina*), black rat snake (*Elaphe obsoleta*), eastern fox snake (*Pantherophis gloydi*), copperbelly water snake (*Nerodia erythrogaster neglecta*), Kirtland's

[81] Breeding range: "The area utilized by an organism during the reproductive phase of its lifecycle and during the time that young are reared" (USEPA, 2015m).
[82] 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, 2015m).

snake (*Clonophis kirtlandii*), queen snake (*Regina septemvittata*), and eastern massasauga rattlesnake (*Sistrurus catenatus*), as well as boreal chorus frog (*Pseudacris maculata*), Blanchard's cricket frog (*Acris crepitans blanchardi*), small-mouthed salamander (*Ambystoma texanum*), marbled salamander (*Ambystoma opacum*), six-lined racerunner (*Aspidoscelis sexlineata*), and western lesser siren (*Siren intermedia netting*). Further, all reptile eggs are protected, as well as amphibians and reptiles protected under the federal ESA. A fishing license is required to take certain amphibians and reptiles during specified open seasons (e.g. June 15 through September 15) that are not regulated by the state, such as snapping turtles (*Chelydra serpentine*), spiny soft-shell turtles (*Apalone spinifera*), and mudpuppies (*Necturus maculosus*) (DNR, 2015j).

Invertebrates

Michigan is home to between 15,000 and 20,000 species of invertebrates, including a wide variety of bees, hornets, wasps, butterflies, moths, beetles, flies, dragonflies, damselflies, spiders, mites, and nematodes (DNR, 2015g). These invertebrates provide an abundant food source for mammals, birds, reptiles, amphibians, and other invertebrates.

In the U.S., one-third of all agricultural output depends on pollinators.[83] 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. Common bee species found in Michigan include bumble bees, carpenter bees, mason bees, leafcutter bees, andrenid bees, and sweat bees (Isaacs & Tuell, 2007). Of the 15,000 to 20,000 invertebrate in the state, there are138 SGCN (DNR, 2005).

Several federally threatened and endangered species are located in Michigan. Section 8.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, identifies these protected species.

[83] Pollinators: "Animals or insects that transfer pollen from plant to plant" (USEPA, 2015m).

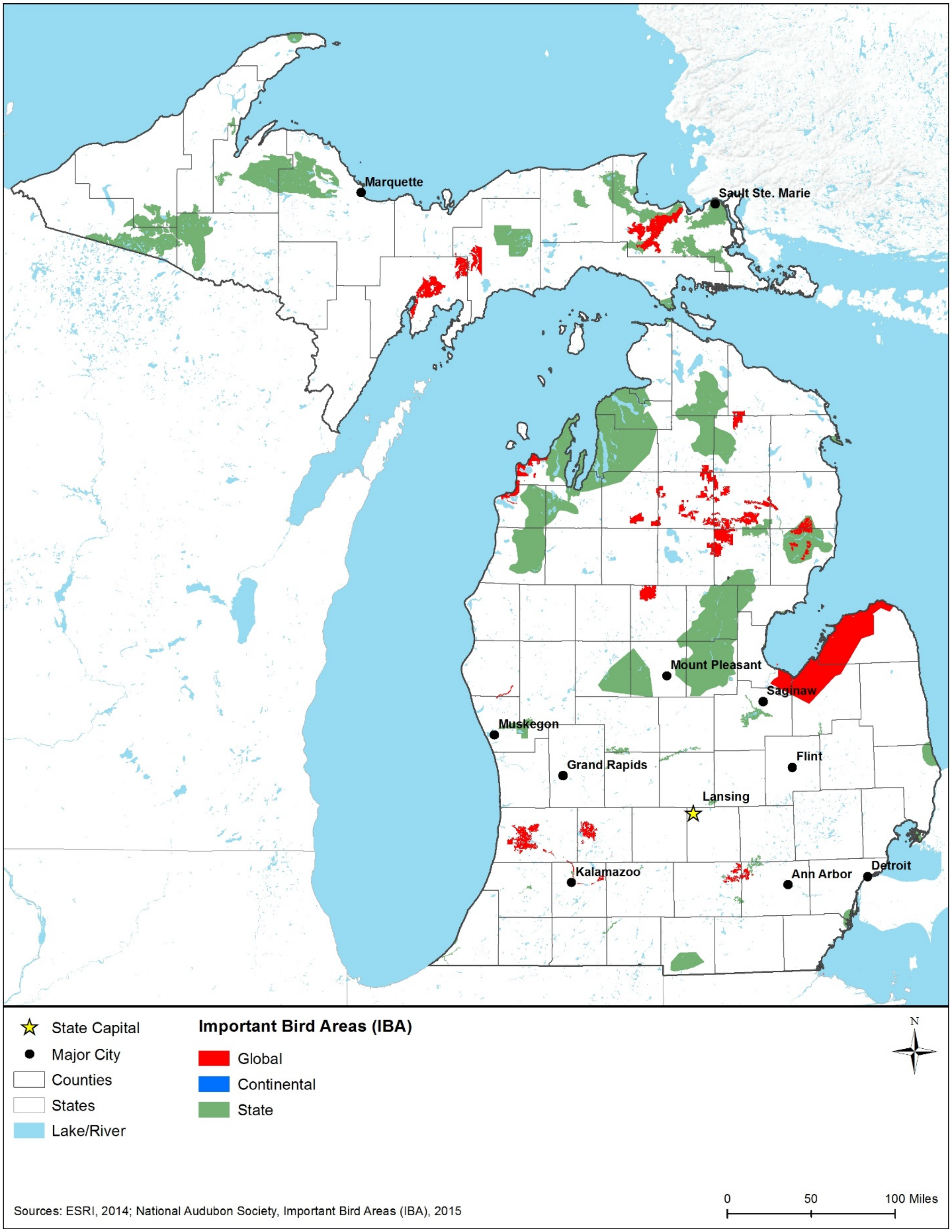

Figure 8.1.6-2: Important Bird Areas in Michigan

Invasive Wildlife Species

Under the Michigan NREPA, Michigan manages a list of prohibited species or restricted species; conditions are also set for harvesting, possessing, and transporting these restricted species (NREPA 451 of 1994, Section 324.41301). The Michigan DNR maintains a list of prohibited[84] species organized into two categories - prohibited and restricted. These lists are published under the NREPA 451 of 1994, Section 423.41301 (DNR, 2015k). The prohibited species list includes Feral Swine (*Sus scrofa Linnaeus*), Nutria (*Myocastor coypus*), the Eurasian collared dove (*Streptopelia decaocto*), the Emerald ash borer (*Agrilus planipennis*), and Asian longhorned beetle (*Anoplophora glabripennis*) (DNR, 2015l). Other species are managed by the state through programs like the mute swan (*Cygnus olor*), are managed by the state by programs to stabilize and reduce populations (DNR - Wildlife Division, 2012).

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

8.1.6.5. Fisheries and Aquatic Habitat

This section discusses the aquatic wildlife species in Michigan, including freshwater fish and invertebrates. A summary of non-native and/or invasive aquatic species is also presented. A distinctive feature of the Michigan landscape with regard to aquatic wildlife are the fisheries present, as well as 46,000 inland lakes, reservoirs, and ponds with a surface area at least one-tenth of an acre or greater and 76,439 miles of rivers and streams (including connecting channels) that span the state, including 43 percent of the Great Lakes, such as Lake Michigan and Lake Huron, within its borders (MDEQ, 2014a) (DNR, 2012a). Michigan includes 2,091 miles on 16 rivers or segments of rivers that have been designated into Michigan's Natural River System (DNR, 2012a) (DNR, 2015s). No essential fish habitat (EFH) identified by the Magnuson-Stevens Fishery Conservation and Management Act exists in Michigan. There are no federally listed threatened and endangered fish species, as defined by the ESA, in Michigan.

Freshwater Fish

Michigan is home to breeding populations of more than 153 species of freshwater fish, including largemouth bass (*Micropterus salmoides*), black crappie (*Pomoxis nigromaculatus*), bluegill (*Lepomis macrochirus*), catfish, lake sturgeon (*Acipenser fulvescens*), musky (*Esox masquinong*), northern pike (*Esox lucius*), yellow perch (*Perca flavescens*), walleye (*Sander vitreus*), salmon and trout, and smallmouth bass (*Micropterus dolomieu*). These species are grouped into 28 families, as follows: lampreys, sturgeons, paddlefishes, gars, bowfins, mooneyes, freshwater eels, herrings, carps and minnows, loaches, suckers, bullhead catfishes,

[84] Prohibited species: Any of the aquatic plant, terrestrial plant, bird, crustacean, fish, insect, mammal, and/or mollusk species; including a hybrid or genetically engineered variant of the species, egg, or a fragment, including a seed or other propagule, of the species or of a hybrid or genetically engineered variant; as listed in Act 451 of 1994 of Michigan state law, Part 413, Transgenic and Nonnative Organisms, 324.41301, paragraph k.

pikes, mudminnows, smelts, trout, trout-perches, pirate perches, cods, killifishes, silversides, sticklebacks, sculpins, striped bass, sunfish, perch, drums, and gobies (DNR, 2015t). A brief description of those families that contain common species, notable sport fish species, or species of concern is included below.

The lampreys family includes five different species, including the chestnut lamprey (*Ichthyomyzon castaneus*) and the Northern brook lamprey (*Ichthyomyzon fossor*). There are no SGCN in this fish family. (DNR, 2015t)

The sturgeon family includes only one species, the lake sturgeon (*Acipenser fulvescens*), which is also identified as a threatened species of concern and a SGCN. Unlike many other Michigan fish species, the lake sturgeon has no scales; it is covered with five rows of bone like plants on its back, sides, and stomach. It is also one of the longest-lived of any of Michigan's fish species, living up to 100 years. In Michigan, lake sturgeon spawn in the upper Black River in Cheboygan County. Within the United States, Michigan and Wisconsin are the only states to have major populations of these fish (DNR, 2015r).

The paddlefish family contains the paddlefish (*Polyodon spathula*), an extirpated species that prefers large rivers and lakes. Paddlefish spawn over mud or gravel in the early spring during high flows and spawning occurs from early May through early June. They are mainly distributed in Michigan in slower-moving waters of river side channels, in protected bays, and eddies of tailwaters below dams, however there are no known occurrences in Michigan (MNFI, 2007).

The gar family contains two fish species the spotted gar (*Lepisosteus oculatus*) and the longnose gar (*Lepisosteus osseus*). The spotted gar is a SGCN; the longnose gar is a fish that is native only to North America's fresh and brackish waters (MNFI, 2002).

Three other fish families consist of the bowfin, mooneyes, and freshwater eel, which include the bowfin (*Amia calva Linnaeus*), mooneye (*Hiodon tergisus*), and American eel (*Anguilla rostrata*). The bowfin and freshwater eel are not SGCN; however the mooneye is a SGCN. (DNR, 2015t)

The herring family consists of three species, including skipjack herring (*Alosa chrysochloris*), a species known to occur more in Wisconsin than Michigan. Skipjack herring prefer open water, larger rivers, lakes, and channels below dams. They may congregate in swift currents below dams; they have also been caught in the nearshore areas of Lake Michigan. The herring family does not contain SGCN. (DNR, 2015t)

The carp and minnow family contains 40 species, including four endangered species and three extirpated species. The four endangered species include the redside dace (*Clinostomus elongatus*), silver shiner (*Notropis photogenis*), pugnose minnow (*Opsopoeodus emiliae*), and southern redbelly dace (*Phoxinus erythrogaster*) (DNR, 2002). The three extirpated species include the bigeye chub (*Notropis amblops*), ironcolor shiner (*Notropis chalybaeus*), and weed shiner (*Notropis texanus*). The carp and minnow family also contain 11 SGCN: redside dace (*Clinostomus elongatus*), brassy minnow (*Hybognathus hankinsoni*), striped shiner (*Luxilus chrysocephalus*), silver chub (*Macrhybopsis storeiana*), river chub (*Nocomis micropogon*), pugnose shiner (*Notropos anogenus*), bigmouth shiner (*Notropis dorsalis*), silver shiner

(*Notropis photogenis*), pugnose minnow (*Opsopoeodus emiliae*), southern redbelly dace (*Phoxinus erythrogaster*), and finescale dace (*Phoxinus neogaeus*). (DNR, 2015t)

The sucker family contains 15 species, including one endangered species, one threatened species, and several SGCN. The one endangered and SGCN is the western creek chusucker (*Erimyzon claviformis*). The one threatened species is the river redhorse (*Moxostroma carinatum*). The six other SGCN include the lake chubsucker (*Erimyzon sucetta*), black buffalo (*Ictiobus niger*), spotted sucker (*Minytrema melanops*), river redhorse (*Moxostoma carinatum*), black redhorse (*Moxostoma duquesnei*), and golden redhorse (*Moxostoma erythrurum*). Most of the SGCN population is distributed on the lower peninsula of southern Michigan. (DNR, 2015t)

The bullhead catfish family contains 10 species, including one endangered species and five SGCN (DNR, 2005). The northern madtom (*Noturus stigmosus*) listed as endangered and a SGCN. The four SGCN include brown bullhead (*Ameiurus nebulosus*), stonecat (*Noturus flavus*), tadpole madtom (*Noturus gyrinus*), and brindled madtom (*Noturus miurus*). Brown bullhead is a common catfish species. However, experts believe the species has experienced a 50 percent reduction due to hybridization. The species occurs throughout the upper and lower peninsula of Michigan (DNR, 2005). The other four SGCN occur mainly in southern Michigan in shoreline, nearshore, and medium to large lake habitats, with the exception of the northern madtom. The northern madtom occupies medium to large river habitats where the gradient is fast and there is rock substrate (DNR, 2005).

The trout family includes several popular sport fishes and species of special concern, including the cisco or lake herring (*Coregonus artedii*), a threatened species; deepwater cisco (*Coregonus johannae*) and shortnose cisco (*Coregonus reighardi*),both extinct species; shortjaw cisco (*Coregonus zenithicus*), a threatened species; and arctic grayling (*Thymallus arcticus*),an extirpated species. More common trout species, such as the rainbow trout (*Oncorhynchus mykiss*) and brook trout (*Salvelinus fontinalis*), are also present in Michigan in the trout family. In this family, the four SGCN include the cisco, kiyi (*Coregonus kiyi*), shortjaw cisco, and pygmy whitefish (*Prosopium coulterii*). (DNR, 2015t)

The sunfish family consists of 12 species, including commonly known species, such as the bluegill (*Lepomis macrofhirus*), smallmouth bass (*Micropterus dolomieu*), largemouth bass (*Micropterus salmoides*), and the white crappie (*Pomoxis annularis*). None of the species in the sunfish family are threatened or endangered, and none are identified as SGCN (DNR, 2005).

The perch family consists of 18 species, including two threatened and two endangered species, and eight SGCN (DNR, 2005). The eastern sand darter (*Ammocrypta pellucid*) and sauger (*Sander canadensis*) are both threatened species. The channel darter (*Percina copelandi*) and river darter (*Percina shumardi*) are both endangered species. The eight SGCN include the eastern sand darter, fantail darter (*Etheostoma flabellare*), least darter (*Etheostoma microperca*), orangethroat darter (*Etheostoma spectabile*), banded darter (*Etheostoma zonale*), channel darter (*Percina copelandi*), river darter (*Percina shumardi*), and sauger species. With the exception of the least darter, most of the SGCN occur on the lower peninsula of Michigan, with the majority concentrated near Saginaw Bay (DNR, 2005).

Other families that consist of common fish, notable sport fishes, or species of concern, but fewer overall species diversity within Michigan include the loach, pike, mudminnow, and smelt family, as well as the trout-perch, pirate perch, cod, killifish, silverside, sticklebacks, sculpins, striped bass, drums, and gobie families (DNR, 2005).

Shellfish and Other Invertebrates

Michigan is home to over 79 species of mollusk (DNR, 2015f). Of the 79 species, 45 mollusk species are tracked by the state, and currently 19 of the 45 species (more than a third) are listed by the state as endangered, threatened, or SGCN (MNFI, 2005). Twenty-eight of the 45 mollusk species that occur in Michigan are listed as SGCN. Most of the mollusk species recorded and tracked in Michigan are part of the *Unionidae* bivalve[85] family. The *Unionidae* family is tracked because of their unique life history, importance to aquatic ecosystems, and use as indicators of change in water and habitat quality. Species from the other three families of bivalves (i.e. *Sphaeriidae, Corbiculidae,* and *Dreissenidae*) are also tracked, such as fingernail or pea clams, which are also widespread in Michigan; however less is known about the range and status of individual species (MNFI, 2005).

Michigan's waters are home approximately 195 non-insect arthropod[86] species, including snails (DNR, 2015f). Approximately 36 SGCN snail species are tracked by the state. Similarly, two crayfish species identified as SGCN are also tracked by the state (DNR, 2005).

Invasive Aquatic Species

As previously discussed, Michigan has adopted regulations that prohibit the possession, transport, importation, sale, transfer, or introduction of certain invasive species in without a permit. The MDNR maintains a list of prohibited and restricted species. The list of regulated invasive aquatic species consists of 13 prohibited plant species, three prohibited crustacean species, eight prohibited mollusk species, and 16 prohibited crustacean species. The list also includes five restricted plant species one restricted crustacean species, and two restricted mollusk species (DNR, 2015l). Invasive aquatic species commonly detected in Michigan include zebra mussels (*Dreissena polymorpha*) and Eurasian water milfoil (*Myriophyllum spicatum*). Prohibited and restricted aquatic plant species include flowering rush (*Butomus umbellatus*), Curly-leaf pondweed (*Potamogeton crispus*), Hydrilla (*Hydrilla verticillata*), and Phragmites or common reed (*Phragmites australis*) (DNR, 2015l).

8.1.6.6. 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 Michigan. The USFWS has identified 14 federally endangered and 11 federally threatened species in

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

[86] Arthropods: "Any member of the phylum Arthropoda, which are characterized by jointed appendages, an exoskeleton, and segmented body parts. Arthropods are the most diverse group of animals on Earth and include insects, crustaceans, arachnids, myriapods, and onychophorans as well as extinct forms like trilobites" (Smithsonian Institution, 2016).

Michigan (USFWS, 2015c) (USFWS, 2015d). Of these 25 federally listed species, three have designated critical habitat[87], as shown in Figure 8.1.6-3. Listed species include four mammals, one reptile, three birds, nine invertebrates, and eight plants, and are discussed in detail under the following sections (USFWS, 2015e). There are no federally listed amphibian or fish species in Michigan. 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 two threatened mammal species are federally listed for Michigan as summarized in Table 8.1.6-4. The Canada lynx (*Lynx canadensis*) and the gray wolf (*Canis lupus*) occur in northern Michigan. The Indiana bat (*Myotis sodalis*) and the northern long-eared bat (*Myotis septentrionalis*) occur throughout Michigan. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Michigan is provided below.

Table 8.1.6-4. Federally Listed Mammal Species of Michigan

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Michigan	Habitat Description
Canada Lynx	*Lynx canadensis*	T	No	Boreal forests; found in 15 counties above Lake Michigan, in northern Michigan.
Gray Wolf	*Canis lupus*	E	Yes; Isle Royale National Park, northern Michigan.	High elevation forests adjacent to grasslands; found in 15 counties above Lake Michigan in northern Michigan.
Indiana Bat	*Myotis sodalis*	E	No	Trees and snags, caves, and abandoned mines; found in 41 counties throughout Michigan.
Northern Long-eared Bat	*Myotis septentrionalis*	T	No	Trees and snags, caves, and abandoned mines; found in 83 counties throughout Michigan.

Source: (USFWS, 2015c)

[a] E = Endangered, T = Threatened

[87] 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)).

Figure 8.1.6-3: ESA Designated Critical Habitat in Michigan

Canada Lynx. The Canada lynx is an average-sized cat (ranging from 30 to 35 inches long and 14 to 31 pounds) with "large, well-furred paws, long, black ear tufts, and a short, black-tipped tail" that separates it from a bobcat (*Lynx rufus*) (USFWS, 2013b). This cat inhabits boreal forests dominated by spruce and fir, and is skilled at hunting in deep snow. Their primary prey is the snowshoe hare (*Lepus americanus*) and as a result, the abundance and survival of the Canada lynx is directly related to the density and health of regional snowshoe hare populations. Only a few places in the lower 48 states regularly support the Canada lynx populations, occurring on public lands in the Rocky Mountains, and to the west of Lake Superior. In Michigan, it is found in 15 counties above Lake Michigan, in the northern part of the state (USFWS, 2015f).

The Canada lynx was listed in 2000 primarily due to concerns with regard to habitat destruction, and need for more regulatory control and consistent guidance for forest management activities. Given the lynx travels back and forth between the U.S. and Canada, contiguous habitat is important for this species. In addition, snowshoe hare habitat is also important because of the direct link between snowshoe hare abundance and lynx abundance and survival. While incidental take of lynx from hunting or trapping is possible, available data do not indicate this to be a cause for low species densities (USFWS, 2005a) (USFWS, 2013b).

Gray Wolf. The gray wolf is a member of the dog (canine) family, with fur color, which may be white, red, brown, black, and many variations in between. The species reaches an approximate length of six feet, weigh approximately 100 pounds, and typically live up to five years (USFWS, 2010a). The gray wolf was listed as endangered in 1978 (42 FR 9607 9615, March 9, 1978), and has since been divided into a number of distinct populations. Portions of the gray wolf populations have been proposed for delisting by the USFWS. The species' distribution ranges from Canada to the American southwest and Mexico. The North American gray wolves' existing range extends from northern Michigan to Washington and northern California. The gray wolf is found in 15 counties above Lake Michigan in the northern part of the state (USFWS, 2010a) (USFWS, 2015g). Critical habitat was designated in 1978 (43 FR 9607 9615, March 9, 1978) in Michigan in Isle Royale National Park (USFWS, 1978).

Habitat for the gray wolf includes dense woodlands in mountainous regions where large ungulate species (hoofed mammals) are found, adjacent to higher-elevation grasslands. As a top predator and keystone species to many ecosystems, the species feeds on deer, elk, small mammals, and livestock. Threats to the gray wolf include habitat destruction via human population increase and expansion, potential viral or bacterial diseases, and illegal shooting (USFWS, 2010a).

Indiana bat Photo Credit: USFWS

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*) (DNR, 2016e) (USFWS, 2006a). 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 range, less than half of the population of 1967 (USFWS, 2015h). Regionally, this species is currently found in the central portion of the eastern U.S. from Vermont west to Wisconsin, Missouri, and Arkansas, and south and east to northwest Florida. In Michigan, the Indiana bat is known to occur in 41 counties throughout the state (USFWS, 2015i).

In the fall, the Indiana bats migrate to their hibernation sites in caves and abandoned mines in order to mate and build up fat reserves for hibernation season in the winter. Upon emerging from hibernation, the bats feed near their hibernations sites (within 10 miles) before they migrate to their summer habitats, where the females roost (USFWS, 2006a). Some of these summer habitats can be as far as 300 miles away from their hibernation areas (USFWS, 2004). Indiana bats roost in trees during the day and feed at night in a variety of habitats, although streams, floodplain forests, ponds, and reservoirs are preferred. Females roost together in maternity colonies under the loose bark of dead or dying trees, or under the loose bark of shaggy-barked trees, although the physical characteristics of individual trees appear to be more of a factor than the species of tree. Nevertheless, tree species that have been noted as preferred by Indiana bat include shagbark hickory (*Carya ovata*), white oak (*Quercus alba*), silver maple (*Acer saccharinum*), sugar maple (*Acer saccharum*), green ash (*Fraxinus pennsylvanica*), eastern cottonwood (*Populus deltoides*), and American elm (*Ulmus rubra*) (USFWS, 2012b).

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 (DNR, 2016e) (USFWS, 2004) (USFWS, 2015h). 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, 2015j). 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 2, 2015). In the U.S., its range includes most of the eastern and north central states. In Michigan, the northern long-eared bat is known to occur in 83 counties throughout the state (USFWS, 2015k).

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, 2015j).

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, 2015k). 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, 2015j).

Birds

Two endangered and one threatened bird species are federally listed for Michigan as summarized in Table 8.1.6-5. The Kirtland's warbler (*Setophaga kirtlandii*) occurs throughout Michigan. The piping plover (*Charadrius melodus*) occurs throughout the Great Lakes watershed of Michigan. The red knot (*Calidris canutus rufa*) occurs along the beaches of Michigan. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Michigan is provided below.

Table 8.1.6-5. Federally Listed Bird Species of Michigan

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Michigan	Habitat Description
Kirtland's Warbler	*Setophaga kirtlandii*	E	No	They nest in the southern region of the jack pine range and on the driest, most basic sand soils of Michigan. They migrate from their nesting grounds in the northern U.S. to the southeastern coast of the U.S. on their way to wintering grounds in the Bahamas. Found in 20 counties throughout Michigan.
Piping Plover	*Charadrius melodus*	E	No	Open, sparsely vegetated beaches composed of sand or gravel on islands or shorelines of inland lakes or rivers. Found in 19 counties within the Great Lakes watershed of Michigan.
Red Knot	*Calidris canutus rufa*	T	No	Found in 43 counties along the beaches of Michigan.

Source: (USFWS, 2015c)

[a] E = Endangered, T = Threatened

Kirtland's Warbler. The Kirtland's warbler is a yellow-breasted songbird with dark blue and black back feathers; it is approximately six inches long, and the males have a mask with white eye rings while the females do not. The species was listed as endangered 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.). The species is found throughout the central and northwestern Great Lakes region and in localized areas of South Carolina and Florida during migration. In Michigan, it can be found in 20 counties throughout the state (USFWS, 2015l).

Though red pine plantations have also been utilized by the species, habitat for the Kirtland's warbler primarily consists of jack pine areas with sparse ground cover. The species prefers dry, sandy soils with rapid water drainage to prevent flooding from rainfall. Burned jack pine habitats have been noted as very significant to the species, with much more successful nesting rates in these areas, though ground cover is still important when choosing a site. Threats to the

Kirtland's warbler include habitat loss due to its specific habitat needs, the increase of forest fire control, parasitic threats from the crown-headed cowbird (*Molothrus ater*), and predation during nesting and at its Bahamas mating grounds (DNR, 2015m) (Kirtland's Warbler Recovery Team, 1985).

Piping Plover. The piping plover is a small, pale-colored shorebird with a short beak and black band across the forehead, listed as endangered in 1985 for the Great Lakes watershed of both the United States and Canada, and as threatened in the remainder of its range including the U.S. Northern Great Plains, Atlantic and Gulf Coasts, Puerto Rico, Virgin Islands (50 FR 50726 50734, Dec 11, 1985) (USFWS, 2015m). Piping plovers breed in three geographic regions of North America, composed of two separate subspecies (USFWS, 2015n). In Michigan, the bird is found in 19 counties within the Great Lakes watershed of the state (USFWS, 2015m).

Piping plover Photo Credit: USFWS

Suitable habitat consists of open, sparsely vegetated beaches composed of sand or gravel on islands or shorelines of inland lakes or rivers. Nesting often occurs in palustrine wetlands[88] in the Northern Great Plains (USACE, 1988). They feed on worms, fly larvae, beetles, crustaceans, and other macroinvertebrates. Current threats to this species include habitat loss and habitat degradation, human disturbance, pets, predation[89], flooding from coastal storms, and environmental contaminants (USFWS, 2003a).

Red Knot. The red knot is approximately 9 inches in length with a wingspan up to 20 inches, making it among the largest of the small sandpipers (USFWS, 2005b). It was recently federally listed as a threatened species in 2014 (79 FR 73705 73748, December 11, 2014). The red knot migrates annually from its 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, 2014b) (USFWS, 2005b). In Michigan, the red knot can be found in 43 counties along the beaches of the state (USFWS, 2015o).

Red knots eat mussels and other mollusks mostly all year (USFWS, 2005b). Current threats to the red knot include sea level rise, climate change, and reduced food availability at their migration stopover sites (USFWS, 2014b).

[88] Palustrine wetlands: "Palustrine wetlands include nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens" (USEPA, 2015m).
[89] Predation: "The act or practice of capturing another creature (prey) as a means for securing food" (USEPA, 2015m).

Reptiles and Amphibians

One threatened reptile species is federally listed in Michigan as summarized in Table 8.1.6-6. The copperbelly water snake (*Nerodia erythrogaster neglecta*) occurs in southern Michigan. Information on the habitat, distribution, and threats to the survival and recovery of this species in Michigan is provided below.

Table 8.1.6-6. Federally Listed Reptile Species of Michigan

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Michigan	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 6 counties in southern Michigan.

Source: (USFWS, 2015c)

[a] T = Threatened

Copperbelly water snake Photo Credit: USFWS

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, 2015p). The northern population of the copperbelly water snake was listed as threatened in 1997 (62 FR 4183 4192, January 29, 1997) (USFWS, 2015q). 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, 2015p).

This snake occurs in two geographic populations – the northern population, which is protected by the ESA, and the southern population, which is not. In Michigan, this species can be found in six counties in the southern part of the state (USFWS, 2015r).

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

Invertebrates

Nine[90] endangered invertebrate species are federally listed for Michigan as summarized in Table 8.1.6-7. The Hine's emerald dragonfly (*Somatochlora hineana*) and the Hungerford's crawling water beetle (*Brychius hungerfordi*) occur in northern Michigan. The Karner blue butterfly (*Lycaeides melissa samuelis*) occurs in western Michigan. The northern riffleshell (*Epioblasma torulosa rangiana*) occurs in eastern Michigan. The clubshell (*Pleurobema clava*), Mitchell's satyr butterfly (*Neonympha mitchellii*), and the snuffbox mussel (*Epioblasma triquetra*) occur in southern Michigan. The Karner blue butterfly (*Lycaeides melissa samuelis*), northern riffleshell (*Epioblasma torulosa rangiana*), Poweshiek skipperling (*Oarisma poweshiek*), and the rayed bean (*Villosa fabalis*) occur in southeastern Michigan. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Michigan is provided below.

[90] The American Burying Beetle (*Nicrophorus americanus Olivier*) is listed as an endangered species in Michigan; however, there have been no recent sightings in Michigan, and it is not further discussed in this document.

Table 8.1.6-7. Federally Listed Invertebrate Species of Michigan

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Michigan	Habitat Description
Clubshell	*Pleurobema clava*	E	No	River and streams with clean, loose sand, and gravel; found in Hillsdale County, southern Michigan.
Hine's Emerald Dragonfly	*Somatochlora hineana*	E	Yes; Alpena, Mackinac, and Presque Isle counties in northern Michigan.	Marshes and slow moving water next to forests; found in 5 counties in northern Michigan.
Hungerford's Crawling Water Beetle	*Brychius hungerfordi*	E	No	Moderate to fast clear, cool streams with aerated riffles, cobble over sand substrate, and alkaline water. It is frequently found in areas downstream from blockages such as beaver and natural dams, water pipes, and human-built impoundments. Found in 5 counties in northern Michigan.
Karner Blue Butterfly	*Lycaeides melissa samuelis*	E	No	Early successional communities; found in 11 counties in the western and southeastern parts of Michigan.
Mitchell's Satyr Butterfly	*Neonympha mitchellii*	E	No	Wetlands that are low nutrient wetlands and receive carbonate rich groundwater; found in 9 counties in southern Michigan.
Northern Riffleshell	*Epioblasma torulosa rangiana*	E	No	Clean, firmly packed, coarse sand and gravel in riffles and streams; found in Monroe, Sanilac, and Wayne counties, in the east and southeast portions of Michigan.
Poweshiek Skipperling	*Oarisma poweshiek*	E	Yes; 6 counties in southeastern Michigan.	Prairie fens and tallgrass; found in 6 counties in southeastern Michigan.
Rayed Bean	*Villosa fabalis*	E	No	Small headwater creeks and wave-washed areas of glacial lakes with aquatic vegetation in the Lake Erie and Allegheny forest regions; found in Oakland and St. Clair counties, in southeastern Michigan.
Snuffbox Mussel	*Epioblasma triquetra*	E	No	Small to medium sized creeks, lakes, and rivers with shoal habitats and swift current; found in 7 counties in southern Michigan.

Source: (USFWS, 2015c)

[a] E = Endangered

Clubshell. The clubshell mussel is a small to medium size mussel with yellow to brown shell exterior. It was federally listed as an endangered species in 1993 (58 FR 5638 5642, January 22, 1993). Regionally this species is known to occur from Michigan south to Tennessee and Illinois east to New York, with an experimental population in Tennessee. In Michigan, it can be found in Hillsdale County, in the southern part of the state (66 FR 32250 32264, June 14, 2001) (USFWS, 2015s).

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

Hine's Emerald Dragonfly. The Hine's emerald dragonfly is a dark green dragonfly with two cream-colored horizontal lines and bright green eyes. The species grows to approximately 2.5 inches and may have translucent, yellowish-brown fringed wings. The dragonfly was listed as endangered in 1995 (60 FR 5267 5273, January 26, 1995). The species' range extends from a localized population in southeastern Missouri to the northeastern region of Michigan around the intersection of Lake Michigan and Lake Huron, and has historically been present in Ohio and Indiana (USFWS, 2001). In Michigan, it can be found in five counties in the northern part of the state (USFWS, 2015t). Critical habitat was established in 2010 (75 FR 21394 21453, April 23, 2010) in Alpena, Mackinac, and Presque Isle counties, northern Michigan (USFWS, 2016a).

Habitat for Hine's emerald dragonfly include marshes and sedge meadows fed by calcium-rich groundwater seepage on top of sedimentary bedrock, in locations with slow moving water next to forests. Threats to the dragonfly primarily include habitat loss due to agriculture and human development, successional habitat progression, and alterations to biological and hydrological systems (USFWS, 2001).

Hungerford's Crawling Water Beetle. The Hungerford's crawling water beetle is an aquatic beetle that spends its entire active life in the water. Adult beetles are small, torpedo shaped, reach 0.15 to 0.17 inches in length, and are yellowish-brown in color with dark markings and stripes on the wing cases. The larvae have light yellowish brown colored, stiff, cylindrical bodies that narrow to a hooked tail, and short legs (USFWS, 2006b). The Hungerford's crawling water beetle was federally listed as endangered in 1994 (59 FR 10580 10584, March 7, 1994).

This species is known or believed to occur in Michigan and Canada. Within Michigan, it can be found in five counties in the northern part of the state (USFWS, 2015u). It inhabits moderate to fast clear, cool streams with aerated riffles, cobble over sand substrate, and alkaline water. It is frequently found in areas downstream from blockages such as beaver and natural dams, water pipes, and human-built impoundments (USFWS, 2006b). Threats to the Hungerford's crawling water beetle include beaver control by humans, natural beaver activity that disrupts its habitat, dredging, stream pollution, logging near streams, channelization, bank stabilization, and manmade impoundments (USFWS, 2009b).

Karner Blue Butterfly. The Karner blue butterfly is generally a dark blue or brownish-silver butterfly with orange accents and a black trim. The species is small, with a wingspan of approximately one inch, and has been federally listed as endangered since 1992 (57 FR 59236 59244, Dec 14, 1992) (USFWS, 2015v). Their range extends across 12 states from Minnesota to Maine (USFWS, 2008b). In Michigan, it can be found in 11 counties in the western and southeastern parts of the state (USFWS, 2015v).

The staple food for the caterpillars is wild lupine (*Lupinus perennis*) which restricts the Karner blue butterfly's distribution. Two hatches occur every year, one approximately in April and another in June. 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, June 25, 1991). It was regionally known to occur in 30 locations within the states in the Great Lakes region. It has since been extirpated from many locations but isolated populations have been documented in regions of Alabama, Indiana, Michigan, Mississippi, Ohio, and Virginia. In Michigan, it can be found in nine counties in the southern portion of the state (USFWS, 2015w) (XSIC, 2015).

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, January 22, 1993). It is regionally known to occur in Indiana, Kentucky, Michigan, Ohio, Pennsylvania, and West Virginia. In Michigan, it is known to occur in Monroe, Sanilac, and Wayne counties, in the east and southeast portions of the state. The preferred habitat is clean, firmly packed, coarse sand and gravel in riffles and streams. The reproduction lifecycle of the northern rifleshell 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 mussel has also become a major threat as it is spreading rapidly and killing the northern riffleshell (USFWS, 2010c) (USFWS, 2015x).

Poweshiek Skipperling. The Poweshiek skipperling is a small, dark brown and orange butterfly with streaked, white veins on the underside of its wings (USFWS, 2014c). The species was listed as endangered in 2014 (79 FR 63671 63748, October 24, 2014). The range for the Poweshiek skipperling historically extended from Canada to Iowa, and is now reduced to the eastern regions of North and South Dakota, and the eastern edge of Michigan. Further, 2014 surveys have only found single populations within Michigan, Wisconsin, and central Canada (USFWS, 2014c). In Michigan, it can be found in 6 counties in the southeastern part of the state (USFWS, 2015y).

Habitat for the Poweshiek skipperling consists of high-quality prairie tallgrass and moist prairie fens, feeding on prairie flower nectar and utilizing sedges for larvae development. Habitat loss and habitat fragmentation are the primary reasons for the species' decline, and remain as current threats to the species' survival. Incompatible grazing or controlled burning techniques pose significant threats to the species' habitat health (USFWS, 2014c).

Rayed Bean. The rayed bean mussel is a small, freshwater mussel, usually less than 1.5 inches long. Its shell is green, yellowish-green, or brown with greenish lines (USFWS, 2015z). The rayed bean mussel was federally listed as endangered in 2012 (77 FR 8632 8665, February 14, 2012). Its historical North American range included 115 streams and lakes, but current populations have reduced 76 percent and are only found in 31 streams and 1 lake. In the lower Great Lakes systems, it is known to occur in 10 streams (USFWS, 2012c). In Michigan, it can be found in Oakland and St. Clair counties, in the southeastern part of the state (USFWS, 2015z).

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

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). 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). In Michigan, it can be found in seven counties in the southern part of the state (USFWS, 2015aa).

The snuffbox mussels live in small to medium sized creeks, lakes, and rivers and feed on suspended algae, bacteria, and dissolved organic material. This species prefers shoal habitats with swift current over sand and gravel, as they usually burrow deep in sand. For reproduction a stable and undisturbed habitat is require with a sufficient population of host fish such as logperch (*Percina caprodes*) and several other darters. 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).

Plants

One endangered and seven threatened plant species are federally listed for Michigan as summarized in Table 8.1.6-8. The American Hart's-tongue fern (*Asplenium scolopendrium var. americanum*), Dwarf Lake iris (*Iris lacustris*), Houghton's goldenrod (*Solidago houghtonii*), lakeside daisy (*Hymenoxys herbacea*), and the Michigan monkey-flower (*Mimulus michiganensis*) occur in northern Michigan. The small whorled pogonia (*Isotria medeoloides*) occurs in southwestern Michigan. The eastern prairie Fringed orchid (*Platanthera leucophaea*) and the Pitcher's thistle (*Cirsium pitcheri*) occur throughout Michigan. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Michigan is provided below.

Table 8.1.6-8. Federally Listed Plant Species of Michigan

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Michigan	Habitat Description
American Hart's-tongue Fern	*Asplenium scolopendrium* var. *americanum*	T	No	It grows on or next to limestone in entrances to pit caves. Found in Chippewa and Mackinac counties in northern Michigan.
Dwarf Lake Iris	*Iris lacustris*	T	No	Adjacent to shoreline forests; found in 10 counties along the northern shorelines of Michigan.
Eastern Prairie Fringed Orchid	*Platanthera leucophaea*	T	No	Wetlands and prairies with full sunlight; found in 15 counties throughout Michigan.
Houghton's Goldenrod	*Solidago houghtonii*	T	No	Moist sandy beaches of the Great Lakes; found in nine counties in northern Michigan.
Lakeside Daisy	*Hymenoxys herbacea*	T	No	Outcrops of dolomite or limestone bedrock and on dry, gravelly prairies on terraces or on hills associated with river systems. Found in Mackinac County in northern Michigan.
Michigan Monkey-flower	*Mimulus michiganensis*	E	No	Cold, alkaline spring seepages and streams, usually with swamps that are formed in drainages that are found at the bottom of steep slopes and bluffs. Found in six counties in northern Michigan.
Pitcher's Thistle	*Cirsium pitcheri*	T	No	Active grassland dunes in sporadic population clumps; found in 26 counties along most of Michigan's shoreline.
Small Whorled Pogonia	*Isotria medeoloides*	T	No	Hardwood forest; found in Berrien County in the southwestern corner of Michigan.

Source: (USFWS, 2015c)

[a] E = Endangered, T = Threatened

American Hart's-tongue Fern. The American Hart's-tongue fern is an evergreen fern with strap-shaped fronds that grow from 5 to 17 inches long, 0.75 to 1.75 inches wide, and are lobed at the base. Groups of spore-producing structures form in lines on the underside of the blade part of the frond. The green stem is 1 to 5 inches long and has cinnamon-colored scales. The fronds grow up from a short, creeping horizontal root that is covered with cinnamon-colored scales (USFWS, 1993). The American Hart's-tongue fern was federally listed as threatened in 1989 (54 FR 29726 29730, July 14, 1989).

Regionally, this species is known or believed to occur in Alabama, Michigan, New York, and Tennessee. In Michigan, it can be found in Chippewa and Mackinac counties in the northern portion of the state (USFWS, 2015ab). It grows on or next to limestone in entrances to pit caves. It needs high humidity, substrate moisture, and some shade to grow. Threats to the American Hart's-tongue fern include trampling and habitat alteration and destruction due to timber removal, quarrying, and residential development (USFWS, 1993).

Dwarf Lake Iris. The Dwarf Lake iris is a perennial, lavender-blue, yellow-accented flower with a short stem and long, wide green leaves which was listed as threatened in 1988 (53 FR 37972 37975, September 28, 28). Regionally, the species' range extends "along the northern shorelines of lakes Michigan and Huron in Wisconsin, Michigan and Ontario, Canada" (USFWS, 2013c). Within Michigan, it can be found in 10 counties along the northern shorelines of the state (USFWS, 2015ac).

Habitat for the Dwarf Lake iris consists of thin soil over moist and calcium-rich sands or gravel. A balance between open sunlight and shade is necessary for reproduction, and is primarily found adjacent to shoreline forests. Significant threats to this species includes habitat loss such as from shoreline development, inadequate regulations to protect the species (such as only partial Canadian protection), climate change, and competition from invasive species such as the orange hawkweed (*Hieracium aurantacum*) (USFWS, 2013c).

Eastern Prairie Fringed Orchid. The eastern prairie 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 primarily in the Great Lakes and Illinois region, though also sparsely occurs from Maine south to Georgia. In Michigan, it can be found in 15 counties throughout the state (USFWS, 2015ad).

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 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, 2015ad). Threats to the eastern prairie orchid include altered hydrology, invasive plant species, succession to woody vegetation, foot traffic, and collection (USFWS, 2012f).

Houghton's Goldenrod. The Houghton's goldenrod is a perennial plant with small yellow flowers and thin leaves of up to 4.5 inches long (USFWS, 2015ae). It was federally listed as threatened in 1988 (53 FR 27134 27137, July 18, 1988). Regionally, this species is known or believed to occur in Michigan and New York, with most of the population occurring in Michigan. Within Michigan, it can be found in nine counties in the northern part of the state (USFWS, 2015ae).

The species is restricted to calcareous, wetland habitats of the Great Lakes, growing in moist sandy beaches and shallow depressions along shorelines and dunes. Threats to the Houghton's goldenrod include development and construction, habitat loss, sand mining, and erosion control that prevents dune formation (USFWS, 2015d).

Lakeside Daisy. The lakeside daisy is a perennial plant with bright yellow flowers that blooms from late April to early June (USFWS, 1990). It was listed as threatened in 1988 (53 FR 23742 23745, June 23, 1988). It has oblanceolate to lanceolate leaves that are dark green in color, although leaves are paler if the plant is experiencing drought. Leaf length varies widely, from less than an inch to over 6 inches (USFWS, 1990). Regionally, this species is known or believed to occur in Illinois, Michigan, and Ohio. In Michigan, it can be found in Mackinac County in the northern part of the state (USFWS, 2015af).

The lakeside daisy requires full sun and occurs on outcrops of dolomite or limestone bedrock and on dry, gravelly prairies on terraces or on hills associated with river systems. The primary threat to the lakeside daisy is habitat loss due to quarries or other disturbances, such as mining activities and fill disposal, and habitat succession (USFWS, 1990).

Michigan Monkey-flower. The Michigan monkey-flower is an aquatic to semi-aquatic perennial flower that grows in mats. The stems can grow to 15.7 inches or more in length, and root at lower leaves to produce more clone shoots. The roundish leaves grow opposite and are sharp-toothed. The flowers are bright yellow with a red-spotted lower lip and tube, and look like snapdragon flowers (USFWS, 1997b). The Michigan monkey-flower was federally listed as endangered in 1990 (55 FR 25596 25599, June 21, 1990).

This species is only known or believed to occur in six counties in northern Michigan (USFWS, 2015ag). It inhabits cold, alkaline spring seepages and streams, usually with swamps that are formed in drainages that are found at the bottom of steep slopes and bluffs. It grows best in openings in the tree canopy, along the edges of forests, or along streams next to open, meadows. Threats to the Michigan monkey-flower include habitat loss and alteration, hydrological disruptions, invasive species encroachment, and climate change (USFWS, 2011).

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 Michigan, it can be found in 26 counties along most of the shoreline of the state (USFWS, 2015ah).

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 "shoreline development, dune stabilization, recreation, and invasive non-native plants and insects," along with erosion by high lake levels (USFWS, 2002).

Small Whorled Pogonia. The small whorled pogonia is a member of the orchid family which grows between 10 to 14 inches in height with greenish yellow flowers. The small whorled pogonia was federally listed as endangered in 1982 (47 FR 39827 39831, September 9, 1982) and in 1994 was reclassified as threatened (59 FR 50852 50857, October 6, 1994) (USFWS, 2015aj). Regionally, this species is known to occur sparsely distributed from Maine south to Georgia and eastern to Illinois (USFWS, 2008c). In Michigan, it can be found in Berrien County in the southwestern corner of the state (USFWS, 2015aj).

The small whorled pogonia occurs in hardwood stands that have an open understory, preferring acidic soils along small streams that have a thick layer of litter (USFWS, 2008c). Small whorled pogonias bloom in May to June, producing a single tiny yellowish or greenish flower that lasts for seven days (Newcomb, 1989). One distinct feature of this species is that it can remain dormant underground for 10 to 20 years before reappearing (Petersen, 1968). Current threats to small whorled pogonia include habitat loss due to urban expansion and forestry practices (USFWS, 2008c).

8.1.7. Land Use, Recreation, and Airspace

8.1.7.1. Definition of the Resources

The following summarizes major land uses, recreational venues, and airspace considerations in Michigan, characterizing existing, baseline conditions for use in evaluating the potential environmental consequences resulting from implementing the proposed action or alternatives.

Land Use, Recreation, and Airspace

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

Recreational uses are activities in which residents and visitors participate. They include outdoor activities, such as hiking, fishing, boating, athletic events (e.g., golf), and other attractions (e.g., historic monuments and cultural sites) or indoor activities, such as museums and historic sites. Recreational resources can include trails, 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 according to the following areas: upper peninsula, northern, western, central, and eastern 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, 2015a). Airspace is a finite resource that can be defined vertically and horizontally, as well as temporally, when discussing it in relation to aircraft activities. Airspace management addresses how and in what airspace aircraft fly. Air flight safety considers aircraft flight risks, such as aircraft mishaps and bird/animal-aircraft strikes. The 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 and Aeronautical Center, etc.) assist in regulating civil aviation to promote safety, and develop and carry out programs that control aircraft noise and other environmental effects (e.g., air pollutants) attributed from civil aviation (FAA, 2015d). The FAA works with state aviation officials and airport planners, military airspace managers, and other organizations in deciding how best to use airspace.

8.1.7.2. Specific Regulatory Considerations

Land use planning in Michigan is the primary responsibility of local governments (i.e., county). The main planning tools for local governments include comprehensive plans, zoning ordinances, and subdivision ordinances. 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. Comprehensive plans propose land uses and locations of public facilities and utilities and project long-term population growth. Zoning ordinances set forth the rules used to govern the land by dividing localities into zoning districts and establish allowable uses (e.g., agriculture, industry, commercial use). Subdivision ordinances manage the process for dividing large land parcels into smaller lots.

Because the Nation's airspace is governed by federal laws, there are no specific Michigan state laws that would alter the existing conditions relating to airspace for this PEIS. Michigan legislature, Chapter 259 Aviation, addresses aviation for the state (Michigan Legislature, 2015b).

8.1.7.3. Land Use and Ownership

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

Land Use

Table 8.1.7-1 identifies the major land use by coverage type in Michigan. Forests and woodlands comprise the largest portion of land use, with 59 percent of the total land area in Michigan occupied by this category. Agricultural land is the second largest area of land use (26 percent). Developed areas account for approximately 10 percent of the total land area in Michigan. The remaining percentage of land includes public land, surface water (excluding the Great Lakes), and other land covers, shown in Figure 8.1.7-1, that are not associated with specific land (USGS, 2011).

Table 8.1.7-1: Major Land Use in Michigan by Coverage Type

Land Use	Square Miles*	Percent of Land
Forest and Woodland	33,310	59%
Agricultural Land	14,945	26%
Developed Land	5,377	10%
Public Land, Surface Water, and other Land Covers	2,907	5%

*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 14,945 square miles, or 26 percent of the total land area (Table 8.1.7-1) (USGS, 2011). Approximately 52,194 farms exist in Michigan, with an average size of 0.29 square miles (USDA, 2012a). Michigan's top agricultural products are poultry and eggs (5.4 percent of total agricultural receipts); cattle and calves (7 percent of total agricultural receipts); grains, oilseeds, dry beans, and dry peas (41.6 percent of total agricultural receipts); and milk from cows (nine 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 in the northern portion of the state in the Upper Peninsula. This area is sparsely populated and dominated by forest and wetland cover. The northern portion of the Lower Peninsula also contains substantial forest and woodlands; however, urban areas and agricultural land is interspersed with the forested lands in this area (Figure 8.1.7-1) (USGS, 2011). Section 8.1.6, Biological Resources, presents additional information about terrestrial vegetation.

National Forests

National forestland in Michigan is comprised of approximately 13 percent of the state's total forest land, and includes three national forests: Ottawa, Hiawatha, and Huron-Manistee National Forests. Two of these national forests (Ottawa and Hiawatha National Forests) occur in the Upper Peninsula, while the Huron-Manistee National Forest occurs in the northern portion of the Lower Peninsula (NPS, 2014d). These forests are 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 MDNR manages approximately 6,250 square miles of state forestland, which is scattered across the state and administered within 16 forest management units. These forests are managed for multiple uses and values, including timber production, hiking, wildlife viewing, hunting, fishing, and fish and wildlife habitat protection (USFS, 2015a). Table 8.1.7-2 presents the names and associated square miles of each of the 16 forest management units.

Table 8.1.7-2: Michigan State Forestland

Michigan Department of Natural Resources Forest Management Units	Square Miles
Upper Peninsula	
Baraga	223
Gwinn	434
Shingleton	594
Newberry	550
Sault Ste. Marie	504
Crystal Falls	469
Escanaba	222
Lower Peninsula	
Gaylord	492
Pigeon River Country	164
Traverse City	516
Cadillac	367
Gladwin	344
Southern Lower Peninsula	67
Atlanta	438
Grayling	436
Roscommon	430
Total	**6,250**

Source: (MDNREC, 2015a)

Private Forest and Woodland

The large majority of Michigan's forests and woodlands (approximately 62 percent) are owned by private individuals and companies (MDNREC, 2015c). Private forestlands indirectly provide some public benefit, including forest products, wildlife habitat, scenic beauty, and outdoor recreation opportunities. Approximately 3,125 square miles of private forest are open to the public for hunting and fishing under the Commercial Forest Program administered by the Department of Natural Resources (MDNREC, 2015c). 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 8.1.6, Biological Resources and Section 8.1.8, Visual Resources.

Developed Land

Developed land in Michigan is concentrated within major metropolitan areas and surrounding cities, towns, and suburbs (Figure 8.1.7-1). Although only six percent of Michigan's land is developed, these areas are highly utilized for residential, commercial, industrial, recreational, and government purposes. Table 8.1.7-3 lists the top five developed metropolitan areas within the state and their associated population estimates.

Table 8.1.7-3: Top Five Developed Metropolitan Areas in Michigan (2014 Estimate)

Metropolitan Area	Population Estimate
Detroit, MI	4,260,839
Grand Rapids, MI	1,191,720
Flint, MI	412,895
Lansing, MI	470,458
Ann Arbor, MI	641,517
Total Estimated Population of Metropolitan Areas	**6,977,429**
Total State Estimated Population	**9,909,877**

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

Land Ownership

Land ownership within Michigan has been classified into four main categories: private, federal, state, and tribal (Figure 8.1.7-2).[91]

Private Land

The large majority of land in Michigan is privately owned (Figure 8.1.7-2), with most of this land falling under the land use categories of agricultural, forest and woodland, and developed (Figure 8.1.7-1)). Highly developed, urban, metropolitan areas transition into suburban, agriculture, and woodland areas, which then transition into more wild and remote areas[92].

[91] 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 data set that contains large quantities of information relevant to the Proposed Action. The data was queried to show Owner and used USGS' PAD-US ownership symbolization for consistency. The PADUS 1.3 geodatabase was downloaded in the summer of 2015, and used consistently throughout all these maps for each state and D.C.

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

Federal Land

The federal government manages 6,002 square miles, or approximately 11 percent, of land in Michigan, including national forests, national parks, national wildlife refuges, and military facilities (Figure 8.1.7-2) (NPS, 2014d). Four federal agencies manage the majority of federal lands throughout the state (Table 8.1.7-4 and Figure 8.1.7-2). There may be other federal lands, but they are not shown on the map due to their small size relative to the entire state (USGS, 2014i).

Table 8.1.7-4: Federal Land in Michigan

Agency	Square Miles	Representative Type
United States Forest Service (USFS)	4,486	Forests and Wilderness
NPS	1,047	National Parks, Lakeshores, and Affiliated Areas
DoD	264	Military Installations
USFWS	205	Wildlife Refuges
Total	**6,002**	

- Source: (USGS, 2014i)

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

- The USFS manages 4,486 square miles of land comprised of three national forests (Ottawa, Hiawatha, and Huron-Manistee National Forests), the Upper Peninsula Experimental Forest, and the Grand Island National Recreation Area (USGS, 2014i).
- The NPS manages 1,047 square miles of land comprised of five NPS Units, and affiliated areas, including two national lakeshores: Pictured Rocks and Sleeping Bear Dunes National Lakeshores (USGS, 2014i).
- The DoD manages 264 square miles of land comprised of three Air Force bases (K.I. Sawyer, Wurtsmith, and Selfridge Air Force Bases), the Camp Grayling Military Reservation, and the Custer Reserve Forces Training Area (USGS, 2014i).
- The USFWS manages 205 square miles of land comprised of six National Wildlife Refuges (NWRs): Seney, Harbor Island, Huron, Michigan Islands, Detroit River, and Shiawassee NWRs (USGS, 2014i).

State Land[93]

The state of Michigan owns, leases or manages approximately 7,564 square miles of land, or approximately 13 percent of the total land in the state (Figure 8.1.7-2) (USGS, 2014i). These lands are managed primarily by the Michigan Department of Natural Resources and Environmental Control (MDNREC), which manages approximately 6,250 square miles of state forestland. These forests are scattered across the state and administered within 16 forest management units; they are managed for multiple uses and values, including timber production, hiking, wildlife viewing, hunting, fishing, and fish and wildlife habitat protection (MDNREC,

[93] 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.

2015a). The remaining lands managed by the DNREC are managed as parks and recreation areas, wildlife areas, and fisheries (MDNREC, 2015b).

Tribal Land

Approximately 325 square miles, or less than one percent, of land in Michigan is managed by American Indian tribes across trust lands and reservations held in trust by the Bureau of Indian Affairs (Figure 8.1.7-2) (USGS, 2014i). Table 8.1.7-5 presents the names and associated square miles of the Indian reservations and trust lands currently located in the state. Information on the current locations of the 12 federally recognized tribes in Michigan is provided in Section 8.1.11, below.

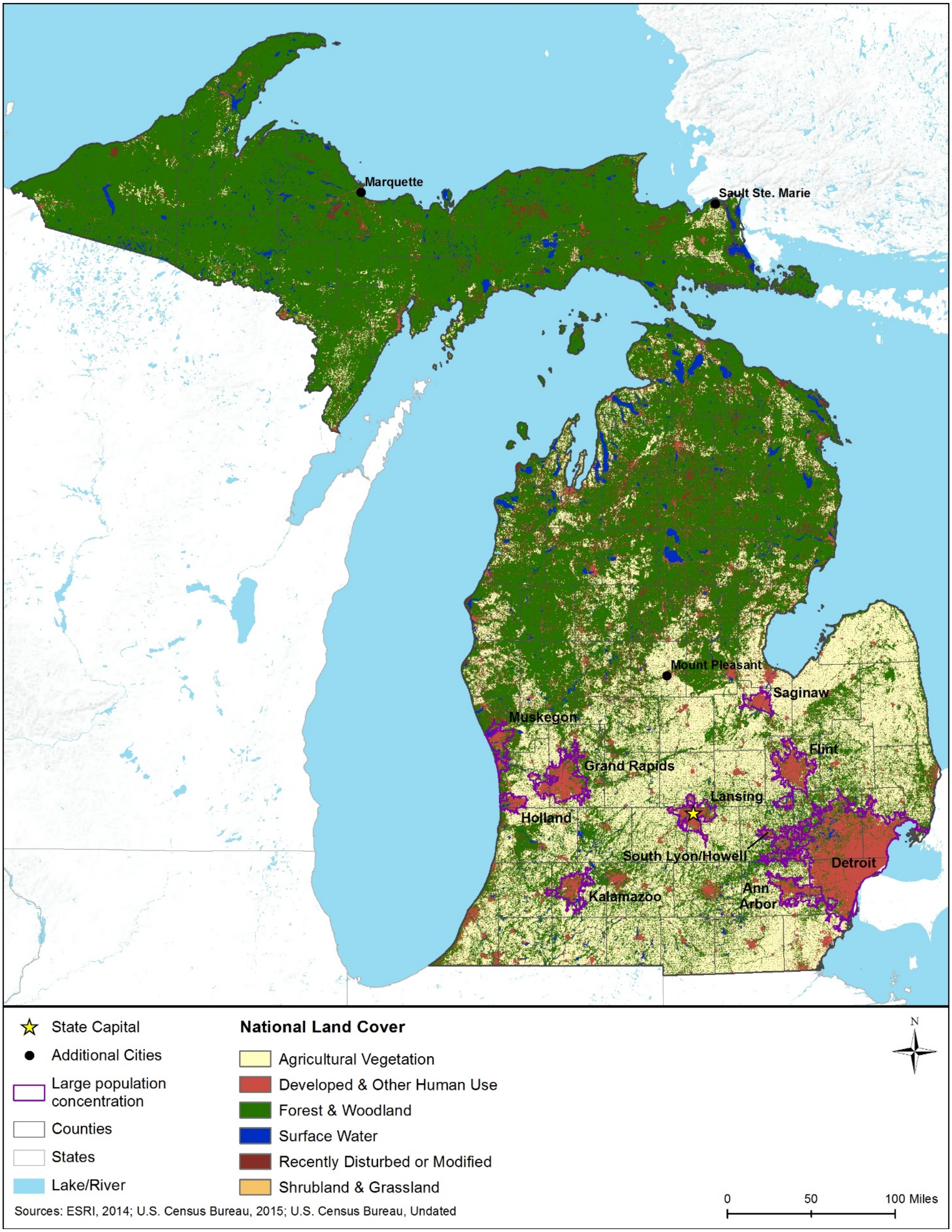

Figure 8.1.7-1: Major Land Use Distribution by Coverage Type

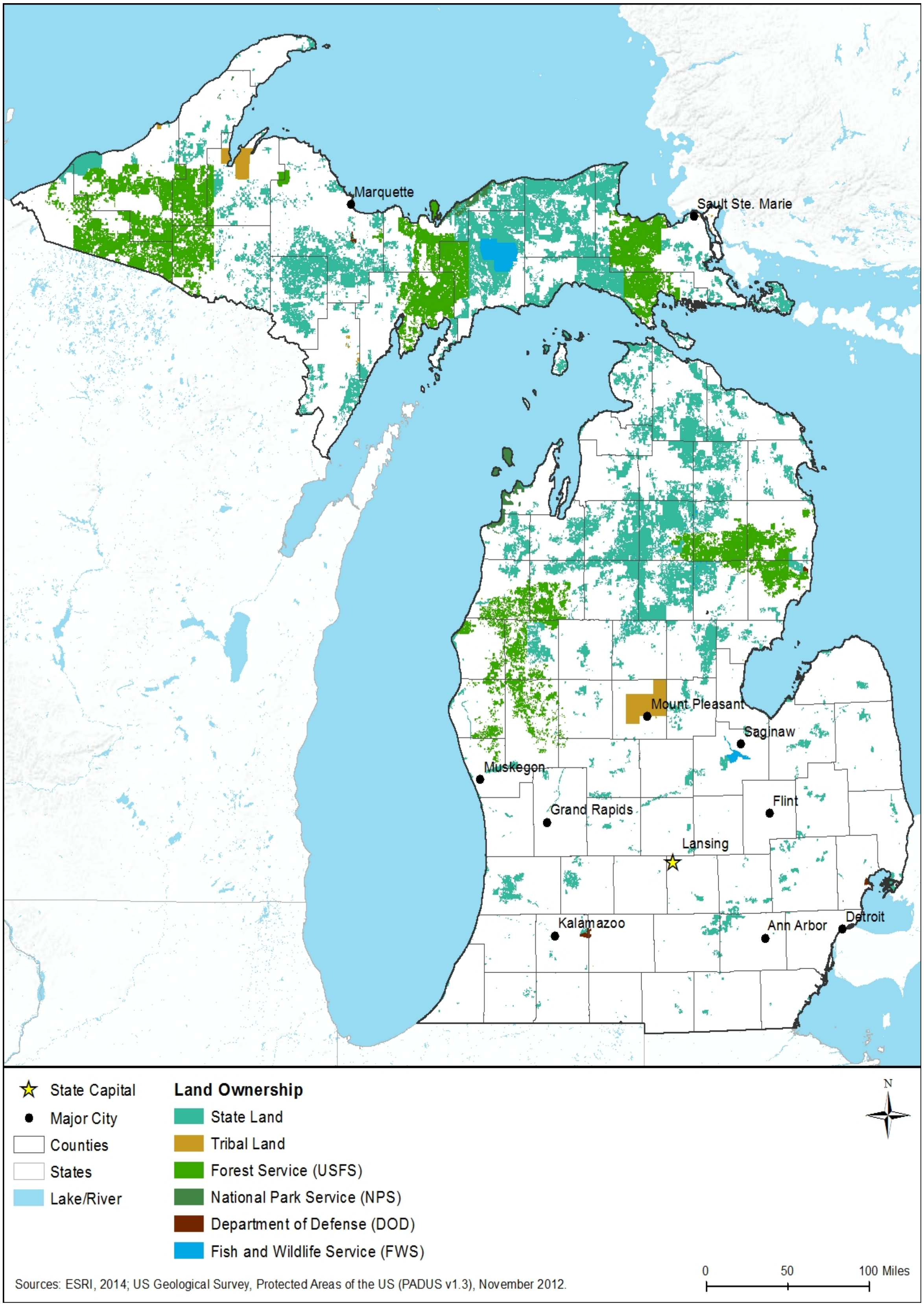

Figure 8.1.7-2: Land Ownership Distribution

Table 8.1.7-5: Indian Reservations and Other Land Holdings in Michigan

Indian Reservations and Other Land Holdings	Square Miles
Isabella Reservation	218.0
L'Anse Reservation	96.3
Hannahville Reservation	5.3
Bay Mills Reservation	3.5
Sault Ste. Marie Reservation	1.1
Grand Traverse Reservation	0.5
Little River Band of Ottawa Indians Land	0.3
L'Anse Trust Land	0.2
Huron Potawatomi Reservation	0.2
Sault Ste. Marie Trust Land	0.1
Lac Vieux Desert Reservation	0.1
Little Traverse Bay Bands Reservation	0.01
Match-E-Be-Nash-She-Wish Band of Pottawatomi Indians	0.008
Pokagon Band of Potawatomi Indians	0.008

Source: (USGS, 2014i)

8.1.7.4. Recreation

Michigan consists of two peninsulas separated by the Straits of Mackinac. The state is bordered by four Great Lakes, with the Porcupine Mountains in the Upper Peninsula, and the state on the whole is heavily forested. Recreation within the state center on the Great Lakes, with fishing and hunting popular activities. 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 Michigan. For information on visual resources, see Section 8.1.8, Visual Resources, and for information on the historical significance of locations, see Section 8.1.11, Cultural Resources.

Upper Peninsula

The Upper Peninsula is bordered to the north by Lake Superior, to the east by Canada, to the west by Wisconsin. The southern shoreline is mainly on Lake Superior, although a brief shoreline is located on Lake Huron (see Figure 8.1.7-3).[94]

The Ottawa National Forest is known for its wildlife and waterfalls, found along hiking trails. The Hiawatha National Forest contains shorelines on the Lakes Superior, Huron, and Michigan, and is known for lakeshores and lighthouses. Recreational opportunities in the forests include: hiking, bicycling, horseback riding, caving, and other trail use; camping and picnicking; boating,

[94] 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.

swimming, fishing, lake beaches, and other water activities; downhill skiing, snowboarding, cross-country skiing, and other winter sports; and licensed, seasonal big game, small game, and game bird hunting. (USFS, 2015a) (USFS, 2015b)

The Pictured Rocks National Lakeshore is popular for all water-related activities, swimming, SCUBA diving, kayaking, boating, and fishing. Other activities include camping, hiking and bicycling, and winter activities such as cross-country skiing, snowshoeing, and ice climbing. (NPS, 2015a) The Isle Royale National Park, a cluster of islands in Lake Michigan, has camping and hiking as well as water activities including boating, fishing, and kayaking (NPS, 2015b).

Northern

The Northern Region consists of the northern part of the Lower Peninsula, bordered to the east by Lake Michigan and the west by Lake Huron (see Figure 8.1.7-3). It is separate from the Upper Peninsula by the Straits of Mackinac. Popular recreational activities center on the lakes and the forested areas within the region.

The Huron National Forest contains the Crater Lake and the Highbanks River Trail, used for hiking, wildlife viewing, and cross-country skiing. Other recreational activities include bicycling, horseback riding, and other trail use; camping and picnicking; boating, swimming, fishing, lakefront beaches, and other water activities; cross-country skiing and other winter sports; and licensed, seasonal hunting. (USFS, 2015c)

The Sleeping Bear Dunes National Lakeshore, located on Lake Michigan, has over 35 miles of mainland beaches with swimming, sunbathing, and water-based recreation. Hiking and bicycling are popular in the summer, cross-country skiing and snowshoeing are popular in the winter. (NPS, 2015c)

Western

Michigan's Western Region is bordered to the west by Lake Michigan and to the south by Indiana (see Figure 8.1.7-3). Grand Rapids is the major population center in the Western Region, with a vibrant downtown, rides on the historic Santa Train railway, and a variety of museums (NPS, 2016a).

The Manistee National Forest contains the White River, a state-designated scenic river popular for fishing, and the North Country National Scenic Trail. Recreational opportunities include hiking, bicycling, horseback riding, and other trail use; camping and picnicking; boating, swimming, fishing, lakefront beaches, and other water activities; cross-country skiing and other winter sports; and licensed, seasonal hunting. (USFS, 2015c)

Central

The Central Region is located on the interior of the Lower Peninsula, bordered on the east by the Saginaw Bay (see Figure 8.1.7-3). Lansing is the major population center of the region, popular for agri-tourism with wineries, breweries, farmer's markets, and orchards and farms (Greater Lansing Convention and Visitors Bureau, 2015).

The Bay City Recreation Area, Sleepy Hollow State Park, and the Pine Haven Recreation Area have bicycling, hiking, cross-country skiing, and other trail activities; swimming, beach play, fishing, and other water activities; camping; and seasonal, licensed hunting (DNR, 2015n) (DNR, 2015o) (County of Midland, 2015).

Eastern

The Eastern Region consists mainly of the Detroit and Flint metro areas, bordered to the north by Lake Huron, to the east by Canada, and to the south by Lake Erie (Figure 8.1.7-3). Detroit is known for live music, casinos, and museums detailing the city's music and auto-industry history (Detroit Metro Convention & Visitors Bureau, 2015). Flint is known as the origin of General Motors, it contains several auto-related museums including the Alfred P. Sloan Museum and the Buick Automotive Gallery (Michigan Economic Development Corporation, 2015).

The MotorCities National Heritage Area contains over 100 sites associated with the area's significance in the automotive industry. Museums, historic homes, and speedways within the Historic Area include the Henry Ford Estate, the Motorsports Hall of Fame, and the Michigan International Speedway. (MotorCities National Heritage Area, 2015)

8.1.7.5. Airspace

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

Airspace Categories

There are two categories of airspace or airspace areas:

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

Within each of these two categories, there are four types of airspace: controlled, uncontrolled, special use, and other airspace. The categories and types of airspace are dictated by the complexity or density of aircraft movements, the nature of the operations conducted within the airspace, the level of safety required, and the national and public interest. Figure 8.1.7-4 depicts the different classifications and dimensions for controlled airspace. Air Traffic Control (ATC)[95] service is based on the airspace classification (FAA, 2008).

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

Figure 8.1.7-3: Michigan Recreation Resources

Controlled Airspace

- **Class A:** Airspace from 18,000 feet to 60,000 feet Mean Sea Level (MSL)[96]. 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).[97]

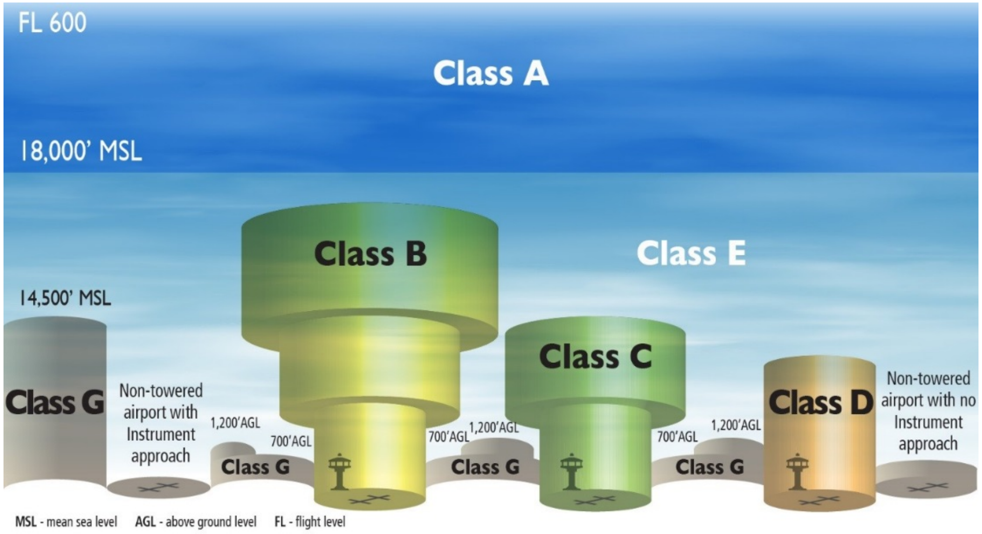

Figure 8.1.7-4: National Air Space Classification Profile

Source: Derived from (FAA, 2008)

- **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).

[96] MSL – The average level of for the surface of the ocean; "The height of the surface of the sea midway between the average high and low tides" (Merriam Webster Dictionary, 2015b).
[97] IFR – Rules for the conduct of flights under instrument meteorological conditions (FAA, 2015k).

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 8.1.7-6).

Table 8.1.7-6: SUA Designations

SUA Type	Definition
Prohibited Areas	"Airspace of defined dimensions identified by an area on the surface of the earth within which the flight of aircraft is prohibited. Such areas are established for security or other reasons associated with the national welfare. These areas are published in the Federal Register and are depicted on aeronautical charts."
Restricted Areas	"Airspace identified by an area on the surface of the earth within which the flight of aircraft, while not wholly prohibited, is subject to restrictions. Activities within these areas must be confined because of their nature or limitations imposed upon aircraft operations that are not a part of those activities or both. Restricted areas denote the existence of unusual, often invisible, hazards to aircraft such as artillery firing, aerial gunnery, or guided missiles. Penetration of restricted areas without authorization from the using or controlling agency may be extremely hazardous to the aircraft and its occupants. Restricted areas are published in the Federal Register and constitute 14 CFR Part 73."
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, 2015a) (FAA, 2008)

Other Airspace Areas

Other airspace areas, explained in Table 8.1.7-7, include Airport Advisory, Military Training Routes (MTRs), Temporary Flight Restrictions (TFRs), Parachute Jump Aircraft Operations, published Visual Flight Rules (VFR) and IFRs, and Terminal Radar Service Areas.

Table 8.1.7-7: Other Airspace Designations

Type	Definition
Airport Advisory	There are three types: • Local Airport Advisory – Operated within 10 statute miles of an airport where there is a Flight Service Station (FSS) located on an airport, but no operational control tower. The FSS advises the arriving and departing aircraft on particular conditions; • Remote Airport Advisory – Operated within 10 statute miles for specific high activity airports with no operational control tower; and • 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, 2015a) (FAA, 2008)

8.1.7.6. 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.

8.1.7.7. 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.

8.1.7.8. Michigan Airspace

The Michigan Office of Aeronautics, as part of the MDOT, has three sections: Planning and Development, Programming, and Transport and Safety. The Office of Aeronautics mission is to "develop and preserve a safe, high quality state-wide air transportation system," which is designed to protect the public pursuant the state's aeronautic codes (MDOT, 2016a). The Office of Aeronautics and the Michigan Aeronautics Commission are responsible for ensuring a safe airport system (preservation and expansion) to include implementing the Michigan Airport Systems Plan. The Planning and Development Section oversees the permitting of tall structures (MDOT, 2016b). There are two FAA FSDO for Michigan located in Belleville and Grand Rapids (FAA, 2015d).

Michigan airports are classified as those included in the State Aviation System Plan (SASP) and those that are not part of the SASP. The SASP addresses the strategic planning and future development for the State's airport system, as well as addressing key associated with their airports (National Association of State Aviation Officials (NASAO), 2015). Figure 8.1.7-5 presents the different aviation airports/facilities residing in Michigan, while Figures 8.1.7-6 and 8.1.7-7 presents the breakout by public and private airports/facilities. There are approximately 466 airports within Michigan as presented in Table 8.1.7-8 and Figures 8.1.7-5 through 8.1.7-7 (USDOT, 2015).

Table 8.1.7-8: Type and Number of Michigan Airports/Facilities

Type of Airport or Facility	Public	Private
Airport	220	134
Heliport	6	96
Seaplane	2	5
Ultralight	0	2
Balloonport	1	0
Gliderport	0	0
Total	**229**	**237**

Source: (USDOT, 2015)

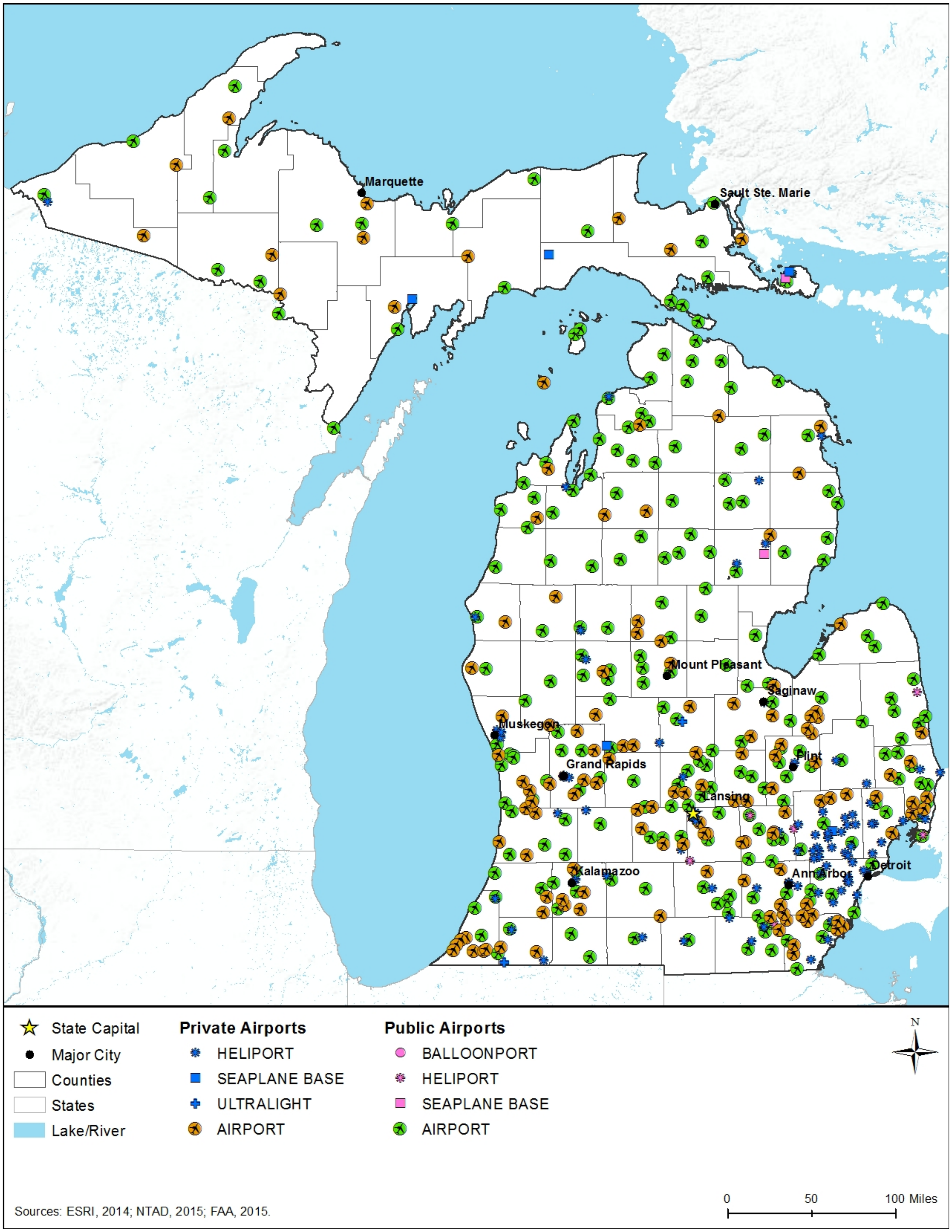

Figure 8.1.7-5: Composite of Michigan Airports/Facilities

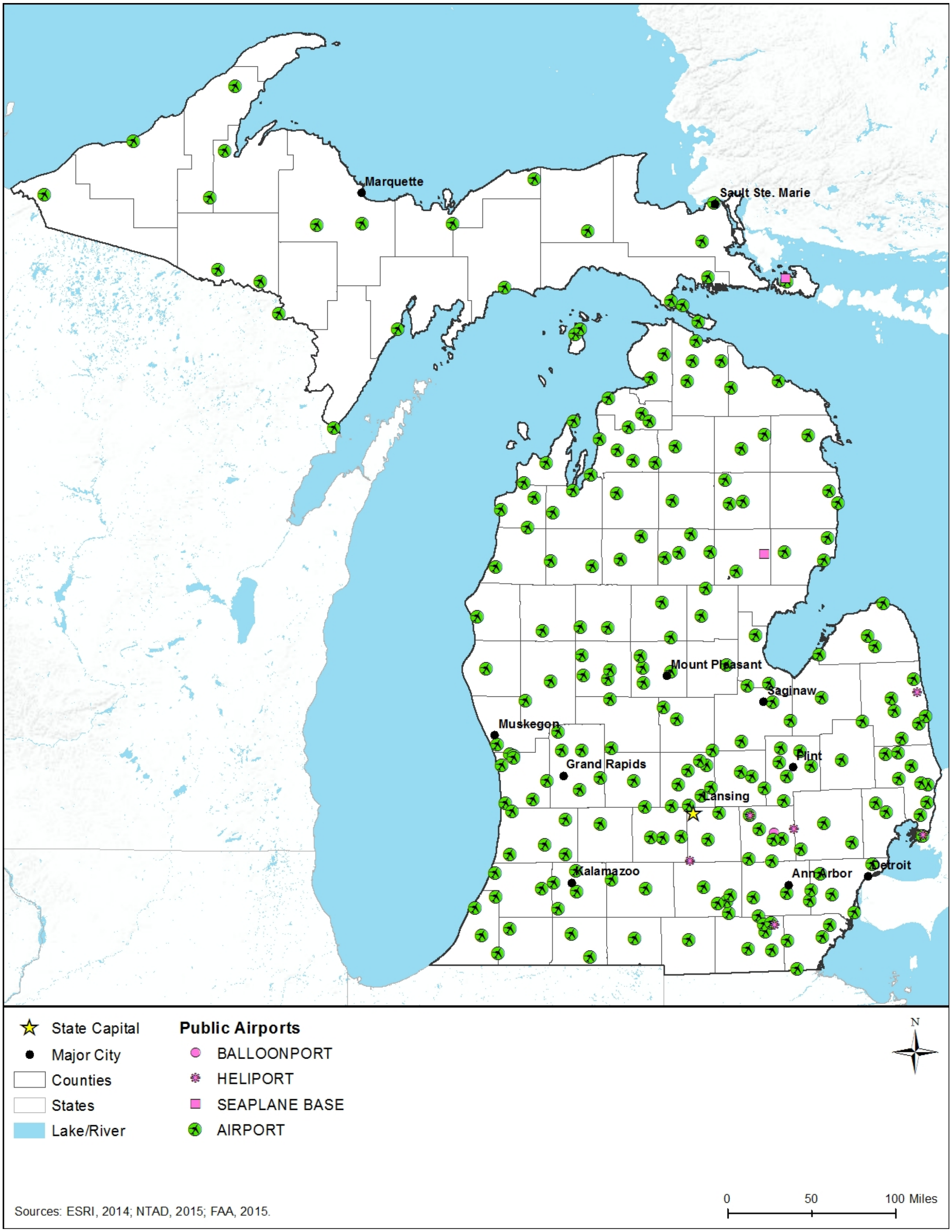

Figure 8.1.7-6: Public Michigan Airports/Facilities

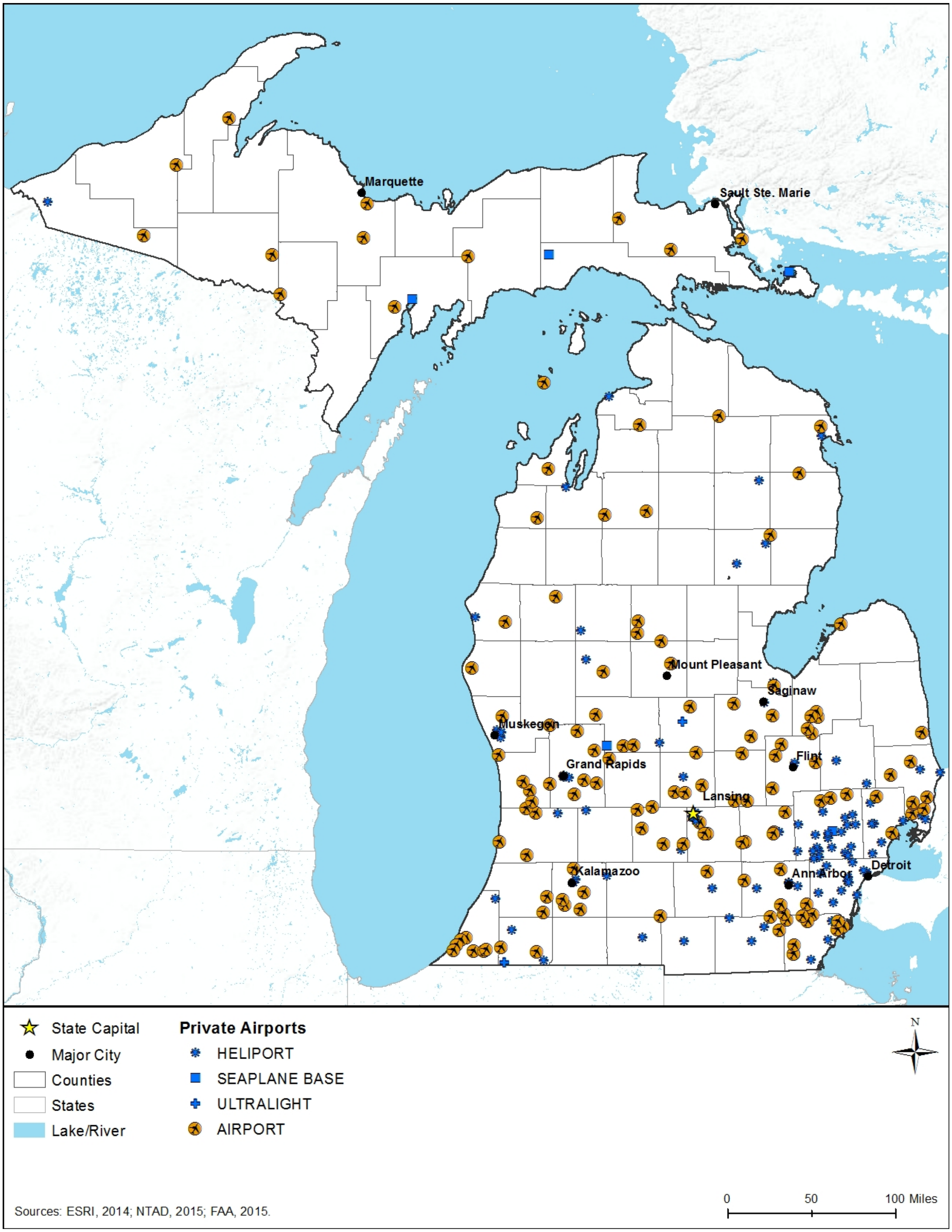

Figure 8.1.7-7: Private Michigan Airports/Facilities

There are Class B, C, D, and E controlled airports in Michigan as follows:

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

- One Class B –
  - Detroit Metropolitan Wayne County
- Three Class C
  - Bishop International, Flint
  - Gerald R. Ford International, Grand Rapids
  - Capital City, Lansing
- Fourteen Class D –
  - Alpena County Regional
  - Ann Arbor Municipal
  - W.K. Kellogg Field, Battle Creek
  - Willow Run Airport, Detroit
  - Detroit City
  - Grayling Army Airfield
  - Jackson County Airport-Reynolds Field, Jackson
  - Kalamazoo/Battle Creek International, Kalamazoo
  - Sawyer International, Marquette
  - Selfridge Air National Guard Base, Mount Clemens
  - Muskegon County, Muskegon
  - Oakland County International, Pontiac
  - MBS International, Saginaw
  - Cherry Capital, Traverse City (FAA, 2015f)

SUAs (i.e., four restricted areas and six MOAs) located in Michigan are as follows:

- Camp Grayling (Restricted)
  - R-4201A – Surface to 23,000 feet MSL
  - R-4201B – Surface to 9,000 feet MSL
- Lake Margrethe (Restricted)
  - R-4202 – Surface to 8,200 feet MSL
- Upper Lake Huron (Restricted)
  - R-4207 – Surface to FL 450 (FAA, 2015g)

The six MOAs for Michigan are as follows:

- Big Bear – 500 feet AGL to, but not including, FL 180
- Hersey – 5,000 feet MSL up to, but not including, FL 180
- Ontonagon – 500 feet AGL to, but not including, FL 180
- Pike –
  - East – 300 feet AGL to, but not including, FL 180; Excluding that airspace within R-4207 when activated
  - West – 6,000 feet MSL up to, but not including, FL 180

- Steelhead – 6,000 feet MSL to, but not including, FL 180 (FAA, 2015g)

The SUAs for Michigan are presented in Figure 8.1.7-8. There are no TFRs (Figure 8.1.7-8) (FAA, 2015h). MTRs in Michigan, presented in Figure 8.1.7-9, consist of 17 Visual Routes, 2 Instrument Routes, and 5 Slow Routes.

UAS Considerations

The NPS signed a policy memorandum on June 19, 2014 that "directs superintendents nationwide to prohibit launching, landing, or operating unmanned aircraft on lands or waters administered by the NPS" (NPS, 2014g). There are five NPS units in Michigan that must comply with this agency directive (NPS, 2015d).

Obstructions to Airspace Considerations

Several references in the Michigan legislature address airspace hazards. As defined in the Michigan Statute, Chapter 259 Aviation, Section 259.433 Airport Zoning Act, an airport hazard is "any structure or tree or use of land or of appurtenances thereof which obstructs the air space required for the safe flight of aircraft in landing or taking off at an airport or is otherwise hazardous or creates hazards to such safe landing or taking off of aircraft. (Michigan Legislature, 2015c) "Permitting for tall structures in Michigan follows for the most part the FAA requirements. Section 259.482 Permit required for construction of certain structures, of the Michigan Statutes, provides the following conditions for which a permit is required as it pertains to airport and airspace safety:

"A person shall not construct any of the following:

(a) A structure regulated under section 2a or 4.

(b) A structure that is, or that increases the height of an existing structure, higher than 200 feet above the ground elevation at the structure's site or higher than an imaginary plane extending outward and upward at any of the following slopes:

(i) For an airport with at least 1 runway that is more than 3,200 feet in length, 100 to 1 for a horizontal distance of 20,000 feet from the nearest point of the nearest runway.

(ii) For an airport whose longest runway is 3,200 feet or less in length, excluding heliports, 50 to 1 for a horizontal distance of 10,000 feet from the nearest point of the nearest runway.

(iii) For a heliport, 25 to 1 for a horizontal distance of 5,000 feet from the nearest point of the nearest landing and takeoff area. (Michigan Legislature, 2015d)"

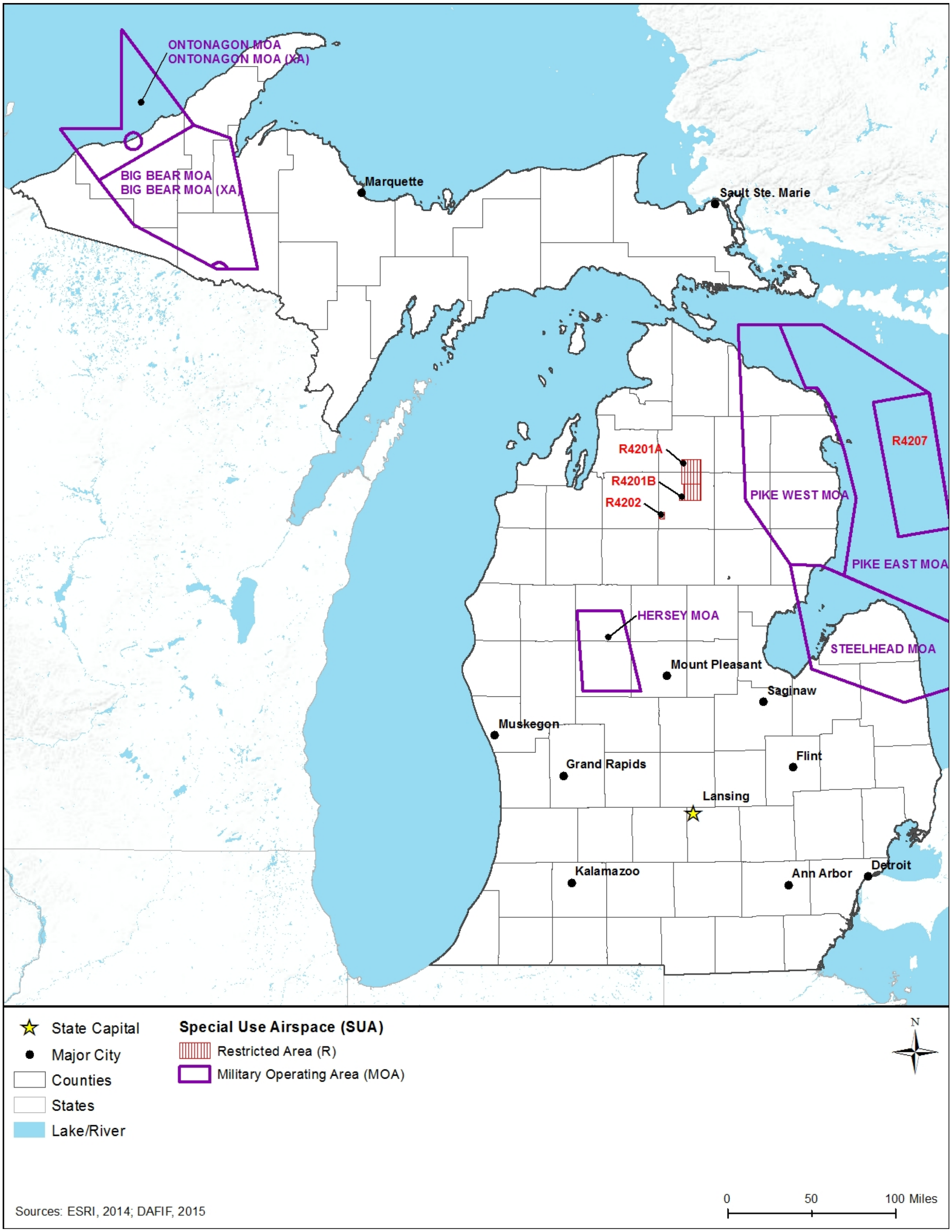

Figure 8.1.7-8: SUAs in Michigan

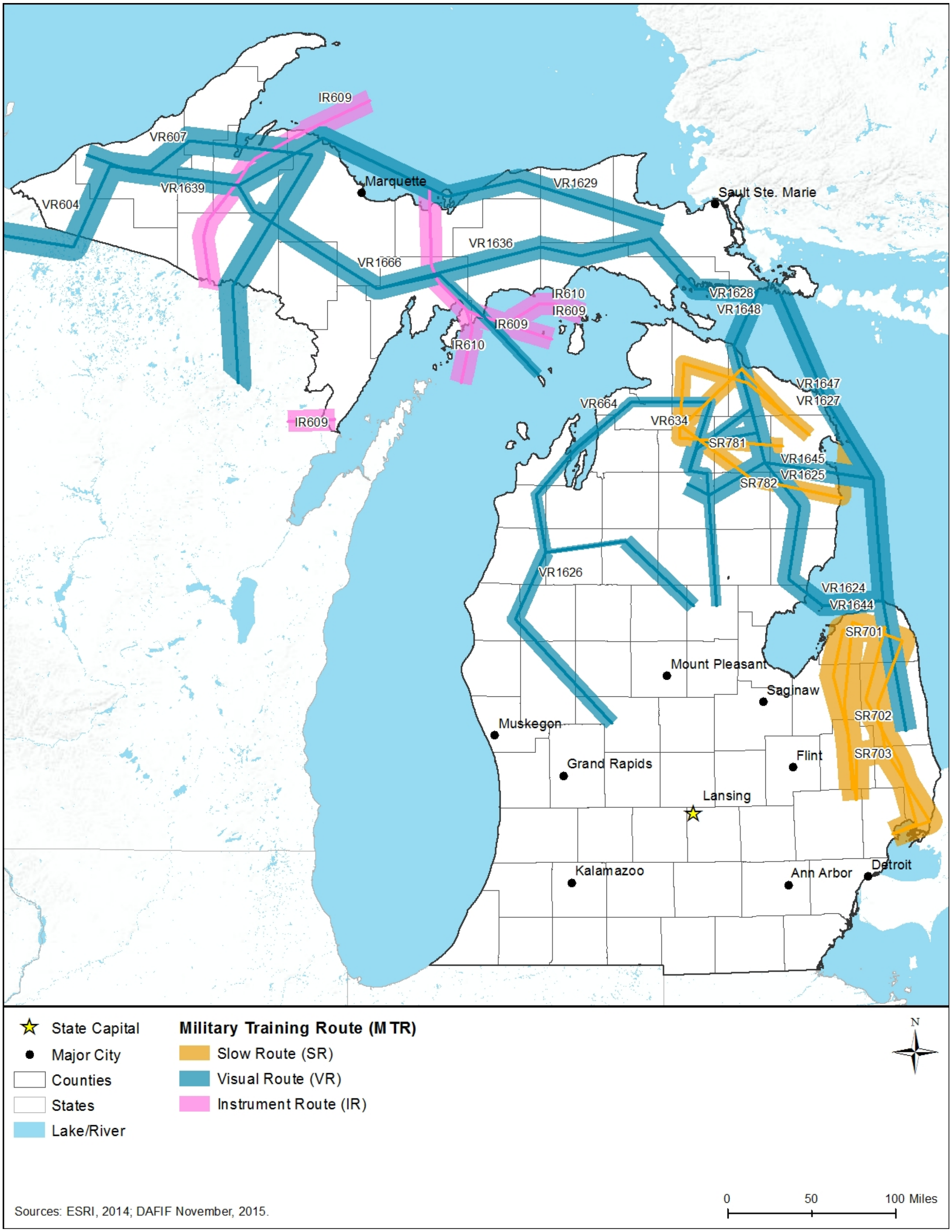

Figure 8.1.7-9: MTRs in Michigan

8.1.8. Visual Resources

8.1.8.1. Definition of the Resource

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

8.1.8.2. Specific Regulatory Considerations

Table 8.1.8-1 presents state and local laws and regulations that relate to visual resources for Michigan.

Table 8.1.8-1: Relevant Visual Resources Laws and Regulations

State Law/Regulation	Regulatory Agency	Description
Natural River Designation, MCL 324.30502	Department of Natural Resources (DNR), Fisheries Division	Designates "a river or portion of a river as a natural river area for the purpose of preserving and enhancing its values for water conservation, its free flowing condition, and its fish, wildlife, boating, scenic, aesthetic, floodplain, ecologic, historic, and recreational values and uses. The area shall include adjoining or related lands as appropriate to the purposes of the designation."
Wilderness and Natural Areas, MCL 324.35102	DNR, Wildlife Division	Dedication and administration of wilderness areas, wild areas, and natural areas in accordance with this part.
Designation of Pure Michigan Trails, MCL 324.72103	DNR, Parks and Recreation Division	Designation and requirements for "Pure Michigan Trails" which promote "healthy lifestyles, economic development, recreation, and conservation of the natural and cultural resources of this state."
Local Historic Districts, MCL 399.201	State Historic Preservation Office	Requirements for the identification, certification, and preservation of historical sites.

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 (Knight, 2008).

8.1.8.3. Character and Visual Quality of the Existing Landscape

Michigan is divided into two separate land areas and is bordered by four of the five Great Lakes. The state has nearly 3,300 miles of shoreline – the longest shoreline in the continental U.S. There are two sets of mountains in the Upper Peninsula, the Porcupine and Huron Mountains. Michigan's highest point is Mount Arvon in the Huron Mountains at 1,978 feet. The eastern portion of the Upper Peninsula is flat with some inland swamps. Michigan's Lower Peninsula is mostly flat, but also has some hilly areas, especially in the north and central portions. Michigan has numerous islands, 46,000 inland lakes, reservoirs, and ponds, and 76,439 miles of rivers and streams. Isle Royale, located in Lake Superior, is the only island National Park in the United States.

More than half of Michigan is characterized as forested areas (Figure 8.1.7-1 in Section 8.1.7, Land Use, Recreation, and Airspace). Forested areas generally have 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. Croplands are the second most dominant landscape in the state, which generally contain similar visual resources as forested areas. (USDA, 2015c)

One aspect of importance for visual resources is to maintain the character of the area. For example, in a farm community, keeping the character of the town consistent with farm-style houses, barns, and silos would be key in maintaining the character of the community. In a more metropolitan area, there may be many different visual styles within each neighborhood, but keeping the character of the neighborhood is important to maintain if new development were to occur. Section 8.1.7, Land Use, Recreation, and Airspace, discusses land use and contains further descriptions of land cover within the state.

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

8.1.8.4. 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 8.1.8-1 shows areas that are included in the National Register of Historic Places (NRHP) that may be considered visually sensitive. In Michigan, there are 1,870 NRHP listed sites, which include 41 National Historic Landmarks, 1 National Battlefield, and 1 National Historical Park. Some state sites and parks 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 Heritage Areas

National Heritage Areas (NHAs) are "places where natural, cultural, and historic resources combine to form a cohesive, nationally important landscape" (NPS, 2011). These areas help tell the history of the United States. Based on this criteria, NHAs in Michigan may contain scenic or aesthetic areas considered visual resources or visually sensitive. There is one NHA in Michigan, Motor Cities. The Motor Cities National Heritage Area highlights automotive and labor history in the U.S., including the start of automotive companies Ford, General Motors, and DamilerChrysler (NPS, 2015e).

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, 2015f).
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 attributed, that may be considered visual resources or visually sensitive at these sites. In Michigan, there are 41 NHLs as shown in Table 8.1.8-2 (NPS, 2016a). By comparison, there are over 2,500 NHLs in the United States, with less than 2 percent of these located in Michigan (NPS, 2015f). Figure 8.1.8-1 provides a representative sample of some historic and cultural resources that may be visually sensitive.

Figure 8.1.8-1: Representative Sample of Some Cultural and Heritage Resources that May be Visually Sensitive

Table 8.1.8-2: Michigan National Historic Landmarks

National Historic Landmark Name	
Bay View	Ernest Hemingway Cottage
Calumet Historic District	Highland Park Ford Plant
City of Milwaukee (Great Lakes Car Ferry)	Lafayette Park
Columbia (Excursion Steamer)	Lightship No. 103, “Huron”
Cranbrook	Mackinac Island
The Detroit Industry Murals	Marshall Historic District
Alden Dow House and Studio	McGregor Memorial Conference Center
Herbert H. Dow House	Meadow Brook Hall
Durant-Dort Carriage Company Office	Michigan State Capitol
Edison Institute (Greenfield Village and Henry Ford Museum)	Milwaukee Clipper (Passenger Steamship)
Edson (USS)	North Manitou Island Lifesaving Station
Fair Lane (Henry Ford Estate)	Norton Mound Group
Fisher Building	Parke-Davis Research Laboratory
Ford Piquette Avenue Plant	Pewabic Pottery
Ford River Rouge Complex	Quincy Mining Company Historic District
Fort Michilimackinac	St. Clair River Tunnel
Fox Theater	St. Ignace Mission
General Motors Building	St. Mary’s Falls Canal
General Motors Technical Center	Ste. Claire (Passenger Steamboat)
Grand Hotel	Silversides (USS)
Guardian Building	

Source: (NPS, 2016a)

National Battlefield

The general title national battlefield includes national battlefield, national battlefield park, national battlefield site, and national military park. Michigan has one national battlefield park, which is an area associated with American military history (NPS, 2016a). River Raisin National Battlefield Park “preserves, commemorates, and interprets the January 1813 battles of the War of 1812 and their aftermath in Monroe and Wayne counties in SE Michigan” (NPS, 2015g).

National Historical Parks

Michigan has one National Historical Park, which is preserved by the NPS to “commemorate persons, events, and activities important in the nation’s history” (NPS, 2016a). Parks are generally larger in size and complexity than sites (NPS, 2016a). Keweenaw National Historical Park preserves the history and culture of Keweenaw copper mining by Native people 7,000 years ago to immigrants in the 19^{th} and 20^{th} centuries (NPS, 2015g). This site may contain aesthetic and scenic values associated with history.

State Heritage Areas

The Michigan State Historic Preservation Office (SHPO) maintains a listing of the State Register of Historic Sites and a comprehensive inventory of State Survey Data that contains information on Michigan's historic resources, including buildings, sites, and structures (MSHDA, 2016a). Michigan also has over 70 local communities with historic district ordinances to protect historically significant resources through a historic district commission. Other communities support historic preservation at the local level through advisory or historical commissions (MSHDA, 2016b).

8.1.8.5. 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 8.1.7-3 identifies parks and recreational resources in Michigan. Figure 8.1.8-2 displays natural areas that may be visually sensitive, including park and recreation areas.[98]

National Park Service

National Parks are managed by the NPS and contain natural, historic, cultural, visual, ecological, and recreational resources of significance to the nation and are maintained for the public's use. In Michigan, there are five[99] officially designated National Parks/Units (i.e., Isle Royale National Park, Keweenaw National Historical Park, River Raisin National Battlefield Park, Pictured Rocks National Lakeshore, Sleeping Bear Dunes National Lakeshore) in addition to other NPS affiliated areas, such as National Heritage Areas, National Recreation Areas, and National Forests (Table 8.1.8-3). Figure 8.1.8-1 identifies the NPS units located in Michigan.

[98] 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.

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

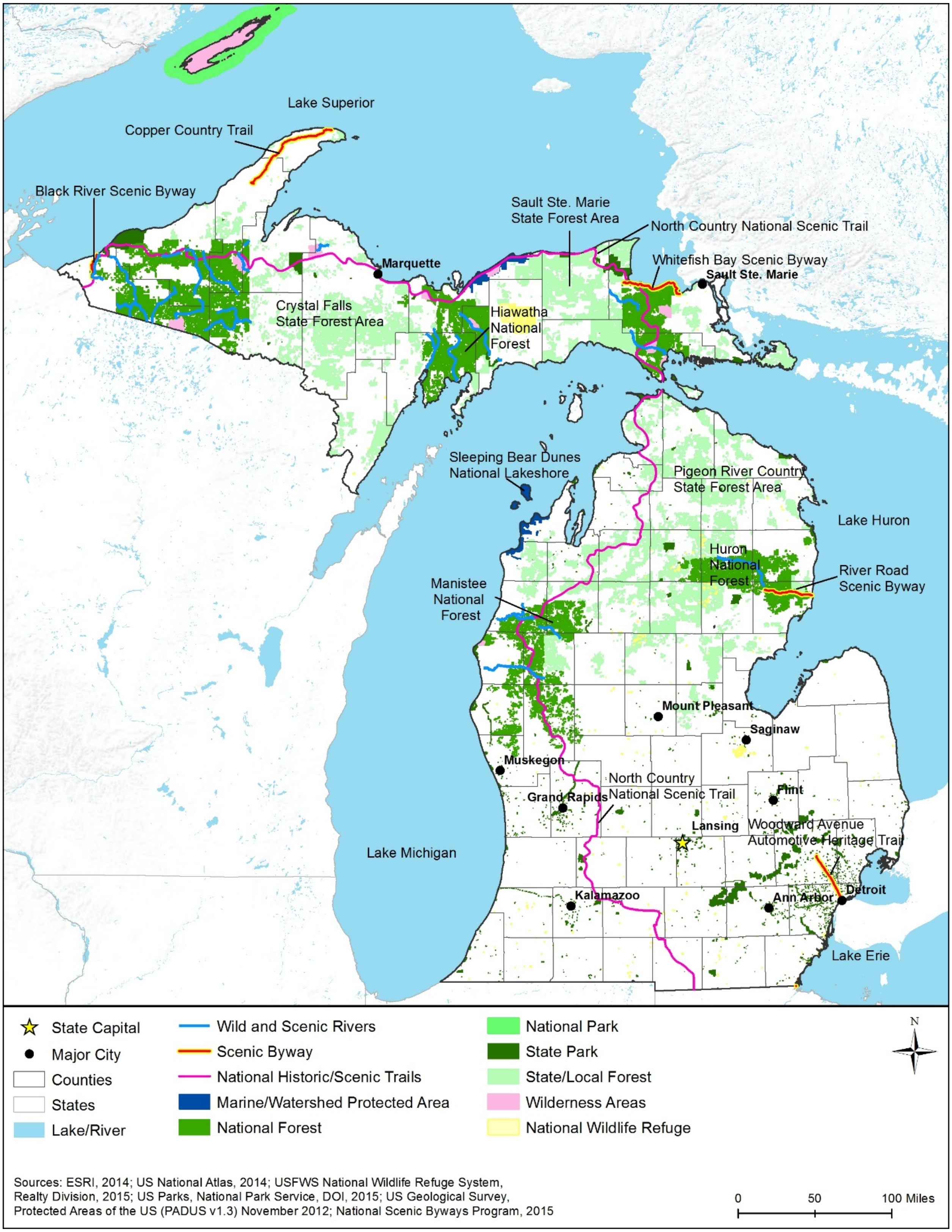

Figure 8.1.8-2: Natural Areas that May be Visually Sensitive

Table 8.1.8-3: Michigan National Parks and Affiliated Areas

NPS Area Name	
Grand Island National Recreation Area	Motor Cities National Heritage Area
Hiawatha National Forest	Ottawa National Forest
Huron-Manistee National Forest	Pictured Rocks National Lakeshore
Isle Royale National Park	River Raisin National Battlefield Park
Keweenaw National Historical Park	Sleeping Bear Dunes National Lakeshore

Sources: (NPS, 2015g), (USFS, 2013), (USFS, 2015d)

Pictured Rocks National Lakeshore (Figure 8.1.1-3) has a variety of visual resources, including sandstone cliffs, beaches, sand dunes, waterfalls, lakes, forest, and a 40 mile shoreline along Lake Superior (NPS, 2015g). For additional information regarding parks and recreation areas, see Section 8.1.7, Land Use, Recreation, and Airspace.

Figure 8.1.8-3: Grand Portal Point at Pictured Rocks National Lakeshore

Source: (NPS, 2014d)

National Forests

The USFS manages three National Forests in Michigan (Figure 8.1.8-2). Hiawatha National Forest is nearly 900,000 acres along three of the Great Lakes – Michigan, Superior, and Huron. The forest is home to a National Recreation Area, Whitefish Scenic Byway, six lighthouses, and six Wildernesses, creating unique habitats and wildlife viewing (USFWS, 2016b). The Huron-Manistee National Forests are nearly one million acres of lands for recreation, fish, and wildlife (USFWS, 2016c). Ottawa National Forest is also almost one million acres of lands with wildlife viewing, rolling hills, lakes, rivers, and waterfalls (MDNREC, 2015a).

U.S. Forest Service National Recreation Area

National Recreation Areas are "lands and waters set aside for recreation use" (NPS, 2003). In Michigan, there is one National Recreation Area that is managed by the USFS, Grand Island National Recreation Area (Figure 8.1.8-1). The island is located in Lake Superior and is comprised of 13,500 acres of forest, white sand beaches, and 300-foot high sandstone cliffs (Recreation.gov, 2014).

U.S. Army Corps of Engineers (USACE) Recreation Areas

There are two USACE recreation and flood risk management areas in Michigan (USACE, 2015). Waterways such as the Keweenaw Waterway and St. Marys River are specifically managed by the USACE for scenic and aesthetic qualities in their planning guidance in addition to managing risks for floods (USACE, 1997).

State Parks and Forests

State parks contain natural, historic, cultural, and/or recreational resources of significance to Michigan residents and visitors. There are 77 state parks throughout Michigan, including six historic state parks, most of which likely contain scenic or aesthetic areas considered to be visual resources or visually sensitive (DNR, 2016c). Figure 8.1.8-1 contains a sampling of state parks and their associated visual attributes (Table 8.1.8-4).

Table 8.1.8-4: Examples of Michigan State Parks and Associated Visual Attributes

State Park	Visual Attributes
Burt Lake State Park	2,000 feet of sandy shorelines
Cheboygan State Park	Scenic Lake Huron vistas, rare wildflowers
Grand Haven State Park	Sandy shores on Lake Michigan and Grand River, scenic views of Lake Michigan and the Grand Haven pier and lighthouse
Hartwick Pines State Park	49-acre forest of Old Growth Pines, logging museum
Ludington State Park	Scenic sand dunes, shoreline vista, ponds, marshlands, forests, and beaches
Porcupine Mountains Wilderness State Park	Large wilderness areas, towering virgin timber, secluded lakes, and miles of wild rivers and streams on 60,000 acres
Port Crescent State Park	3 miles of sandy shoreline on Lake Huron's Saginaw Bay, wooden boardwalk, scenic vistas of Saginaw Bay

Source: (DNR, 2016c)

Federal and State Trails

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 through which they pass" (NPS, 2016c). The only National Scenic Trail in Michigan is the North Country National Scenic Trail administered by the NPS (Figure 8.1.8-2). North Country National Scenic Trail covers seven states from New York to North Dakota, including over 1,150 miles in Michigan. "The trail links scenic, natural, historic, and cultural areas across seven states allowing visitors to experience a variety of northern landscapes" (NPS, 2015g).

In addition to National Scenic Trails, the National Trails System Act authorized the designation of National Recreational Trails near urban areas by either the Secretaries of the Interior or Agriculture, depending upon the ownership of the designated land (American Trails, 2016a). In Michigan, there are 25 National Recreation Trails administered by a variety of organizations including federal, state, local, and non-profits. Trails can be used for snowmobiling, cross-country skiing, bicycling, and hiking (American Trails, 2016b).

The MDNR manages trails and pathways used primarily for hiking and other recreational activities in conjunction with the Michigan Trails Advisory Council. Visual resources on these scenic trails include farm and country sides, rivers, and forests, and connect small communities and many state forest campgrounds. Michigan's Iron Belle Trail "showcases Michigan's spectacular natural, cultural and historic resources" across the 791-mile bicycle route or the 1,273-mile hiking route (DNR, 2016b).

8.1.8.6. 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" (NPS, 2015h). 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. Twenty-five percent of these federal lands are in 47 national parks (44 million acres) and part of National Park System. These designated wilderness areas are managed by the USFS, BLM, USFWS, and NPS (NPS, 2015h).

Michigan is home to 16 federally managed Wilderness Areas as listed in Table 8.1.8-5 (Wilderness.net, 2016).

Table 8.1.8-5: Michigan National Wilderness Areas

NPS Area Name	
Beaver Basin Wilderness	Michigan Islands Wilderness
Big Island Lake Wilderness	Nordhouse Dunes Wilderness
Delirium Wilderness	Rock River Canyon Wilderness
Horseshoe Bay Wilderness	Round Island Wilderness
Huron Islands Wilderness	Seney Wilderness

NPS Area Name	
Isle Royale Wilderness	Sleeping Bear Dunes Wilderness
Mackinac Wilderness	Sturgeon River Gorge Wilderness
McCormick Wilderness	Sylvania Wilderness

Source: (Wilderness.net, 2016)

State Forest Preserves

In addition to state parks, Michigan also has 4 million acres of state-managed forestland – the largest state forest system in the nation. These forests provide “critical habitat for wildlife, valuable resources for a thriving timber products industry, and beautiful outdoor spaces for a variety of outdoor recreation activities” (DNR, 2016a).

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. Michigan’s has 656.4 river miles designated as wild, scenic, or recreational (National Wild and Scenic Rivers System, 2015), which represents nearly 1 percent of Michigan’s 76,439 miles of rivers, streams, and connecting channels. Table 8.1.8-6 identifies the 16 rivers designated as National Wild, Scenic, or Recreational Rivers in Michigan and Figure 8.1.8-2 displays their geographic boundaries.

Table 8.1.8-6: Michigan National Wild, Scenic, or Recreational Rivers

River	Classification
Au Sable River	Scenic
Bear Creek	Scenic
Black River	Scenic
Carp River	Wild, Scenic, Recreational
Indian River	Scenic, Recreational
Manistee River	Recreational
Ontonagon River	Wild, Scenic, Recreational
Paint River	Recreational
Pere Marquette River	Scenic
Pine River	Scenic
Presque Isle River	Scenic, Recreational
Sturgeon River (Hiawatha National Forest)	Scenic, Recreational
Sturgeon River (Ottawa National Forest)	Wild, Scenic
Tahquamenon River (East Branch)	Wild, Recreational
Whitefish River	Scenic, Recreational
Yellow Dog River	Wild

Source: (National Wild and Scenic Rivers System, 2015)

Michigan's Natural Rivers Program was "developed to preserve, protect and enhance our state's finest river systems for the use and enjoyment of current and future generations by allowing property owners their right to reasonable development, while protecting Michigan's unique river resources" (DNR, 2015p). The Habitat Management Unit within the Fisheries Division of the Department of Natural Resources manages 2,091 miles on 16 rivers or segments of rivers as listed in Table 8.1.8-7.

Table 8.1.8-7: Michigan's Natural Rivers Program

River Name	
Au Sable River	Pere Marquette River
Betsie River	Pigeon River
Boardman River	Pine River
Flat River	Rifle River
Fox River	Rogue River
Huron River	Two Hearted River
Jordan River	Upper Manistee River
Lower Kalamazoo River	White River

Source: (DNR, 2015p)

National Wildlife Refuges, Wetlands Management Districts, and State Wildlife Management Areas

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, 2015ak). There are six NWRs shown in Figure 8.1.8-1 and Michigan also contains one Wildlife Management Area and one Wetland Management District in Michigan (USFWS, 2015ak). Detroit River (Figure 8.1.8-1) is the only International Wildlife Refuge in North America, with "nearly 6,000 acres of islands, coastal wetlands, marshes, shoals, and waterfront lands along 48 miles of Detroit River and Western Lake Erie shorelines" (FHWA, 2015a).

Table 8.1.8-8: Michigan National Wildlife Refuge

National Wildlife Refuge Area Name	
Detroit River International Wildlife Refuge	Michigan Wetland Management District
Harbor Island National Wildlife Refuge	Michigan Islands National Wildlife Refuge
Huron National Wildlife Refuge	Seney National Wildlife Refuge
Kirtlands Warbler Wildlife Management Area	Shiawassee National Wildlife Refuge

Source: (USFWS, 2015ak)

The MDNR Wildlife Division (WLD) manages 77 State Wildlife Management Areas, or "or areas which are WLD-interest areas but are formally dedicated or administered by another DNR Division or agency." WLD also directly administers 110 "dedicated types" areas, including 94 State Game Areas, 13 State Wildlife Areas, 1 State Fish and Wildlife Area, and 3 State Wildlife

Research Areas (DNR, 2012b). For additional information on wildlife refuges and management areas, see Section 8.1.6, Biological Resources.

Figure 8.1.8-4: Detroit River International Wildlife Refuge

Source: (USFWS, 2016d)

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, 2014e). These landmarks may be considered visual resources or visually sensitive. In Michigan, there are 12 NNLs as listed in Table 8.1.8-9. Some of the visual resources located within these areas include boreal bog (Black Spruce Bog Natural Area), northern swamp forests (Dead Stream Swamp), glacial formations and lakes (Porcupine Mountain), and marshland (Tobico Marsh) (NPS, 2012).

Table 8.1.8-9: National Natural Landmarks in Michigan

NNL Name	
Black Spruce Bog Natural Area	Porcupine Mountain
Dead Stream Swamp	Roscommon Virgin Pine Stand
Dukes Research Natural Area	Strangmoor Bog
Grand Mere Lakes	Tobico Marsh
Haven Hill State Natural Area	Toumey Woodlot
Newton Woods	Warren Woods Natural Area

Source: (NPS, 2012)

8.1.8.7. Additional Areas

State and National Scenic Byways

National Scenic Byways are resources designated specifically for scenic or aesthetic areas or qualities which would be considered visual resources or visually sensitive. The U.S. Department of Transportation, FHWA, manages the National Scenic Byways Program (FHWA, 2015d). Michigan has three designated National Scenic Byways: Copper Country Trail (47 miles), River Road Scenic Byway (22 miles), and Woodward Avenue (M-1) – Automotive Heritage Trail (27 miles) (Figure 8.1.8-2). The Automotive Heritage Trail is also designated an All-American Road, which is one of the nation's most scenic byways with multiple inherent qualities (e.g., cultural, historic, scenic) (FHWA, 2012).

Pure Michigan Byways, formerly the Michigan Heritage Route Program, was created and designed to "to identify, inventory, protect, enhance, and in some cases, promote state trunklines and adjacent land with distinctive or unique scenic, cultural, or historic qualities" (Michigan Highways, 2015). Pure Michigan Byway routes are designated under six different "intrinsic qualities" (categories): scenic, historic, and recreational byways and heritage routes, and cultural, archaeological, and natural byways. The scenic, historic, and recreational byways and heritage routes are listed in Table 8.1.8-10, while the latter three categories are new under the Pure Michigan Byways program and have yet to be designated.

Table 8.1.8-10: Pure Michigan Byways

Byway Name	
Leelanau Scenic Heritage Route (70 miles)	Monroe Street Heritage Route (1.5 miles)
Old Mission Peninsula Scenic Heritage Route (17.26 miles)	Woodward Avenue Recreational Heritage Route (28 miles)
Copper Country Trail Scenic Heritage Route and National Byway (47 miles)	Pathway to Family Fun Recreational Heritage Route (85 miles)
M-119 Tunnel of Trees Scenic Heritage Route (13 miles)	Huron Shores Recreational Heritage Route (193 miles)
Tahquamenon Scenic Byway (62 miles)	U.P. Hidden Coast Recreational Heritage Route (64 miles)
Iron County Heritage Trail (16 miles)	I-69 Recreational Heritage Route (47 miles)
US-12 Heritage Trail (209 miles)	North Huron Byway (50 miles)
Center Avenue Heritage Route/Bay City Historic Route (1.5 miles)	Chief Noonday Recreational Heritage Route (17 miles)
Marshall's Territorial Road Historic Heritage Route (2.3 miles)	

Source: (Michigan Highways, 2015)

8.1.9. Socioeconomics

8.1.9.1. 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 projects, and in addition, FirstNet projects may affect the socioeconomic conditions of a region.

The choice of socioeconomic topics and depth of their treatment depends on the relevance of potential topics to the types of federal actions under consideration. FirstNet's mission is to provide public safety broadband and interoperable emergency communications coverage throughout the nation. Relevant socioeconomic topics include population density and growth, economic activity, housing, property values, and state and local taxes. The financial arrangements for deployment and operation of the FirstNet network may have socioeconomic implications. Section 1.1 frames some of the public expenditure and public revenue considerations specific to FirstNet; however this is not intended to be either descriptive or prescriptive of FirstNet's financial model or anticipated total expenditures and revenues associated with the deployment of the Nationwide Public Safety Broadband Network (NPSBN). This socioeconomics section provides some additional, broad context, including data and discussion of state and local government revenue sources that FirstNet may affect.

Environmental justice is a related topic that specifically addresses the presence of minority populations (defined by race and Hispanic ethnicity) and low-income populations, in order to give special attention to potential impacts on those populations, per Executive Order 12898. This PEIS addresses environmental justice in a separate section (Section 8.1.10). This PEIS also addresses the following topics, sometimes included within socioeconomics, in separate sections: land use and recreation (Section 8.1.7, Land Use, Recreation, and Air Space), infrastructure (Section 8.1.1, Infrastructure), and aesthetic considerations (Section 8.1.8, Visual Resources).

Wherever possible, this section draws on nationwide datasets from federal sources such as the U.S. Census Bureau[100] (Census Bureau) and U.S. Bureau of Labor Statistics (BLS). This ensures

[100] 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

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, these 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.

8.1.9.2. 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.

8.1.9.3. Communities and Populations

This section discusses the population and major communities of Michigan (MI) and includes the following topics:

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

Statewide Population and Population Growth

Table 8.1.9-1 presents the 2014 estimated population and population density of Michigan in comparison to the Central region[101] and the nation. The estimated population of Michigan in 2014 was 9,909,877. The population density was 175 persons per square mile (sq. mi.), which was higher than the population density of both the region (66 persons/sq. mi.) and the nation (90 persons/sq. mi.). In 2014, Michigan was the 10th largest state by estimated population among the 50 states and the District of Columbia, 22nd largest by land area, and had the 19th greatest population density (U.S. Census Bureau, 2015z; U.S. Census Bureau, 2015b).

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a Microsoft Excel option). In some cases, the structure of the resulting file may be easier to work with under one format or another. Note that in most cases, the on-screen or downloaded data contains additional parameters besides those used in the FirstNet PEIS report table. Readers must locate the FirstNet PEIS-specific data within the Census Bureau tables. In many cases, the FirstNet PEIS report tables contain data from multiple Census Bureau tables and sometimes incorporate other sources.

[101] The Central region is comprised of the states of Colorado, Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Montana, 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.

Table 8.1.9-1: Land Area, Estimated Population, and Population Density of Michigan

Geography	Land Area (sq. mi.)	Estimated Population 2014	Population Density 2014 (persons/sq. mi.)
Michigan	56,539	9,909,877	175
Central Region	1,178,973	77,651,608	66
United States	3,531,905	318,857,056	90

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

Estimated population growth is an important subject for this PEIS given FirstNet's mission. Table 8.1.9-2 presents the population growth trends of Michigan from 2000 to 2014 in comparison to the Central region and the nation. The state's annual growth rate increased in the 2010 to 2014 period compared to 2000 to 2010, from -0.06 percent (population decline) to 0.07 percent. The growth rate of Michigan in the 2010 to 2014 period was considerably lower than the growth rate of the region, at 0.45 percent. Both geographies showed lower growth rates in both periods compared to the nation's growth rate of 0.81 percent (2010 to 2014).

Table 8.1.9-2: Recent Population Growth of Michigan

Geography	Estimated Population			Numerical Estimated Population Change		Rate of Estimated Population Change (AARC)[a]	
	2000	2010	2014	2000 to 2010	2010 to 2014	2000 to 2010	2010 to 2014
Michigan (statewide)	9,938,444	9,883,640	9,909,877	-54,804	26,237	-0.06%	0.07%
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, 2015z)

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 8.1.9-3 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) (UVA 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 Michigan's estimated population will increase by approximately 619,378 people, or 6.3 percent, from 2014 to 2030. This reflects an average annual projected growth rate of 0.38 percent, which is higher than the historical growth rate from 2010 to 2014 of 0.07 percent. The projected growth rate of the state is lower than that of the region (0.60 percent) and the nation (0.80 percent).

Table 8.1.9-3: Projected Estimated Population Growth of Michigan

Geography	Estiamted Population 2014	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	Average Annual Rate of Change (AARC) (compound growth rate) 2014 to 2030
Michigan (statewide)	9,909,877	10,225,304	10,833,205	10,529,255	619,378	6.3%	0.38%
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, 2015z; ProximityOne, 2015; UVA Weldon Cooper Center, 2015)

AARC = Average Annual Rate of Change (compound growth rate)

Population Distribution and Communities

Figure 8.1.9-1 presents the distribution and relative density of the estimated population of Michigan. 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. State and federal lands comprise a large portion of the very sparsely populated Upper Peninsula of Michigan (Figure 8.1.9-1). For more information about the Upper Peninsula and other areas, see Section 8.1.7, Land Use, Recreation, and Airspace.

Table 8.1.9-4 provides the populations of the 10 largest population concentrations in Michigan, based on the 2010 census. It also shows the changes in population for these areas between the 2000 and 2010 censuses.[102] In 2010, the largest population concentration by far was the Detroit area, which had over 3.7 million people. The state had no other population concentrations over 1 million. It had one area (Grand Rapids) with a population between 500,000 and 1 million, and

[102] 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.

seven areas with populations between 100,000 and 500,000. The smallest of the 10 population concentrations was the Holland area, with a 2010 population of 99,941. The fastest growing area, by average annual rate of change from 2000 to 2010, was the South Lyon/Howell area, with an annual growth rate of 1.19 percent. The only other area with a growth rate over 1.00 percent was the Kalamazoo area (1.10 percent). Three areas (Detroit, Flint, and Saginaw) experienced a population decline during this period.

Table 8.1.9-4 also shows that the top 10 population concentrations in Michigan accounted for over 60 percent of the state's population in 2010. Further, while the population of the entire state (including the 10 population concentrations) declined by only 54,084 from 2000 to 2010, the population within the 10 population concentrations declined by 76,603. These figures indicate that the population of the remainder of the state, as a whole, increased from 2000 to 2010.

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

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

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

Social institutions – educational, family, political, public service, military, and religious – are present throughout the state. The institutions most relevant to FirstNet projects are public services such as medical and emergency medical services and facilities. This PEIS addresses public services in Section 8.1.1, Infrastructure. Project-level NEPA analyses may need to examine other institutions, depending on specific locations and specific types of actions.

Table 8.1.9-4: Population of the 10 Largest Population Concentrations in Michigan

Area	Population				Population Change 2000 to 2010	
	2000	2010	2009–2013	Rank in 2010	Numerical Change	Average Annual Rate of Change (AARC) (compound growth rate)
Ann Arbor	283,904	306,022	308,991	5	22,118	0.75%
Detroit	3,903,377	3,734,090	3,730,910	1	(169,287)	-0.44%
Flint	365,096	356,218	352,456	3	(8,878)	-0.25%
Grand Rapids	539,080	569,935	577,841	2	30,855	0.56%
Holland	91,795	99,941	100,741	10	8,146	0.85%
Kalamazoo	187,961	209,703	212,445	6	21,742	1.10%
Lansing	300,032	313,532	314,854	4	13,500	0.44%
Muskegon	154,729	161,280	161,086	7	6,551	0.42%
Saginaw	140,985	126,265	124,078	8	(14,720)	-1.10%
South Lyon/Howell	106,139	119,509	121,296	9	13,370	1.19%
Total for Top 10 Population Concentrations	**6,073,098**	**5,996,495**	**6,004,698**	**NA**	**(76,603)**	**-0.13%**
Michigan (statewide)	**9,938,444**	**9,883,640**	**9,886,095**	**NA**	**(54,804)**	**-0.06%**
Top 10 Total as Percentage of State	**61.1%**	**60.7%**	**60.7%**	**NA**	**139.8%**	**NA**

Sources: (U.S. Census Bureau, 2012; U.S. Census Bureau, 2015f; U.S. Census Bureau, 2015g)

AARC = Average Annual Rate of Change

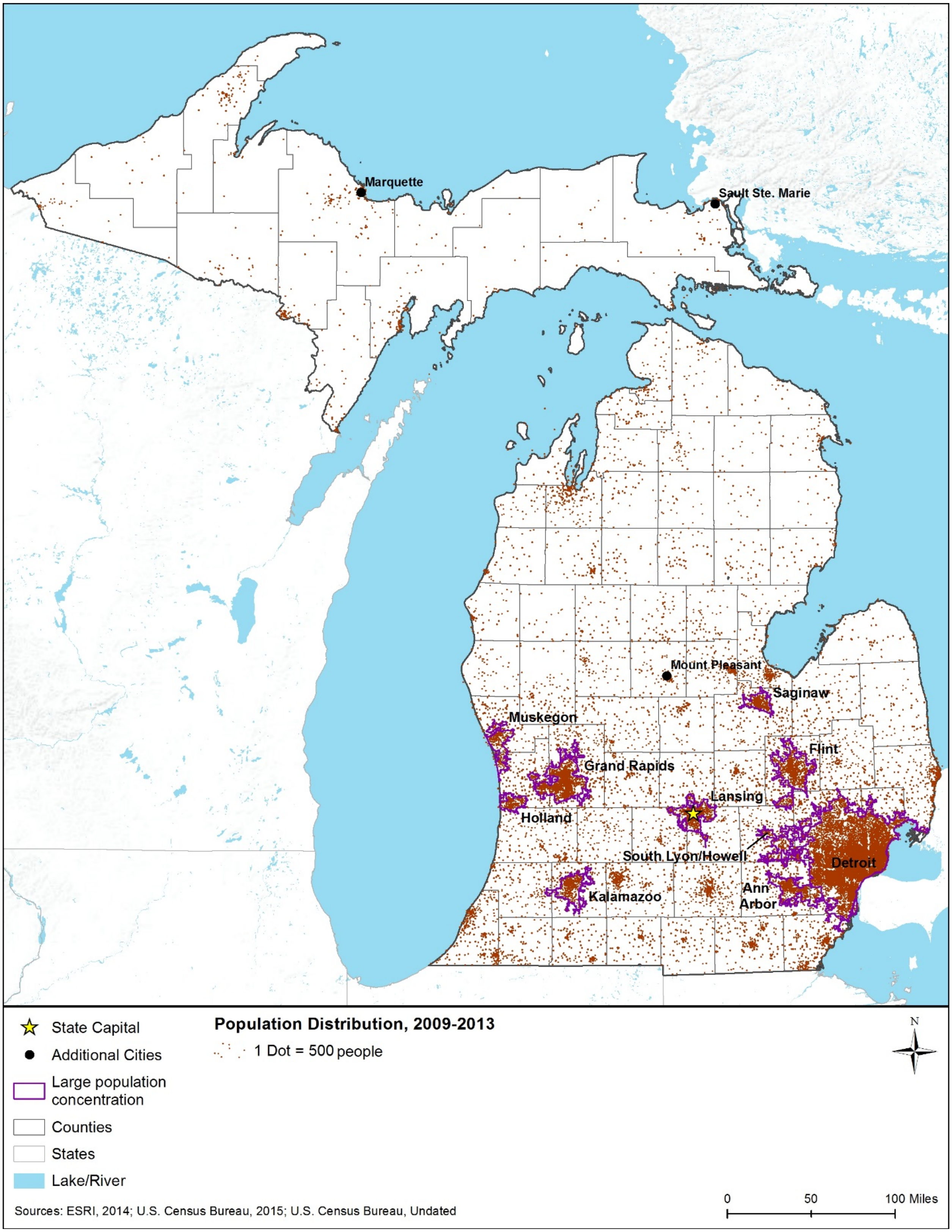

Figure 8.1.9-1: Estimated Population Distribution in Michigan, 2009–2013

Economic Activity

Table 8.1.9-5 compares several economic indicators for Michigan to the Central region and the nation. The table presents two indicators of income[103] – 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 8.1.9-5, the per capita income in Michigan in 2013 ($25,918) was $1,610 lower than that of the region ($27,528), and $2,266 lower than that of the nation ($28,184).

Household income is a useful measure, and often used instead of family income, because in modern society there are many single-person households and households composed of non-related individuals. Median household income (MHI) is the income at which half of all households have higher income, and half have lower income. Table 8.1.9-5 shows that in 2013, the MHI in Michigan ($48,200) was $3,845 lower than that of the region ($52,045), and $4,050 lower than that of the nation ($52,250).

Employment status is a key socioeconomic parameter because employment is essential to the income of a large portion of the adult population. The federal government calculates the unemployment rate as the number of unemployed individuals who are looking for work divided by the total number of individuals in the labor force. Table 8.1.9-5 compares the unemployment rate in Michigan to the Central region and the nation. In 2014, Michigan's statewide unemployment rate of 7.3 percent was higher than the rates for the region (5.7 percent) and the nation (6.2 percent)[104].

[103] 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)

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

Table 8.1.9-5: Selected Economic Indicators for Michigan

Geography	Per Capita Income 2013	Median Household Income 2013	Average Annual Unemployment Rate 2014
Michigan (statewide)	$25,918	$48,200	7.3%
Central Region	$27,528	$52,045	5.7%
United States	$28,184	$52,250	6.2%

Sources: (Bureau of Labor Statistics, 2015f; U.S. Census Bureau, 2015i; U.S. Census Bureau, 2015j; U.S. Census Bureau, 2015k)

Figure 8.1.9-2 and Figure 8.1.9-3 show how MHI in 2013 (U.S. Census Bureau, 2015i) and unemployment in 2014 (Bureau of Labor Statistics, 2015f) varied by county across the state. These maps also incorporate the same population concentration data as Figure 8.1.9-1 (U.S. Census Bureau, 2012; U.S. Census Bureau, 2015e). Following these two maps, Table 8.1.9-6 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 Michigan.

Figure 8.1.9-2 shows that, in general, counties with a MHI above the national median were located in the southern portion of the state, close to several of the largest population concentrations. A county in the northwest part of the Lower Peninsula, and a county in central Michigan near Mount Pleasant, also had MHI levels above the national median. Counties with the lowest MHI levels were generally located in the northeast portion of the Lower Peninsula and the western portion of the Upper Peninsula. Figure 8.1.9-2 shows that MHI was above the state average in the Ann Arbor, Detroit, Grand Rapids, Holland, and South Lyon/Howell areas. MHI in all other population concentrations was below the state average. MHI was lowest in the Flint and Saginaw areas. Flint is the third largest, and Saginaw is the third smallest, of the areas shown in the table.

Figure 8.1.9-3 presents variations in the 2014 unemployment rate across the state, by county. It shows that counties with unemployment rates below the national average (that is, better employment performance) were located in the southern portion of the state around the Mount Pleasant, Holland, Grand Rapids, South Lyon/Howell, Ann Arbor, and Kalamazoo areas. One county in the northwestern portion of the Lower Peninsula also had an unemployment rate below the national average. Most of the remainder of the state had unemployment rates above the national average. When comparing unemployment in the population concentrations to the state average (Figure 8.1.9-3), 4 of the 10 areas had 2009–2013 unemployment rates that were higher than the state average, including two of the three largest areas (Detroit and Flint).

Detailed employment data provide useful insights into the nature of a local, state, or national economy. Table 8.1.9-7 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 Michigan than in the Central region and the nation. The percentage of government workers was lower in the state than in the region and nation. Self-employed workers in the state were a similar percentage as the region, and a lower percentage than the nation.

By industry, Michigan has a mixed economic base and some notable figures in the table are as follows. Michigan in 2013 had a considerably higher percentage of persons working in "manufacturing" than did the region or the nation. In all other industries, Michigan had relatively similar percentages of employment (within two percentage points) to the region and nation.

Table 8.1.9-6: Selected Economic Indicators for the 10 Largest Population Concentrations in Michigan, 2009–2013

Area	Median Household Income	Average Annual Unemployment Rate
Ann Arbor	$54,537	9.6%
Detroit	$50,531	14.3%
Flint	$39,702	17.1%
Grand Rapids	$50,040	10.0%
Holland	$51,803	9.5%
Kalamazoo	$42,114	12.3%
Lansing	$45,531	10.5%
Muskegon	$40,674	15.3%
Saginaw	$36,098	15.4%
South Lyon/Howell	$68,645	8.9%
Michigan (statewide)	$48,411	12.7%

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

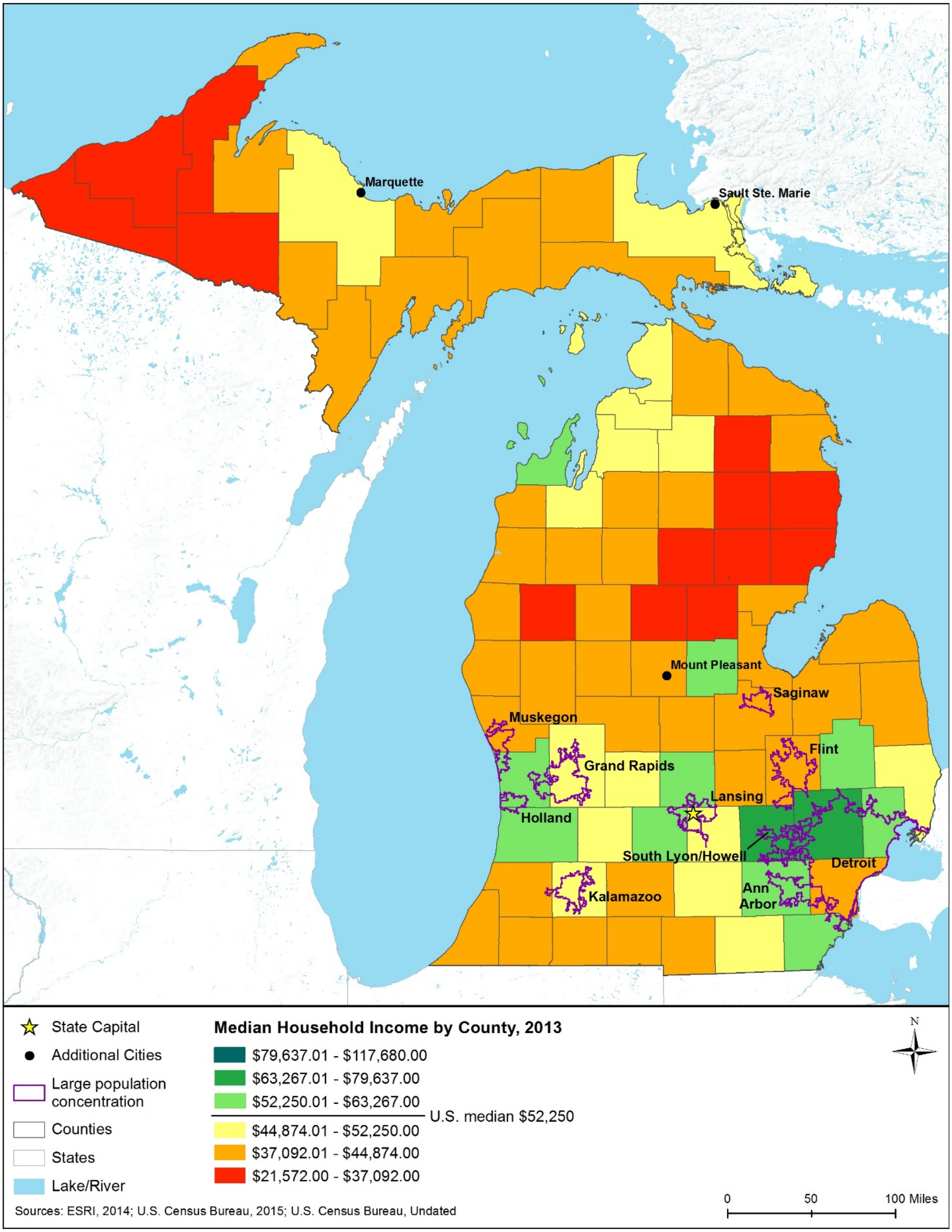

Figure 8.1.9-2: Median Household Income in Michigan, by County, 2013

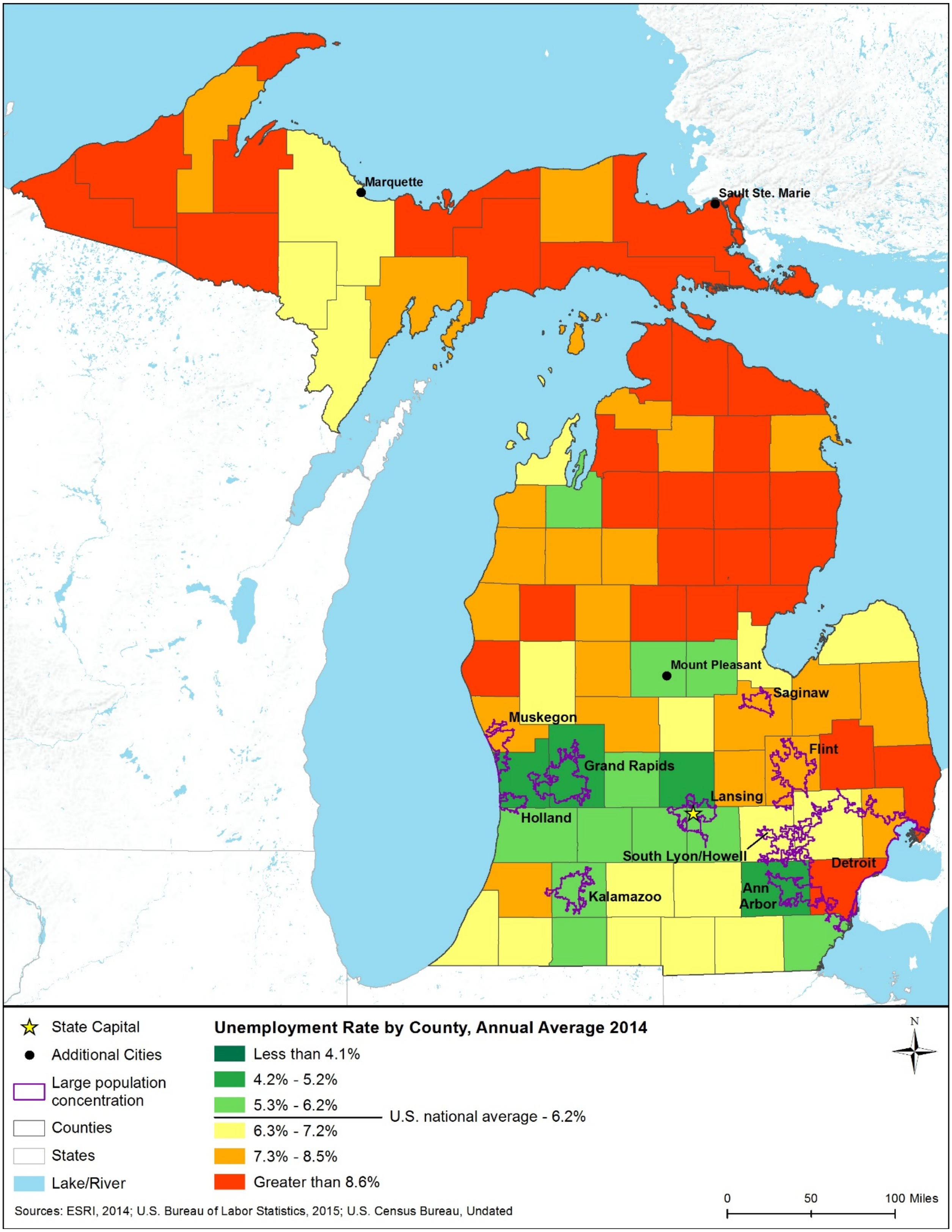

Figure 8.1.9-3: Unemployment Rates in Michigan, by County, 2014

Table 8.1.9-7: Employment by Class of Worker and by Industry, 2013

Class of Worker and Industry	Michigan	Central Region	United States
Civilian Employed Population 16 Years and Over	4,369,787	36,789,905	145,128,676
Percentage by Class of Worker			
Private wage and salary workers	83.5%	81.7%	79.7%
Government workers	11.1%	12.8%	14.1%
Self-employed in own not incorporated business workers	5.2%	5.3%	6.0%
Unpaid family workers	0.2%	0.2%	0.2%
Percentage by Industry			
Agriculture, forestry, fishing and hunting, and mining	1.3%	2.2%	2.0%
Construction	4.7%	5.6%	6.2%
Manufacturing	17.9%	14.0%	10.5%
Wholesale trade	2.3%	2.7%	2.7%
Retail trade	11.4%	11.5%	11.6%
Transportation and warehousing, and utilities	4.1%	4.9%	4.9%
Information	1.6%	1.9%	2.1%
Finance and insurance, and real estate and rental and leasing	5.6%	6.5%	6.6%
Professional, scientific, management, administrative, and waste management services	9.6%	9.7%	11.1%
Educational services, and health care and social assistance	23.7%	23.4%	23.0%
Arts, entertainment, and recreation, and accommodation and food services	9.5%	9.1%	9.7%
Other services, except public administration	4.8%	4.6%	5.0%
Public administration	3.6%	3.9%	4.7%

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

Table 8.1.9-8 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 8.1.9-7 for 2013.

Table 8.1.9-8: Employment by Selected Industries for the 10 Largest Population Concentrations in Michigan, 2009–2013

Area	Construction	Transportation and Warehousing, and Utilities	Information	Professional, Scientific, Management, Administrative and Waste Management Services
Ann Arbor	2.3%	3.5%	2.2%	10.8%
Detroit	4.0%	4.2%	1.9%	11.5%
Flint	4.4%	4.0%	1.3%	8.0%
Grand Rapids	4.3%	3.5%	1.8%	9.6%
Holland	4.2%	3.6%	1.4%	7.0%
Kalamazoo	2.9%	2.9%	1.3%	8.8%
Lansing	3.0%	3.5%	1.7%	9.1%
Muskegon	3.7%	3.1%	1.3%	7.3%
Saginaw	3.1%	3.8%	1.9%	9.0%
South Lyon/Howell	4.9%	3.1%	1.8%	10.9%
Michigan (statewide)	4.8%	4.1%	1.6%	9.2%

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

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 8.1.9-9 compares Michigan to the Central region and nation on several common housing indicators.

As shown in Table 8.1.9-9, in 2013 Michigan had a higher percentage of housing units that were occupied (84.7 percent) than the region (88.4 percent) or nation (87.6 percent). Of the occupied units, Michigan had a somewhat lower percentage of owner-occupied units (70.6 percent) than the region (67.6 percent) and a slightly higher percentage than the nation (63.5 percent). The percentage of detached single-unit housing (also known as single-family homes) in Michigan in 2013 was 71.9 percent, higher than both the region (67.7 percent) and nation (61.5 percent). The homeowner vacancy rate in Michigan (1.9 percent) was slightly higher than the rate for the region (1.8 percent) and the same as the nation (1.9 percent). This rate reflects "vacant units that are 'for sale only'" (U.S. Census Bureau, 2015y). The vacancy rate among rental units was the same in Michigan (6.0 percent) as the region (6.0 percent) and slightly lower than the nation (6.5 percent).

Table 8.1.9-9: Selected Housing Indicators for Michigan, 2013

Geography	Total Housing Units	Housing Occupancy & Tenure				Units in Structure
		Occupied Housing	Owner-Occupied	Homeowner Vacancy Rate	Rental Vacancy Rate	1-Unit, Detached
Michigan (statewide)	4,525,266	84.7%	70.6%	1.9%	6.0%	71.9%
Central Region	33,580,411	88.4%	67.6%	1.8%	6.0%	67.7%
United States	132,808,137	87.5%	63.5%	1.9%	6.5%	61.5%

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

Table 8.1.9-10 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 8.1.9-10: Selected Housing Indicators for the 10 Largest Population Concentrations in Michigan, 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
Ann Arbor	133,900	91.7%	55.6%	2.1%	5.1%	49.6%
Detroit	1,653,236	87.1%	68.9%	2.5%	8.5%	68.8%
Flint	164,615	85.5%	66.8%	2.7%	8.6%	70.0%
Grand Rapids	233,010	93.2%	67.4%	2.0%	6.2%	61.9%
Holland	38,219	93.2%	73.1%	1.8%	4.7%	61.1%
Kalamazoo	93,436	90.7%	59.9%	2.2%	5.8%	58.6%
Lansing	139,013	90.0%	57.7%	2.6%	7.0%	58.6%
Muskegon	71,417	88.4%	71.4%	2.6%	8.3%	70.7%
Saginaw	56,621	87.3%	64.3%	2.4%	7.3%	70.8%
South Lyon/Howell	51,916	92.0%	81.0%	1.7%	9.0%	69.3%
Michigan (statewide)	4,529,311	84.4%	72.1%	2.4%	7.8%	72.0%

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

Property Values

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

Table 8.1.9-11 provides indicators of residential property values for Michigan 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, 2015y).

The table shows that the median value of owner-occupied units in Michigan in 2013 ($117,500) was lower than the corresponding values for the Central region ($151,200) and the nation ($173,900).

Table 8.1.9-11: Residential Property Values in Michigan, 2013

Geography	Median Value of Owner-Occupied Units
Michigan (statewide)	$117,500
Central Region	$151,200
United States	$173,900

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

Table 8.1.9-12 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. Six of the 10 areas had median values higher than the state median value ($121,700). The highest values were in the Ann Arbor and South Lyon/Howell areas, and the lowest values were in the Flint and Saginaw areas. The Flint and Saginaw areas also had the lowest median household incomes (Table 8.1.9-6).

Table 8.1.9-12: Residential Property Values for the 10 Largest Population Concentrations in Michigan, 2009–2013

Area	Median Value of Owner-Occupied Units
Ann Arbor	$176,800
Detroit	$118,500
Flint	$84,900
Grand Rapids	$134,700
Holland	$137,300
Kalamazoo	$127,600
Lansing	$123,900
Muskegon	$106,600
Saginaw	$78,500
South Lyon/Howell	$174,100
Michigan (statewide)	$121,700

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

Government Revenues

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

Table 8.1.9-3 presents total and selected state and local government revenue sources as reported by the Census Bureau's 2012 Census of Governments. It provides both total dollar figures (in millions of dollars) and figures per capita (in dollars), based on total population for each geography. The per capita figures are particularly useful in comparing the importance of certain revenue sources in the state relative to other states in the region and the nation. State and local governments may obtain some additional revenues related to telecommunications infrastructure.

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

Table 8.1.9-13 shows that the Michigan state government received more total revenue in 2012 on a per capita basis than its counterpart governments in the region and nation. Local governments in Michigan received more total revenue per capita than counterparts in the region and less than counterparts in the nation. Additionally, Michigan state and local governments had per capita levels of intergovernmental revenues[105] from the federal government that were somewhat higher than or similar to counterpart governments in the region and nation. The Michigan state government obtained higher levels of property taxes per capita than state governments in the region and nation. Local governments in Michigan obtained levels of property taxes per capita that were higher than local governments in the region, and lower than local governments in the nation. General sales taxes were higher on a per capita basis for the Michigan state government compared to its counterparts in the region and nation. Michigan local governments obtained no revenue from general sales taxes. Selective sales taxes, and public utility taxes specifically, were lower on a per capita basis for Michigan state and local governments than for those governments in the region and nation. Likewise, individual and corporate income tax revenues, on a per capita basis, were lower for Michigan state and local governments than for counterpart governments in the region and nation. Michigan local governments reported no corporate income taxes.

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

Table 8.1.9-13: State and Local Government Revenues, Selected Sources, 2012

Type of Revenue		Michigan		Region		United States	
		State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount
Total Revenue	($M)	$63,986	$44,316	$463,192	$231,980	$1,907,027	$1,615,194
	Per capita	$6,474	$4,484	$6,020	$3,015	$6,075	$5,145
Intergovernmental from Federal	($M)	$17,850	$1,978	$125,394	$9,383	$514,139	$70,360
	Per capita	$1,806	$200	$1,630	$122	$1,638	$224
Intergovernmental from State	($M)	$0	$17,993	$0	$76,288	$0	$469,147
	Per capita	$0	$1,821	$0	$992	$0	$1,495
Intergovernmental from Local	($M)	$205	$0	$2,721	$0	$19,518	$0
	Per capita	$21	$0	$35	$0	$62	$0
Property Taxes	($M)	$1,911	$11,368	$3,626	$61,015	$13,111	$432,989
	Per capita	$193	$1,150	$47	$793	$42	$1,379
General Sales Taxes	($M)	$8,934	$0	$58,236	$6,920	$245,446	$69,350
	Per capita	$904	$0	$757	$90	$782	$221
Selective Sales Taxes	($M)	$3,721	$271	$33,313	$2,191	$133,098	$28,553
	Per capita	$376	$27	$433	$28	$424	$91
Public Utilities Taxes	($M)	$28	$63	$3,627	$1,153	$14,564	$14,105
	Per capita	$3	$6	$47	$15	$46	$45
Individual Income Taxes	($M)	$6,921	$426	$72,545	$5,148	$280,693	$26,642
	Per capita	$700	$43	$943	$67	$894	$85
Corporate Income Taxes	($M)	$804	$0	$9,649	$310	$41,821	$7,210
	Per capita	$81	$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.

8.1.10. Environmental Justice

8.1.10.1. Definition of the Resource

EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, issued in 1994, sets out principles of environmental justice and requirements that federal agencies should follow to comply with the EO (see Section 1.8.11, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations). 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, 2016b). 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 NEPA to assist federal agencies in meeting the requirements of the EO (CEQ, 1997). Additionally, the USEPA Office of Environmental Justice (USEPA, 2015e) offers guidance on Environmental Justice issues and provides an "environmental justice screening and mapping tool," EJSCREEN (USEPA, 2015b).

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).

8.1.10.2. Specific Regulatory Considerations

Governor Jennifer Granholm signed Executive Directive No. 2007-23, titled "Promoting Environmental Justice," in November 2007. The directive defined environmental justice as "…the fair, non-discriminatory treatment and meaningful involvement of Michigan residents regarding the development, implementation, and enforcement of environmental laws, regulations, and policies by this state" (MDNREC, 2010). The directive also required the Department of Environmental Quality to develop and implement an environmental justice plan (MDNREC, 2010).

Accordingly, in December 2010, Michigan finalized the Environmental Justice Plan for the State of Michigan and Department of Natural Resources and Environment (MDNREC, 2010), which was developed by a collaborative work group comprising representatives from state agencies, academia, business organizations, tribes, advocacy groups, and others. The plan sets forth requirements and guidance for state regulators and "…does not require any action by persons outside of state government…" (MDNREC, 2010).

8.1.10.3. Environmental Setting: Minority and Low-Income Populations

Table 8.1.10-1 presents 2013 data on the composition of Michigan's estimated population by race and by Hispanic origin. The state's estimated population has higher percentages of individuals who identify as Black/African American (13.9 percent) than the estimated populations of the Central region (9.3 percent) and the nation (12.6 percent). Michigan's populations of individuals identifying as Asian (2.7 percent) or Some Other Race (1.0 percent) are lower than corresponding percentages for the region and nation. (Those percentages are, for Asian, 2.8 percent for the region and 5.1 percent for the nation; and for Some Other Race, 2.4 percent and 4.7 percent respectively.) The state's estimated population of persons identifying as White (79.1 percent) is smaller than that of the Central region (82.2 percent), and larger than that of the nation (73.7 percent).

The percentage of the estimated population in Michigan that identifies as Hispanic (4.7 percent) is lower than in the Central region (8.5 percent), and substantially 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. Michigan's All Minorities estimated population percentage (24.1 percent) is slightly higher than in the Central region (23.3 percent), and considerably lower than in the nation (37.6 percent).

Table 8.1.10-2 presents the percentage of the estimated population living in poverty in 2013, for the state, region, and nation. The figure for Michigan (17.0 percent) is considerably higher than that for the Central region (14.7 percent) and higher than the figure for the nation (15.8 percent).

Table 8.1.10-1: Estimated Population by Race and Hispanic Status, 2013

Geography	Total Estimated Population	Race							Hispanic	All Minorities
		White	Black/ African Am	Am. Indian/ Alaska Native	Asian	Native Hawaiian /Pacific Islander	Some Other Race	Two or More Races		
Michigan (statewide)	9,895,622	79.1%	13.9%	0.5%	2.7%	0.0%	1.0%	2.7%	4.7%	24.1%
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 consider themselves Hispanic or of any race other than White. Because some Hispanics identify as both Hispanic and of a non-White race, "All Minorities" is less than the sum of Hispanics and non-White races.

Table 8.1.10-2: Percentage of Estimated Population (Individuals) in Poverty, 2013

Geography	Percent Below Poverty Level
Michigan (statewide)	17.0%
Central Region	14.7%
United States	15.8%

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

8.1.10.4. Environmental Justice Screening Results

Analysis of environmental justice in a NEPA document typically begins by identifying potential environmental justice populations in the project area. Appendix D, Environmental Justice Methodology, presents the methodology used in this PEIS to screen each state for the presence of potential environmental justice populations. The methodology builds on CEQ guidance and best practices used for environmental justice analysis. It uses data at the census-block group level; block groups are the smallest geographic units for which regularly updated socioeconomic data are readily available at the time of writing.

Figure 8.1.10-1 visually portrays the results of the environmental justice population screening analysis for Michigan. 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).

Figure 8.1.10-1 shows that Michigan has many areas with high potential for environmental justice populations. The distribution of these high potential areas is fairly even across the state, and occurs both within and outside of the 10 largest population concentrations. This includes some of the state's most sparsely populated areas, such as areas in the Upper Peninsula. The distribution of areas with moderate and low potential for environmental justice populations is also fairly even across the state.

It is important to understand how these data behind Figure 8.1.10-1 affect the visual impact of this map. Block groups have similar populations (hundreds to a few thousand individuals) regardless of population density. In sparsely populated areas, a single block group may cover tens or even hundreds of square miles, while in densely populated areas, block groups each cover much less than a single square mile. Thus, while large portions of the state outside the areas defined as large population concentrations show moderate or high potential for environmental justice populations, these low density areas reflect modest numbers of minority or low-income individuals compared to the potential environmental justice populations within densely populated areas. The overall effect of this relative density phenomenon is that the map visually shows large areas of the state having environmental justice potential, but this over-represents the presence of environmental justice populations.

It is also very important to note that Figure 8.1.10-1 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, these data may represent dispersed individuals of minority or low-income status rather than discrete, place-based communities. Second, the definition of the moderate potential category draws a wide net for potential environmental justice populations. As discussed in Appendix D, the definition includes some commonly used thresholds for environmental justice screening that tend to over-identify environmental justice potential. Before FirstNet deploys projects, additional site-specific analyses to identify specific, localized environmental justice populations may be warranted. Such analyses could tier off the methodology of this PEIS.

This map also does not indicate whether FirstNet projects would have actual impacts on environmental justice populations. An environmental justice effect on minority or low-income populations only occurs if the effect is harmful, significant (according to NEPA criteria), and "appreciably exceeds or is likely to appreciably exceed the risk or rate to the general population or other appropriate comparison group" (CEQ, 1997). The Environmental Consequences section (Section 8.2) addresses the potential for disproportionately high and adverse environmental or human health impacts on environmental justice populations.

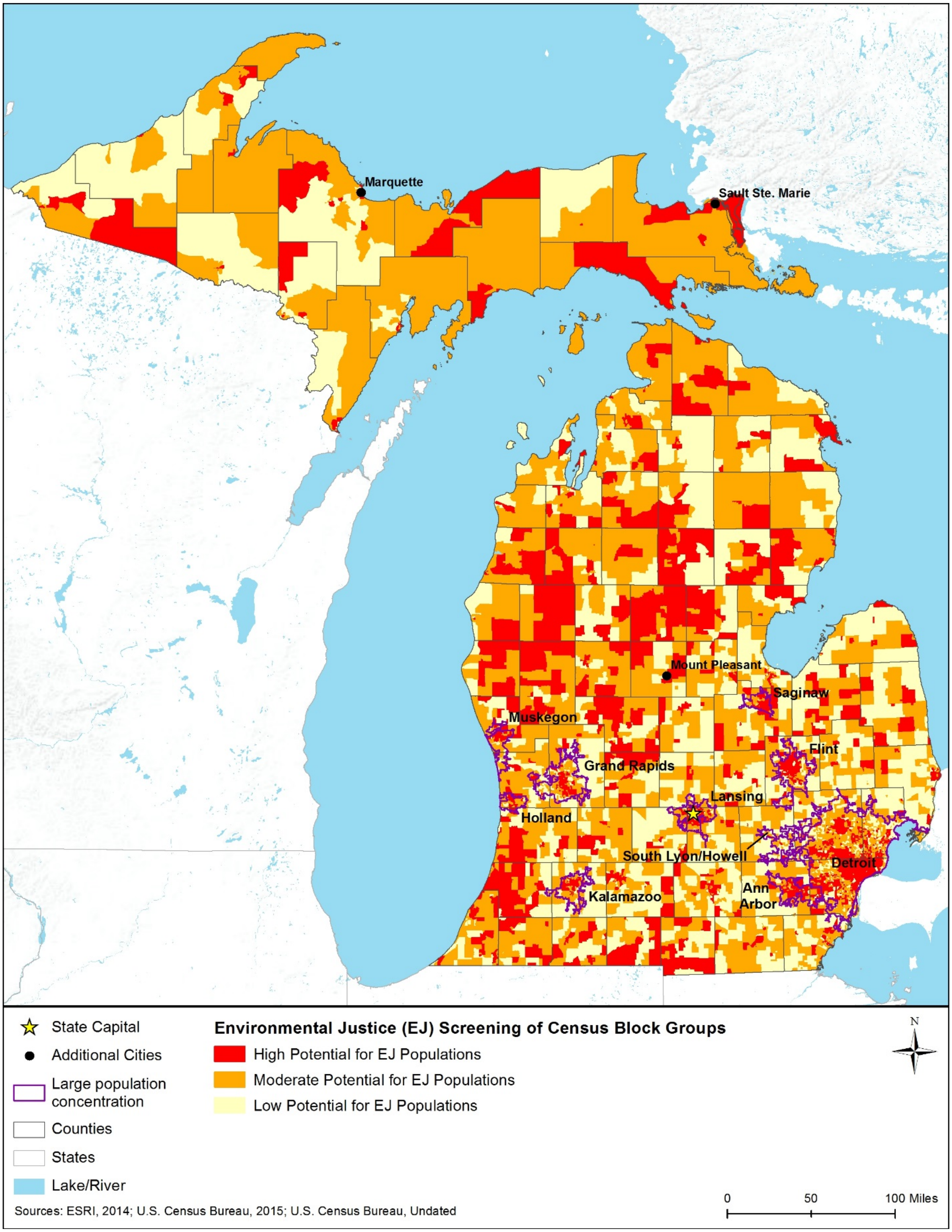

Figure 8.1.10-1: Potential for Environmental Justice Populations in Michigan, 2009–2013

8.1.11. Cultural Resources

8.1.11.1. Definition of the Resource

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

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

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

- Statutory language and implementing regulations for Section 106 of the NHPA, as amended, formerly 16 U.S.C. 470a(d)(6)(A) (now 54 U.S.C. 306131(b)) and 36 CFR 800.16(l)(1);
- Statutory language and Implementing regulations for the Archaeological Resources Protection Act of 1979 (ARPA), 16 U.S.C. 470cc(c) and 43 CFR 7.3(a);
- Statutory language and implementing regulations for the Native American Graves Protection and Repatriation Act (NAGPRA), 25 U.S.C. 3001(3)(D) and 43 CFR 10.2(d);
- NPS's program support of public and private efforts to identify, evaluate, and protect America's historic and archeological resources (NPS, 2016d); and
- Advisory Council on Historic Preservation's (ACHP) guidance for protection and preservation of sites and artifacts with traditional religious and cultural importance to American Indian tribes or Native Hawaiian organizations (Advisory Council on Historic Preservation, 2004).

8.1.11.2. 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 1.8, Overview of the Relevant Federal Laws and Executive Orders), the American Indian Religious Freedom Act (AIRFA), ARPA, and NAGPRA. Appendix C, Environmental Laws and Regulations, summarizes these pertinent federal laws.

Michigan does not have state regulations that are similar to the NHPA or NEPA. 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 8.1.11-1 presents state and local laws and regulations that relate to cultural resources.

Table 8.1.11-1: State Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Designation of Pure Michigan Trails, MCL 324.72103	Department of Natural Resources (DNR), Parks and Recreation Division	Requirements for "Pure Michigan Trails," which promote "healthy lifestyles, economic development, recreation, and conservation of the natural and cultural resources of this state."
Local Historic Districts, MCL 399.201	State Historic Preservation Office (SHPO)	Requirements for the identification, certification, and preservation of historical sites.

8.1.11.3. Cultural and Natural Setting

Human beings have inhabited the Michigan region for more than 12,000 years (Castle Museum of Saginaw County History, 2015). These early people are believed to have crossed the land bridge known as Beringia into North America from Asia following the migrations of the mastodon, caribou, and other large Pleistocene fauna. The majority of evidence of the region's early human habitation comes from the study of prehistoric and historic archaeological sites. There are thousands of archaeological sites in Michigan, with 83 listed in the NRHP (NPS, 2015g). Michigan is within the Superior Upland and Central Lowland physiographic province of the Laurentian Upland and Interior Plains physiographic regions (PNAS, 1917); refer to Figure 8.1.7-1.

Archaeological evidence in Michigan is primarily found on the surface or within one to two feet of the surface. However, due to natural warming trends and the subsequent rises and drops in the water levels that created the Great Lakes, many early archaeological sites may be submerged or buried beneath lake sediments (O'Shea J. M., 2009).

Section 8.1.11.4 presents an overview of the initial human habitation in Michigan and the cultural development that occurred before European contact. Section 8.1.11.5 discusses the federally recognized American Indian Tribes with a cultural affiliation to the state. Section 8.1.11.6 provides a current list of significant archaeological sites in Michigan and tools that the state has developed to ensure their preservation. Section 8.1.11.7 documents the historic context of the state since European contact, and Section 8.1.11.8 summarizes the architectural context of the state during the historic period.

Prehistoric Setting

Archaeologists divide Michigan's prehistory into three periods: Paleoindian (10000 to 8000 B.C.), Archaic (8000 to 500 B.C.), and Woodland (500 B.C. to A.D. 1600). The following timeline (Figure 8.1.11-1) provides a guideline to Michigan's prehistoric habitation. Relatively little is known about the earliest inhabitants, but the amount of evidence uncovered suggests that northern Michigan may not have been inhabited by humans until the Late Archaic (Martin, 1996). New technologies related to deep-water archaeological study have aided in discoveries underwater within the Great Lakes that have led to an evolving cultural understanding of the area's earliest inhabitants, with some of the largest site discoveries having been made within recent years (O'Shea, Lemke, Sonnenburg, Reynolds, & Abbot, 2014).

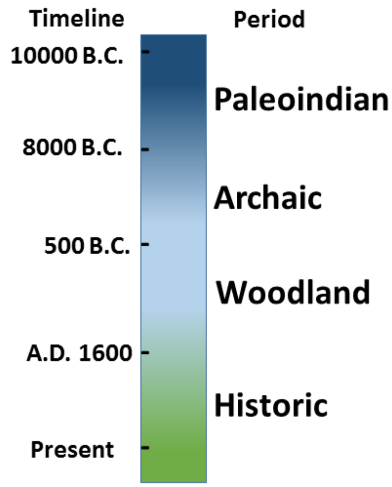

Figure 8.1.11-1: Timeline of Prehistoric Human Occupation

Sources: (Institute of Maritime History, 2015) (Martin, 1996)

Paleoindian Period (10000 – 8000 B.C.)

The Paleoindian Period represents the earliest human habitation in Michigan. The first human beings were thought to have entered the Michigan region through the Alpena-Amberley Ridge (AAR) land formation,[106] which connected Michigan to Ontario during this period (O'Shea J. M., 2009). These earliest inhabitants were hunter-gatherers that subsisted on caribou, supplemented by mastodons, smaller game, and plants (Castle Museum of Saginaw County History, 2015). Large Paleoindian sites in the Michigan region provide archaeological evidence supporting caribou hunting as one of the primary sources of subsistence (Carr, 2012). Several caribou and mastodon skeletons found in Michigan show cut marks on the bones discovered at the site (Castle Museum of Saginaw County History, 2015).

Paleoindian sites are recognized by the presence of Clovis or other diagnostic, fluted projectile points. In addition to using projectile point styles as determinants for prehistoric periods, the materials used to create the points are also a good indicator for identifying the time of occupation. During the Early Paleoindian period, Upper Mercer chert and Flint Ridge chalcedony were the materials most commonly used for projectile points, but by the Late Paleoindian Period, Bay Point chert from the Saginaw Bay area became the most common used material for points (Castle Museum of Saginaw County History, 2015).

Recent underwater surveys by remotely operated vehicles (ROV) of the AAR have revealed more than 60 stone constructions identified by underwater archaeologists "human modified

[106] The Alpena-Amberley Ridge is a long causeway that, during the Lake Stanley low-water phase, would have created a structure across modern day Lake Huron connecting Michigan with Ontario, Canada (O'Shea J. M., 2009). The presence of marsh testate amoeba assemblages in the AAR indicate that the land surface rapidly flooded approximately 8,000 year ago and has remained relatively intact without further disturbance of sedimentation.

features from natural occurrences" (O'Shea et al 2014). The Drop 45 Lane site in the American portion of the AAR (presently under 120 feet of water) was likely a hunting site. The site shows four V-shaped hunting blinds and a possible meat cache (O'Shea, Lemke, Sonnenburg, Reynolds, & Abbot, 2014). The significance of this site is that it provides well-preserved artifacts of Paleoindian hunting habits, whereas above-surface sites for this period are often eroded or altered by later human interaction.

Archaic Period (8000 to 500 B.C.)

The Archaic Period in the Michigan region is marked by a warming trend as the arctic ice sheets retreated north. Large animals, like mastodons and mammoths, disappeared and smaller game, like deer, became more common with the changing environment.

Very little information has been gathered on the Early Archaic Period of the Michigan region, possibly because Early Archaic people had a highly mobile hunting and gathering lifestyle (Castle Museum of Saginaw County History, 2015). What material culture has been gathered leads archaeologists to believe that during this period people first began using new tools, such as the atlatl, with spears (Schonberg, 2004).

Around the Middle Archaic Period, fish became a larger part of the diet, as evidenced by the remains of bone and copper fishhooks, gorges and spears, notched pebble net-sinkers, and fish bones in sites across the Upper Great Lakes Region (Martin, 1996). By the Middle Archaic, it is possible that small base camps (also referred to as "logistic camps") were established to exploit resources found in the Superior Upland and Central Lowland provinces (Castle Museum of Saginaw County History, 2015). There is the possibility that the Middle or Late Archaic people began small scale gardening, but solid evidence of horticultural practices does not appear until the Middle to Late Woodland Period (Emerson, McElrath, & Fortier, 2009). Of available archeological data, the only area of Michigan where plant domestication seems to have occurred during the Archaic Period is the Saginaw Valley.

Though there is disagreement as to precisely when the Old Copper Culture began, there is evidence that it started during the Late Archaic Period, transitioning into the Early Woodland Period. The Old Copper Culture refers to a culture that began mining copper prior to European contact in the Great Lakes area of Michigan and Wisconsin, specifically on Isle Royale and the Keweenaw Peninsula. The culture of this population is identified by its distinctive resource; the array of copper tools and ornaments it left behind, as well as the discovery of nearly pure natural copper deposits used by the prehistoric people (Cullen, 2006).

Woodland Period (500 B.C. to A.D. 1600)

The Early Woodland Period is marked by the first use of fire-treated ceramics (Castle Museum of Saginaw County History, 2015). Archaeologists consider this time to be a transitional period, where populations shifted from nomadic hunter-gatherers to sedentary farming societies. During the Woodland Period, the Upper Great Lakes region developed a broad seasonally-based subsistence economy involving horticulture, hunting, collecting, and an increase in the exploitation of aquatic resources (Drake & Dunham, 2004). People in the northern Lower

Peninsula further added to their subsistence economy by adding corn agriculture (Brashler et al 2000).

The introduction of tools that increased the productivity of horticulture and fishing is thought to have led to increased localization and concentration of populations (Drake & Dunham, 2004). The onset of the Little Ice Age (A.D. 1500) near the end of the Late Woodland Period intensified trade ("exchange") patterns, as food scarcity made exchange and alliances critical to cultures that relied primarily on horticulture (Brashler et al 2000).

Historic Period (A.D. 1600 to Present)

With the influence of European cultures, traditional American Indian cultures drastically changed. Along the coasts, fishing was still an integral part of the regional economy through the 1800s, and Ottawa and Ojibway tribal fishing rights were reaffirmed by the Federal Court in 1979. Much of northwestern Lake Huron was named tribal fishing grounds in 1836, based on the interpretation of the Treaty of Washington (Martin, 1996). The double-ended dugout canoes used by the American Indians to conduct fishing activities were the same as canoes developed by the Copper Culture of the Late Archaic Period (Cullen, 2006).

8.1.11.4. Federally Recognized Tribes of Michigan

According to the Bureau of Indian Affairs and the National Conference of State Legislators, there are 12 federally recognized tribes in the state of Michigan with one crossing state boundaries (refer to Table 8.1.11-2) (National Conference of State Legislatures, 2016). The location of federally recognized tribes are shown in Figure 8.1.11-2. There are several other tribes depicted on the figure below that once lived in Nebraska, but do not retain federal reservation or trust lands in the state any longer.

Table 8.1.11-2: Federally Recognized Tribes of Michigan

Bay Mills Indian Community	Grand Traverse Band of Ottawa and Chippewa Indians
Hannahville Indian Community	Huron Potawatomi
Lac Vieux Desert Band of Lake Superior Chippewa Indians	Keweenaw Bay Indian Community
Little Traverse Bay Bands of Odawa Indians	Little River Band of Ottawa Indians
Saginaw Chippewa Indian Tribe of Michigan	Match-e-be-nash-she-wish Band of Pottawatomi Indians of Michigan
Pokagon Band of Potawatomi Indians (Michigan and Indiana)	Sault Ste. Marie Tribe of Chippewa Indians of Michigan

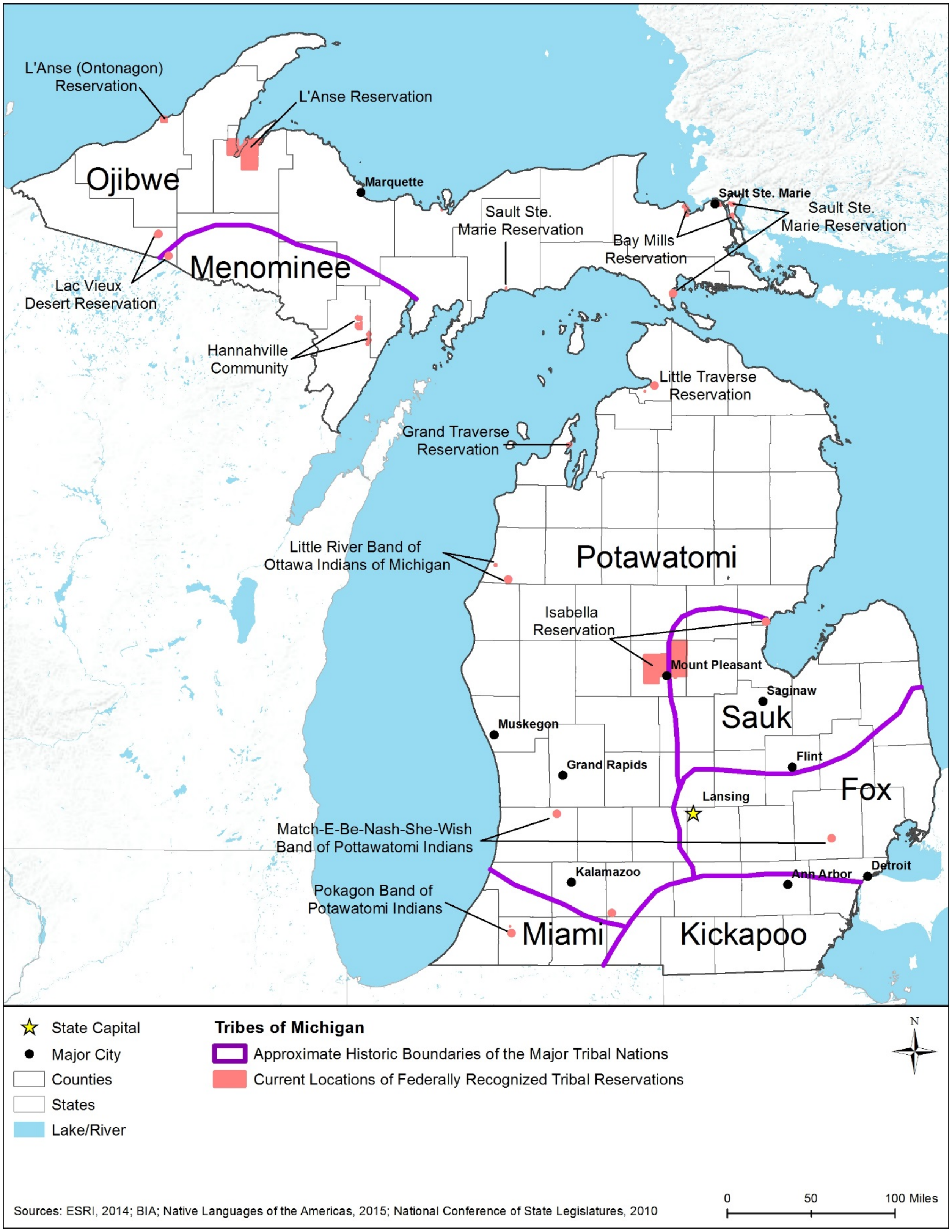

Figure 8.1.11-2: Approximate Historic Boundaries of Tribes in Michigan

8.1.11.5. Significant Archaeological Sites of Michigan

As previously mentioned in Section 8.1.11.3, there are 83 archaeological sites in Michigan listed on the NRHP. Table 8.1.11-3 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 at http://www.nps.gov/nr/ (NPS, 2015i).

Michigan State Cultural Resources Database and Tools

Michigan State Historic Preservation Office (SHPO)

The State Historic Preservation Office (SHPO), which is part of the Michigan State Housing Development Office, works to preserve the cultural resources of Michigan. The office is responsible for overseeing preservation programs and maintaining historical resources. A list of all NRHP nominations is available on the SHPO website, as well as nomination forms and documents (Michigan Legislature, 2015f).

Michigan Archaeological Society

The Michigan Archaeological Society is a statewide organization that encourages the study and preservation of Michigan's multi-cultural heritage. The society's mission is to spread awareness of prehistoric and historic archaeological sites. Information on becoming an affiliate of the MAS is available at http://www.miarch.org (DNR, 2015n).

Table 8.1.11-3: Archaeological Sites on the National Register of Historic Places in Michigan

Closest City	Site Name	Type of Site
Alma	Brown Site (20GR21)	Prehistoric
Alma	Conservation Park Site (20GR33)	Prehistoric
Alma	Holiday Park Site (20GR91)	Prehistoric
Baraga	Sand Point Site	Prehistoric
Bay City	Fletcher Site	Historic - Aboriginal, Prehistoric
Bay Mills Township	Naomikong Point Site	Historic - Aboriginal, Prehistoric
Bellaire	Holtz Site	Prehistoric
Bridgeport	Bugai Site (20SA215)	Prehistoric
Bridgeport	Schmidt Site	Prehistoric
Buchanan	Moccasin Bluff Site	Prehistoric
Campbell	Campbell Farm Site	Historic - Aboriginal, Prehistoric, Military
Charlevoix	Charlevoix City Park Site	Prehistoric
Charlevoix	Garden Island Indian Cemetery	Historic - Aboriginal
Charlevoix	Mt. McSauba Site	Prehistoric
Charlevoix	O'Neill Site	Prehistoric
Charlevoix	Pine River Site	Prehistoric

Closest City	Site Name	Type of Site
Charlevoix	Wood Site	Prehistoric
Crockery	Spoonville Site	Prehistoric
Croton	Croton Dam Mound Group	Prehistoric
Croton	Toft Lake Village Site	Prehistoric
Douglas	Hacklander Site	Prehistoric
Eastern Midland County	Oxbow Archeological District	Historic - Aboriginal, Prehistoric
Empire-Sleeping Bear Dunes NLS	Platte River Campground	Prehistoric
Erie	North Maumee Bay Archeological District	Prehistoric
Escanaba	Bar Lake Site	Prehistoric
Escanaba	Hartney Terrace Site	Prehistoric
Escanaba	Widewaters Site	Prehistoric
Escanaba	Gooseneck Lake III Site	Prehistoric
Escanaba	Gooseneck Lake IV Site	Prehistoric
Escanaba	Jackpine Lake Site	Prehistoric
Escanaba	Thunder Lake II Site	Prehistoric
Fayette	Spider Cave	Prehistoric
Fosters	Fosters Site (20SA74)	Prehistoric
Garden	Winter Site	Prehistoric
Goodland	Younge Site	Prehistoric
Gould City	Scott Point Site	Prehistoric
Grand Rapids	Norton Mound Group	Prehistoric
Green Bay	R. J. HACKETT (steamer) Shipwreck Site	Shipwreck
Isle Royale National Park	ALGOMA	Shipwreck
Isle Royale National Park	AMERICA	Shipwreck
Isle Royale National Park	CHESTER A. CONGDON	Shipwreck
Isle Royale National Park	CUMBERLAND	Shipwreck
Isle Royale National Park	EMPEROR	Shipwreck
Isle Royale National Park	GEORGE M. COX	Shipwreck
Isle Royale National Park	GLENLYON	Shipwreck
Isle Royale National Park	HENRY CHISHOLM	Shipwreck
Isle Royale National Park	KAMLOOPS	Shipwreck
Isle Royale National Park	Minong Mine Historic District	Historic - Aboriginal, Prehistoric
Isle Royale National Park	MONARCH	Shipwreck
Jackson	Clark-Stringham Site	Prehistoric
Kingsford	Graved Rock Site	Historic - Aboriginal, Prehistoric
Kingsford	Menominee River Park Archeological District	Prehistoric
Kingsford	Up Stream Put-In Site	Historic, Historic - Aboriginal, Prehistoric
Lake City	Boven Earthwork	Prehistoric
Levering	Wycamp Creek Site	Prehistoric
Lexington	SPORT (tug) Shipwreck Site	Shipwreck

Closest City	Site Name	Type of Site
Mason County	Not-A-Pe-Ka-Gon Site	Historic - Aboriginal, Prehistoric
Mears	Green Quarry Site	Prehistoric
Menominee	Riverside Site	Prehistoric
Minden City	Sanilac Petroglyphs	Prehistoric
Missaukee County	Aetna Earthworks	Prehistoric
Monroe	River Raisin Battlefield Site (20MR227)	Historic, Military
Moran Township	Gros Cap Archaeological District	Historic, Historic - Aboriginal, Prehistoric
Niles	Fort St. Joseph Site	Historic, Military
Norwood	Pi-wan-go-ning Prehistoric District	Prehistoric
Norwood Township	Pewangoing Quarry	Prehistoric
NW Ottawa County	Battle Point Site	Historic - Aboriginal, Prehistoric
Oscoda	Five Channels Dam Archeological District	Historic
Pentwater	Dumaw Creek Site	Prehistoric
Pointe Aux Pins	Juntunen Site	Prehistoric
Ponshewaing	Ponshewaing Point Site	Prehistoric
Port Huron	Fort Gratiot	Historic, Historic - Aboriginal, Prehistoric, Military
Restricted	Ekdahl-Goudreau Site	Prehistoric
Rogers City	BARNEY, F. T., Shipwreck	Shipwreck
South Haven	HENNEPIN Self-unloading Steamship (Shipwreck)	Shipwreck
Spaulding Township	Schultz Site (20SA2) Green Point Site (20SA1)	Historic, Prehistoric
St. Charles	Mahoney Site (20SA193)	Prehistoric
St. Ignace	Lasanen Site	Historic - Aboriginal
St. Ignace	Marquette Street Archaeological District	Historic, Historic - Aboriginal, Prehistoric
Summer Island	Summer Island Site	Historic - Aboriginal, Prehistoric
Unknown	Spring Creek Site	Prehistoric
Warren	Holcombe Site	Historic - Aboriginal, Prehistoric
Williamsburg	Skegemog Point Site	Prehistoric

Source: (NPS, 2015i)

8.1.11.6. Historic Context

In 1618, the French explorer Etienne Brulé became the first European to explore present day Michigan. European exploration continued during the 17th century, with the first permanent settlement being established at Sault Ste. Marie by Father Jacques Marquette in 1668. Forts, missions, and trading posts were constructed during the 17th century. In 1701, Detroit was founded, but was originally called Fort Pontchartrain de Detroit. The parish of Ste. Anne's Church, which was founded immediately after the founding of Detroit, is now the "second oldest continuously maintained Roman Catholic parish in the United States" (Michigan Legislature, 2015e).

While the French controlled Michigan for much of its early history, the French and Indian War (1754 to 1763) resulted in France losing virtually all of its North American territory, including Michigan. Conflict with American Indians who were allied with the French continued for another year and included a prolonged siege of Detroit. Following the American Revolution, legal ownership of Michigan transferred to the United States; however, the British continued to control the area for a decade longer. In 1787, the Northwest Territory was created, formally known as the "Territory Northwest of the Ohio River," and contained the land that what would eventually become the state of Michigan. In 1805, the Territory of Michigan was created, and on January 26, 1837, Michigan was admitted to the Union as the 26th state (Michigan Legislature, 2015e).

Fur trading was important for much of Michigan's early history, with Mackinac Island being a strategically important location that facilitated control of trade in the Great Lakes. Fur trading peaked in 1830. Timbering became important starting in the early 19th century, with Michigan remaining a top lumber producing state for several years. Various types of mills, including gristmills and lumber mills, were located near rivers that powered the mills and enabled the movement of raw materials to mills and finished products to centers of commerce (Michigan Legislature, 2015e). In 1817, the University of Michigan was organized and founded as the "Catholepistemiad" in Detroit, rather than Ann Arbor, where it would eventually move in 1837 (University of Michigan, 2015). Starting in the second quarter of the 19th century, mining operations commenced in the Upper Peninsula region, including coal, iron ore, and eventually copper (Michigan Legislature, 2015e).

During the Civil War, Michigan supplied approximately 90,000 troops to the Union, with the First Michigan Regiment being the first regiment of western soldiers to reach Washington, D.C. Following the Civil War, mining activities continued to be important, as did timbering, with strikes occurring in both industries; these labor conflicts continued into the early 20th century (Michigan Legislature, 2015e).

Starting in the early 20th century, the automobile industry began to take a dominant role in the development of the state, particularly in the areas around Detroit where many of the companies were headquartered. Olds Motor Works (Oldsmobile) was founded in 1899, Ford Motor Company in 1903, Buick in 1904, and General Motors in 1908 (Michigan Legislature, 2015e). The auto industry developed in this area of the country largely due to its convenient location to the sources for raw materials, well-developed transportation infrastructure (railway systems and both natural and man-made waterways), and ample supply of labor.

During World War I (WWI), Michigan supplied men to serve abroad and participated heavily in the production of wartime goods. Ships were constructed, as were vehicles and engines by the State's automobile manufactures. Michigan experienced heavy unemployment during the Great Depression; however, during World War II (WWII), the economy made a strong recovery. Factories and plants were again converted to wartime production, earning the state the nickname of "The Arsenal of Democracy" (Michigan Legislature, 2015e).

Michigan continued to experience growth following WWII, particularly as the automobile became the primary mode of transportation in America. Detroit maintained its status as a national leader for many years; however, the city began to decline starting in the last quarter of the 20th century. More recently, the state has experienced economic distress, resulting in the abandonment of large urban and suburban areas replete with significant historic resources.

Michigan has 1,870 NRHP listed sites, as well as 41 National Historic Landmarks (NHL) (NPS, 2014f). Michigan contains one National Heritage Area (NHA), the Motor-Cities National Heritage Area (NPS, 2015j). Figure 8.1.11-3 shows the location of NHA and NRHP sites within the state of Michigan.[107]

8.1.11.7. Architectural Context

Michigan's earliest European architecture was built by French trappers and explorers starting in the 17th century. These early buildings consisted of wooden forts, trading posts, and missions, and were primarily in the Upper Peninsula region. Established in 1701, "Fort Pontchartrain de Detroit, a fur trading post at the present site of Detroit…was the first permanent French settlement in the Lower Peninsula" (Eckert, 2012). Early fortifications were constructed of timber and consisted of a large space enclosed by tall palisades. "Throughout the years of transition from frontier to statehood, the architecture of Michigan was marked by a gradual but accelerating intrusion of established stylistic concepts from the Eastern Seaboard into the primitive building environment of the hinterland" (Eckert, 2012).

Starting in the early 19th century, but especially after the completion of the Erie Canal in 1825, migrants began to establish farms in southern Michigan. While many early buildings were built of logs, Federal and Greek Revival style buildings became common as these initial structures were replaced. Both wood and stone were used for construction, with designs being informed by building guides and plan books from farther east. The Lapeer County Courthouse, in Lapeer, MI, is an example of Greek Revival architecture being executed in a grand public building. During the second half of the 19th century, and continuing into the first part of the 20th century, immigration also affected the state's architecture as different ethnic groups contributed their own traditions to Michigan's architectural palate (Eckert, 2012).

Transportation infrastructure, such as roads, bridges, and canals, was built in great numbers during the first half of the 19th century. The railroad construction boom began in the 1830s. The state's supply of lumber fueled the building industry, fostering architectural growth and lending itself to timber heavy Romantic styles. Gothic Revival and Italianate structures were built starting in the second half of the 19th century, while the latter part of the 19th century was dominated by Victorian architecture, such as Queen Anne and Second Empire. The house of lumber baron Charles H. Hackley, in Muskogee, MI, is an example of a grand Victorian house from this era (Eckert, 2012). During the early 20th century, Prairie and Craftsman architecture was popular, and can be seen in many pre-WWII suburbs. Following WWII, ranch neighborhoods were built in communities that continued to spread outward from city centers.

[107] See Section 8.1.7 for a more in-depth discussion of additional historic resources as they relate to recreational resources.

Figure 8.1.11-3: NHA and NRHP Sites in Michigan

Copper and iron mining facilities in the Upper Peninsula sparked growth that lasted into the early 20th century. “The red sandstone city halls and county courthouses, churches, schools and libraries, banks and commercial blocks, and houses they built give the Lake Superior region a distinct identify” (Eckert, 2012). Richardsonian Romanesque was a particularly popular style for grand buildings in this region during the latter part of the 19th century. During the era known as the Gilded Age, which occurred during the latter part of the 19th century and very early part of the 20th century, resorts, hotels, boardinghouses, cottages, villas, boathouses, clubhouses, and casinos were constructed around Michigan’s miles of Great Lakes shoreline (Eckert, 2012).

The automobile industry had a significant and pervasive effect on Michigan during the 20th century, particular the region around Detroit. Starting in the early 20th century, enormous automobile plants were constructed, generally away from the city’s center due to their size, with various types of worker housing springing up around these facilities (Eckert, 2012). The Ford River Rouge Complex (1915), in Dearborn, MI, is one example that has been designated as a National Historic Landmark District (NPS, 2016e).

Figure 8.1.11-4: Representative Architectural Styles of Michigan

- Top Left – Former Packard Plant (Detroit, MI) – (Vergara, 1991)
- Top Middle – Wayne County Building (Detroit, MI) – (Detroit Publishing Company, 1910)
- Top Right – South Manitou Island Lighthouse (South Manitou Island, Glen Arbor, MI) – (Historic American Buildings Survey, 1933)
- Bottom Left – University Hall, University of Michigan (Ann Arbor, MI) – (Detroit Publishing Company, 1905)
- Bottom Right – Ford Motor Company River Rouge Plant (Dearborn, MI) – (Detroit Publishing Company, 1927)

8.1.12. Air Quality

8.1.12.1. Definition of the Resource

Air Quality in a geographic area is determined by the type and amount of pollutants emitted into the atmosphere, the size and topography[108] of the area, and the prevailing weather and climate conditions. The levels of pollutants and pollutant concentrations in the atmosphere are typically expressed in units of parts per million (ppm)[109] or micrograms per cubic meter ($\mu g/m^3$) determined over various periods of time (averaging time).[110] This section discusses the existing air quality in Michigan. The USEPA designates areas within the United States as attainment,[111] nonattainment,[112] maintenance,[113] or unclassifiable[114] depending on the concentration of air pollution relative to ambient air quality standards. Information is presented regarding national and state ambient air quality standards and nonattainment areas that would be potentially more sensitive to impacts from implementation of the proposed action or alternatives.

8.1.12.2. Specific Regulatory Considerations

The Michigan Air Pollution Control Rules, promulgated by MDEQ contain rules that govern several aspects of Air Quality in Michigan. Table 8.1.12-1 provides a brief summary of the pertinent rules regarding permitting.

[108] Topography: The unique features and shapes of the land (e.g., valleys and mountains).
[109] Equivalent to 1 milligram per liter (mg/L).
[110] Averaging Time: "The period over which data are averaged and used to verify proper operation of the pollution control approach or compliance with the emissions limitation or standard" (USEPA, 2015t).
[111] Attainment areas: Any area that meets the national primary or secondary ambient air quality standard for the pollutant (USEPA, 2015o).
[112] Nonattainment areas: Any area that does not meet (or that contributes to ambient air quality in a nearby area that does not meet) the national primary or secondary ambient air quality standard for the pollutant (USEPA, 2015o).
[113] Maintenance areas: An area that was previously nonattainment, but has met the national primary or secondary ambient air quality standards for the pollutant, and has been designated as attainment (USEPA, 2015o).
[114] Unclassifiable areas: Any area that cannot be classified on the basis of available information as meeting the national primary or secondary air quality standard for a pollutant (USEPA, 2015o).

Table 8.1.12-1: Michigan Air Quality Laws

State Law/Regulation	Regulatory Agency	Description
Rules 201 of the Michigan Air Pollution Control Rules	MDEQ	Describes preconstruction permitting requirements.
Rules 210 and 211 of the Michigan Air Pollution Control Rules	MDEQ	Describes applicability of Michigan's Title V operating permit program.
Rules 213 of the Michigan Air Pollution Control Rules	MDEQ	Describes temporary source emissions allowed by the same source at multiple locations.
Rules 285 and 290 of the Michigan Air Pollution Control Rules	MDEQ	Describes permit exemptions.

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[115] or secondary,[116] for each pollutant with varying averaging times. Standards with short averaging times (e.g., 1-hour, 8-hour, and 24-hour) were developed to prevent the acute health effects from short-term exposure at high concentrations. Longer averaging periods (e.g., 3 months or annual) are intended to prevent chronic health effects from long-term exposure. A description of the NAAQS is presented in Appendix E. MDEQ has adopted the NAAQS and has not established additional state-specific ambient air quality standards.

In addition to the NAAQS, there are standards for hazardous air pollutants (HAP), which are those typically associated with specific industrial processes such as chromium electroplating (hexavalent chromium), dry cleaning (perchloroethylene), and solvent degreasing (halogenated solvents) (USEPA, 2015f). 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.

[115] Primary standard: The primary standard is set to provide public health protection, including protecting the health of sensitive populations such as asthmatics, children, and the elderly (USEPA, 2014a).
[116] Secondary standards: The secondary standard is set to provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings (USEPA, 2014a).

Title V Operating Permits/State Operating Permits

Michigan has authorization to issue CAA Title V operating permits on behalf of the USEPA, as outlined in 40 CFR 70. The Title V program refers to Title V of the CAA that governs permitting requirements for major industrial air pollution sources and consolidates all CAA requirements for the facility into one permit (USEPA, 2015h). The overall goal of the Title V program is to “reduce violations of air pollution laws and improve enforcement of those laws” (USEPA, 2015u). Rules 210 and 211 of the Michigan Air Pollution Control Rules (Renewable operating permits and renewable operating permit applicability) describe the applicability of Michigan’s Title V operating permit program. Michigan requires Title V operating permits for any major source if it emits or has the potential to emit pollutants in excess of the major source thresholds (see Table 8.1.12-2). The permit issued to a facility contains both state and federal portions and incorporates a reporting schedule (USEPA, 2014b).

Table 8.1.12-2: Major Air Pollutant Source Thresholds

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

Source: (USEPA, 2014b)

[a] Sources in nonattainment areas will have lower thresholds for some criteria pollutants depending on the classification of the nonattainment area.

Exempt Activities

Under Rules 285 and 290, of the Michigan Air Pollution Control Rules, the following select activities are exempt from obtaining a Permit to Install:

- “Internal combustion engines that have less than 10,000,000 Btu/hour maximum heat input…
- Brazing, soldering, welding, or plasma coating equipment…
- [Sources emitting only noncarcinogenic VOCs or materials] not contributing appreciably to the formation of ozone, if the uncontrolled or controlled emissions of air contaminants are not more than 1,000 or 500 pounds per year, respectively.
- Any emission unit that the total uncontrolled or controlled emissions of air contaminants are not more than 1,000 or 500 pounds per month, respectively, and all of the following criteria are met:
    - For noncarcinogenic air contaminants, excluding noncarcinogenic volatile organic compounds and noncarcinogenic materials…as not contributing appreciably to the formation of ozone, with initial threshold screening levels greater than or equal to 2.0 micrograms per cubic meter, the uncontrolled or controlled emissions shall not exceed 1,000 or 500 pounds per month, respectively.
    - For noncarcinogenic air contaminants, excluding noncarcinogenic volatile organic compounds and noncarcinogenic materials…as not contributing appreciably to the formation of ozone, with initial threshold screening levels greater than or equal to 0.04 micrograms per cubic meter and less than 2.0 micrograms per cubic meter, the

uncontrolled or controlled emissions shall not exceed 20 or 10 pounds per month, respectively.
    - For carcinogenic air contaminants with initial risk screening levels greater than or equal to 0.04 micrograms per cubic meter, the uncontrolled or controlled emissions shall not exceed 20 or 10 pounds per month, respectively.
    - The emission unit shall not emit any air contaminants, excluding noncarcinogenic volatile organic compounds and noncarcinogenic materials…as not contributing appreciably to the formation of ozone, with an initial threshold screening level or initial risk screening level less than 0.04 micrograms per cubic meter.
- Any emission unit that emits only noncarcinogenic particulate air contaminants and other air contaminants that are exempted under [the above bullets] if all of the following provisions are met:
    - The particulate emissions are controlled by an appropriately designed and operated fabric filter collector or an equivalent control system which is designed to control particulate matter to a concentration of less than or equal to 0.01 pounds of particulate per 1,000 pounds of exhaust gases and which do not have an exhaust gas flow rate more than 30,000 actual cubic feet per minute.
    - The visible emissions from the emission unit are not more than 5 percent opacity…
    - The initial threshold screening level for each particulate air contaminant, excluding nuisance particulate, is more than 2.0 micrograms per cubic meter" (MDEQ, 2014c).

Temporary Emissions Sources Permits

Provisions to Title V operating permits, under Rule 213 of the Michigan Air Pollution Control Rules (Content of Renewable Operating Permit), allows for permits to authorize temporary source emissions by the same source at multiple locations (MDEQ, 2015v). Non-Title V temporary sources should contact the MDEQ Air Quality Division to determine applicability and the proper permitting requirements for those sources.

State Preconstruction Permits

Rule 201 of the Michigan Air Pollution Control Rules (Permit to Install) requires a Permit to Install before any installation, construction, reconstruction, relocation, or modification of an air pollution source (MDEQ, 2015v).

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, 2013). 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 (USGPO, 2010).

The estimated pollutant emissions are compared to *de minimis*[117] levels. These values are the minimum thresholds for which a conformity determination must be performed (see Table 8.1.12-3). As a result, lower *de minimis* thresholds for VOCs and NO_X could apply depending on the attainment status of a county.

Table 8.1.12-3: *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: (USGPO, 2010)

If an action does not result in an emissions increase above the *de minimis* levels in Table 8.1.12-3, then a conformity determination is not required. If the applicability analysis shows that the total direct and indirect emissions are above the *de minimis* levels in Table 8.1.12-3, then the action must undergo a conformity determination. The federal agency must first show that the action would meet all SIP control requirements and that any new emissions would not cause a new violation of the NAAQS. To demonstrate conformity[118], the agency would have to fulfill one or more of the following:

- Show any emissions increase is specifically identified and accounted for in the respective state's SIP;
- Receive acknowledgement from the state that any increase in emissions would not exceed the SIP emission budget;
- Receive acknowledgement from the state to revise the SIP and include emissions from the action;

[117] *de minimis*: USEPA states that "40 CFR 93 § 153 defines *de minimis* levels, that is, the minimum threshold for which a conformity determination must be performed, for various criteria pollutants in various areas" (USEPA, 2016h).
[118] Conformity: Compliance with the State Implementation Plan.

- 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, 2010b).

State Implementation Plan (SIP) Requirements

The Michigan SIP is composed of many related actions to ensure ambient air concentrations of the six criteria pollutants comply with the NAAQS. Michigan's SIP is a conglomeration of separate actions taken for each of the pollutants. All of Michigan's SIP actions are codified under 40 CFR Part 52 Subpart X. A list of all SIP actions for all six criteria pollutants can be found on MDEQ's website at http://www.michigan.gov/deq/0,4561,7-135-3310_70940---,00.html.

8.1.12.3. 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 8.1.12-1 and Table 8.1.12-4 present the nonattainment areas in Michigan as of January 30, 2015. The year(s) 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 8.1.12-4 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 the date(s) when USEPA promulgated an ambient air quality standard for that pollutant. Note certain pollutants have more than one standard in effect (e.g. CO, Lead, $PM_{2.5}$, O_3, and SO_2). Unlike Table 8.1.12-4, Figure 8.1.12-1 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.

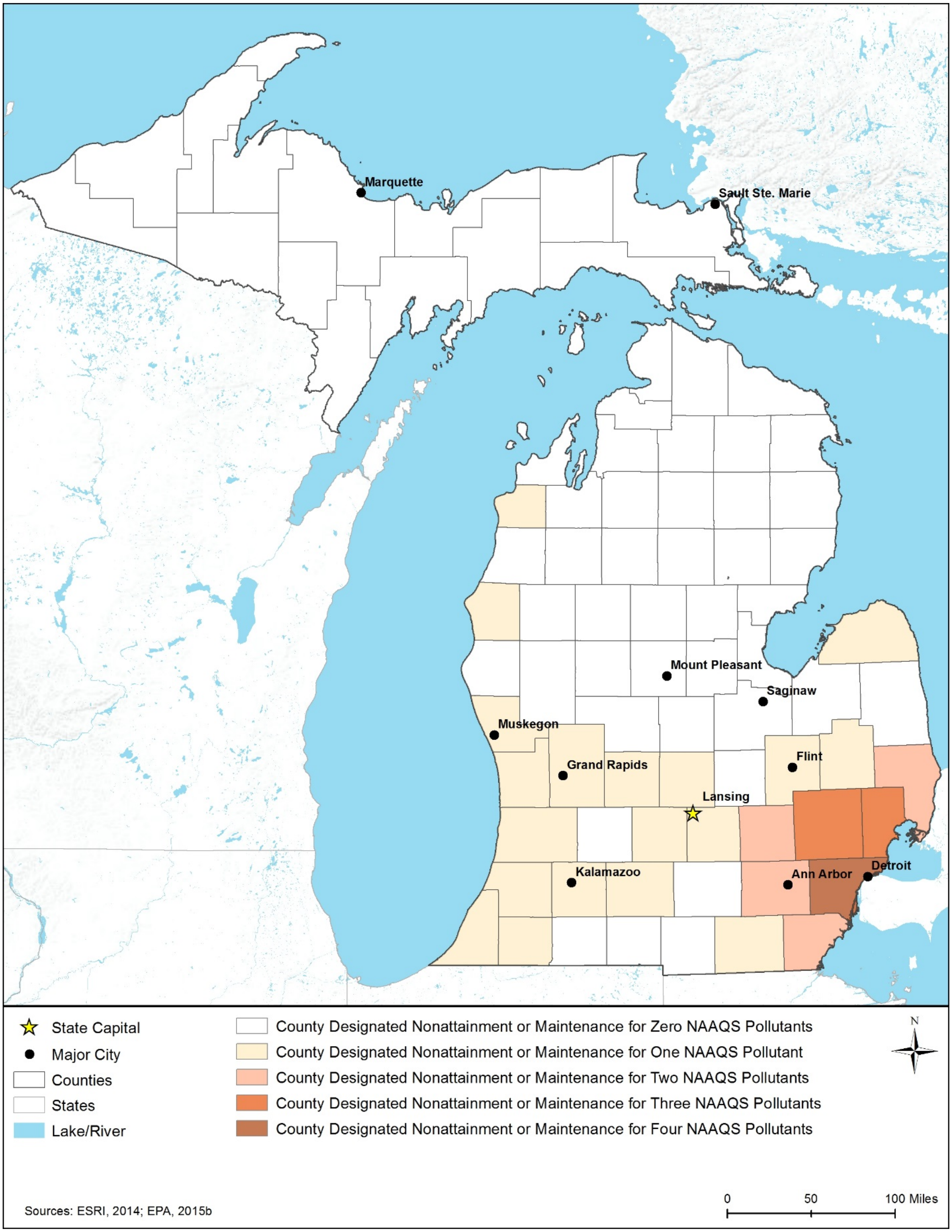

Figure 8.1.12-1: Nonattainment and Maintenance Counties in Michigan

Table 8.1.12-4: Michigan Nonattainment and Maintenance Areas by Pollutant and County

County	Pollutant and Year USEPA Implemented Standard										
	CO	Lead		NO_2	PM_{10}	$PM_{2.5}$		O_3		SO_2	
	1971	1978	2008	1971	1987	1997	2006	1997	2008	1971	2010
Allegan								M			
Benzie								M			
Berrien								M			
Calhoun								M			
Cass								M			
Clinton								M			
Eaton								M			
Genesse								M			
Huron								M			
Ingham								M			
Ionia			X-6								
Kalamazoo								M			
Kent								M			
Lepeer								M			
Lenawee								M			
Livingston						M	M	M			
Macomb	M					M	M	M			
Mason								M			
Monroe						M	M	M			
Muskegon								M			
Oakland	M					M	M	M			
Ottawa								M			
St Clair						M	M	M			
Van Buren								M			
Washtenaw						M	M	M			
Wayne	M				M	M	M	M			X-6

Source: (USEPA, 2015n)

X-1 = Nonattainment Area (Extreme)

X-2 = Nonattainment Area (Severe)

X-3 = Nonattainment Area (Serious)

X-4 = Nonattainment Area (Moderate)

X-5 = Nonattainment Area (Marginal)

X-6 = Nonattainment Area (Unclassified)

M = Maintenance Area

Air Quality Monitoring and Reporting

The MDEQ measures air pollutants at 44 sites across the state as part of the National Air Monitoring Stations Network and the State and Local Air Monitoring Stations Network (MDEQ, 2015z). Annual Michigan State Ambient Air Quality Reports are prepared, containing pollutant data summarized by region. MDEQ reports real-time air quality indices for $PM_{2.5}$, as well as pollutant concentrations for O_3, $PM_{2.5}$, SO_2, and NO_X, on their MIair website.

Throughout 2014, monitoring stations recorded O_3 measurements above the federal standard (0.075ppm) 15 times across the state. These exceedances are summarized by county in Table

8.1.12-5. There were no exceedances of any other NAAQS within Michigan during 2014. (MDEQ, 2015z)

Table 8.1.12-5: 2014 Michigan O_3 Monitoring Exceedances

County	Ozone Exceedances
Muskegon County	3
Allegan County	3
Berrien County	2
Schoolcraft County	1
Lenawee (Detroit-Ann Arbor Area)	1
Washtenaw (Detroit-Ann Arbor Area)	1
Macomb (Detroit-Ann Arbor Area)	2
Wayne (Detroit-Ann Arbor Area)	1

Source: (MDEQ, 2015z)

Air Quality Control Regions

USEPA classified all land in the United States as a Class I, Class II, or Class III Federal Air Quality Control Region (AQCR) (42 U.S.C. 7470). Class I areas include international parks, national wilderness areas which exceed 5,000 acres in size, national memorial parks which exceed 5,000 acres in size, and national parks which exceed 6,000 acres in size. Class I areas cannot be re-designated as Class II or Class III and are intended to maintain pristine air quality. Although USEPA developed the standards for a Class III AQCR, to date they have not actually classified any area as Class III. Therefore, any area that is not classified as a Class I area is, by default, automatically designated as a Class II AQCR (42 U.S.C. 7472).

- In a 1979 USEPA memorandum, the Assistant Administrator for Air, Noise, and Radiation (USEPA, 1979) advised USEPA Regional Offices to provide notice to the Federal Land Manager (FLM) of any facility subject to the Prevention of Significant Deterioration (PSD) permit requirements and within 100 kilometers[119] of a Class I area. "The EPA's policy is that FLMs should be notified by the Regional Office about any project that is within 100 kilometers of a Class I area. For sources having the capability to affect air quality at greater distances, notification should also be considered for Class I areas beyond 100 kilometers" (Page, 2012). The 2005 USEPA guidelines for air quality modeling do not provide a precise modeling range for Class I areas.
- PSD applies to new major sources or major modifications at existing sources for pollutants where the source is in an attainment or unclassifiable area. An air quality analysis is required for sources subject to PSD requirements and generally consists of using a dispersion model to evaluate emission impacts to the area. "Historically, the USEPA guidance for modeling air quality impacts under the PSD program has tended to focus more on the requirements for a Class II modeling analysis. Such guidance has provided that applicants need not model beyond the point of significant impact or the source or 50 kilometers[120] (the normal useful range of USEPA-approved Gaussian plume models)" (Seitz, 1992).

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

- Michigan contains two Federal Class I areas (see Table 8.1.12-6); all other 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 (USEPA, 1992). Wisconsin and Minnesota also have Class I areas (see Table 8.1.12-6) where the 100-kilometer buffer intersects a few Michigan counties. Any PSD-applicable action within these counties would require FLMs notification from the appropriate Regional Office. Figure 8.1.12-2 provides a map of Michigan 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 Table 8.1.12-6 correspond to the numbers and Class I areas listed in Figure 8.1.12-2.

Table 8.1.12-6: Relevant Federal Class I Areas

#[a]	Area	Acreage	State
1	Seney Wilderness Area	25,150	MI
2	Isle Royale National Park	542,428	MI
3	Rainbow Lake Wilderness Area	6,583	WI
4	Boundary Waters Canoe Area Wilderness	747,840	MN

Source: (USEPA, 2012a)

[a] The numbers correspond to the shaded regions in Figure 8.1.12-2.

Figure 8.1.12-2: Federal Class I Areas with Implications for Michigan

8.1.13. Noise

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

8.1.13.1. 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, 2012b). 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, 2016a). 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, 2015i). 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, 2016a).

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; and
- The changes in frequency characteristics or pressure levels through time.

Figure 8.1.13-1 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.

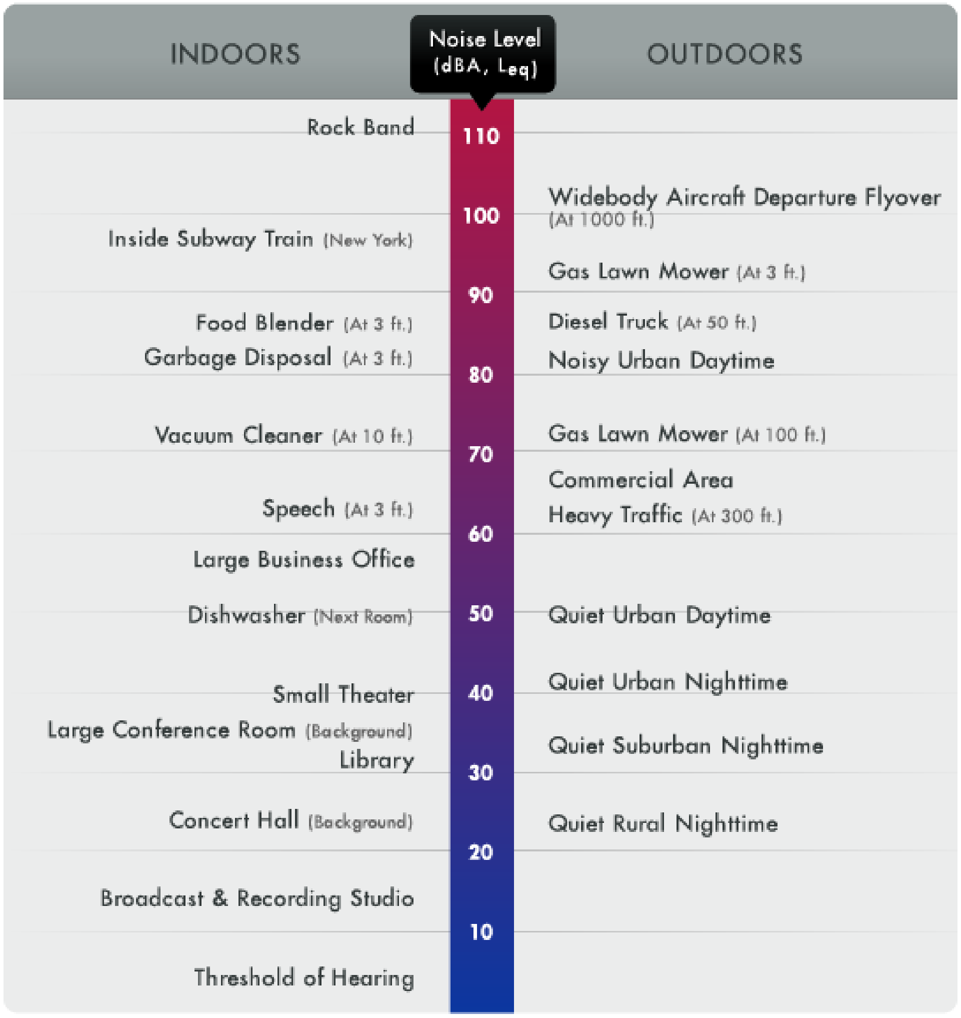

Figure 8.1.13-1: Sound Levels of Typical Sounds

Prepared by: Booz Allen Hamilton

Source: (Sacramento County Airport System, 2015)

Leq: Equivalent Continuous Sound Level

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

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

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

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

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

8.1.13.2. 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.

Michigan has several statewide noise regulations, which are documented in the Michigan Compiled Laws. They mainly apply to motor vehicle functions such as engine running and horns. Table 8.1.13-1 provides a brief summary of these regulations.

Table 8.1.13-1: Michigan Noise Laws

State Law/ Regulation	Regulatory Body	Description
257.707	The Michigan Legislature	Requires all motor vehicles to be equipped with a muffler at all times and establishes motor vehicle maximum noise limits.
259.80b	The Michigan Legislature	Requires aircraft to abide by local noise abatement procedures.

Source: (Michigan Legislature, 2015)

Many cities and towns may have additional, local noise ordinances to further manage community noise levels. The noise limits specified in such ordinances are typically applied to define noise sources and specify a maximum permissible noise level. Large cities and towns, such as Detroit, Grand Rapids, and Lansing 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).

8.1.13.3. Environmental Setting: Ambient Noise

The range and level of ambient noise in Michigan varies widely based on the area and environment of the area. The population of Michigan can choose to live and interact in areas that are large cities, rural or suburban communities, small towns, and national and state parks. Figure 8.1.13-1 illustrates noise values for typical community settings and events that are representative of what the population of Michigan may experience on a day-to-day basis. These noise levels represent a wide range and are not specific to Michigan. As such, this section describes the areas where the population of Michigan can potentially be exposed to higher than average noise levels.

- **Urban Environments:** Urban areas are likely to have higher noise levels on a daily basis due to highway traffic (70 to 90 dBA), construction noise (90 to 120 dBA), and outdoor conversations (e.g., small/large groups of people) (60 to 90 dBA) (USDOI, 2008). The urban areas that are likely to have the highest ambient noise levels in the state are Detroit, Grand Rapids, and Lansing.
- **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 Michigan, Detroit Metropolitan Wayne County Airport (DTW) and Gerald R. Ford International Airport (GRR) have combined annual operations of more than 467,000 flights, with DTW accounting for more than 392,000 of those flights (FAA, 2015j). These operations result in increased ambient noise levels in the surrounding communities. See Section 8.1.7, Land Use, Recreation, and Airspace, and Table 8.1.7-8 for more information about airports in the state.
- **Highways:** Communities near major highways also experience higher than average noise levels when compared to areas that are not in close proximity to a highway (FHWA, 2015f). There are a number of major highways within the state that may contribute to higher ambient noise levels for residents living near those traffic corridors. The major highways in the state tend to have higher than average ambient noise levels on nearby receptors, ranging from 52 to 75 dBA (FHWA, 2015f). See Section 8.1.1, Public Safety Infrastructure, and Figure 8.1.1-1 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 (DOT, 2015). The Michigan section of the Pere Marquette route runs from Grand Rapids to Holland, Bangor, St. Joseph/Benton Harbor, and New Buffalo. The Michigan section of the Blue Water route has stops in Port Huron, Lapeer, Durand, East Lansing, Battle Creek, Kalamazoo, Dowagiac, Niles, and New Buffalo. The Michigan section of the Wolverine has stops in Pontiac, Birmingham, Royal Oak, Detroit, Dearborn, Ann Arbor, Jackson, Albion, Battle Creek, Kalamazoo, Dowagiac, Niles, and New Buffalo (MDOT, 2013). See Section 8.1.1, Public

Safety Infrastructure, and Figure 8.1.1-1 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, 2014h). Michigan has five national parks and 12 National Natural Landmarks (NPS, 2015g). Visitors to these areas expect lower ambient noise conditions than the surrounding urban areas. See Section 8.1.8, Visual Resources, and Figure 8.1.8-2 for more information about national and state parks for Michigan.

8.1.13.4. 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 Michigan 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 the state of Michigan.

8.1.14. Climate Change

8.1.14.1. 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, 2012c). The IPCC is now 95 percent certain that humans are the main cause of current global warming (IPCC, 2013). Human activities result in emissions of four main GHGs: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and halocarbons (a group of gases containing fluorine, chlorine, or bromine) (IPCC, 2007). The common unit of measurement for GHGs is metric tons of CO_2-equivalent (MT CO_2e), 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.

The IPCC reports that "global concentrations of these four GHGs have increased significantly since 1750" (IPCC, 2007). "Atmospheric concentrations of CO_2 increased from 280 parts per million (ppm) of carbon in 1750 to 379 ppm of carbon in 2005" (IPCC, 2007). The atmospheric concentration of CH_4 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 8.2, Environmental Consequences). Existing climate conditions in the project area are described first by state and sub-region, where appropriate, and then by future projected climate scenarios. The discussion focuses on the following climate change impacts: 1) temperature; 2) precipitation/droughts; and 3) severe weather events.

8.1.14.2. 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. Michigan has established goals and regulations to reduce GHG emissions to combat climate change. As shown in Table 8.1.14-1, there is one major primary policy driver for Michigan climate change preparedness and GHG emissions.

Table 8.1.14-1: Relevant Michigan Climate Change Laws and Regulations

State Laws/Regulations	Regulatory Agency	Requirements
Michigan Climate Action Council Climate Action Plan, March 2009	State of Michigan: MDEQ	In March 2009, the Michigan Climate Action Council developed the Climate Action Plan, which proposed the following GHG reduction goals for Michigan: • 20 percent reduction of GHGs below 2005 levels by 2020; and • 80 percent reduction below 2005 levels by 2050 (Michigan Climate Action Council, 2009).

8.1.14.3. Michigan Greenhouse Gas Emissions

Estimates of Michigan'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, 2015d). The USEPA also collects and disseminates national-level GHG emissions data, but by economic sector, not by state (USEPA, 2015g). Individual states have developed their own GHG inventories, 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 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, the source is described and cited.

According to the EIA, Michigan emitted a total of 160.2 MMT of CO_2 in 2013 from fossil fuels. Almost 40 percent of CO_2 emissions came from coal used by the electric power and industrial sectors (Table 8.1.14-1) (EIA, 2015e). Petroleum products, mostly in the transportation and industrial sectors, accounted for another 34 percent. Natural gas was the source of the remaining 28 percent of emissions with residential being the largest sector emitter from this fuel. Annual emissions between 1980 and 2013 are represented in Figure 8.1.14-1. Michigan's CO2 emissions decreased significantly between 1980 and 1983 as a result of declines in emissions from petroleum products. Emissions then increased from all fuel types to a maximum of 196.5 MMT in 1999. From 1999 to 2012 emissions from all fuel types declined although emissions from natural gas began increasing again in 2010 (EIA, 2015e). In 2013, Michigan was ranked 10th in the U.S. for total CO_2 emissions in 2013, and 27th overall for per capita CO_2 emissions (EIA, 2015f).

Table 8.1.14-2: Michigan CO_2 Emissions from Fossil Fuels by Fuel Type and Sector, 2012

Fuel Type (MMT)		**Source (MMT)**	
Coal	62.1	Residential	20.7
Petroleum Products	54.0	Commercial	10.3
Natural Gas	44.1	Industrial	20.5
		Transportation	46.7
		Electric Power	62.1
TOTAL	**160.2**	**TOTAL**	**160.2**

Source: (EIA, 2015e)

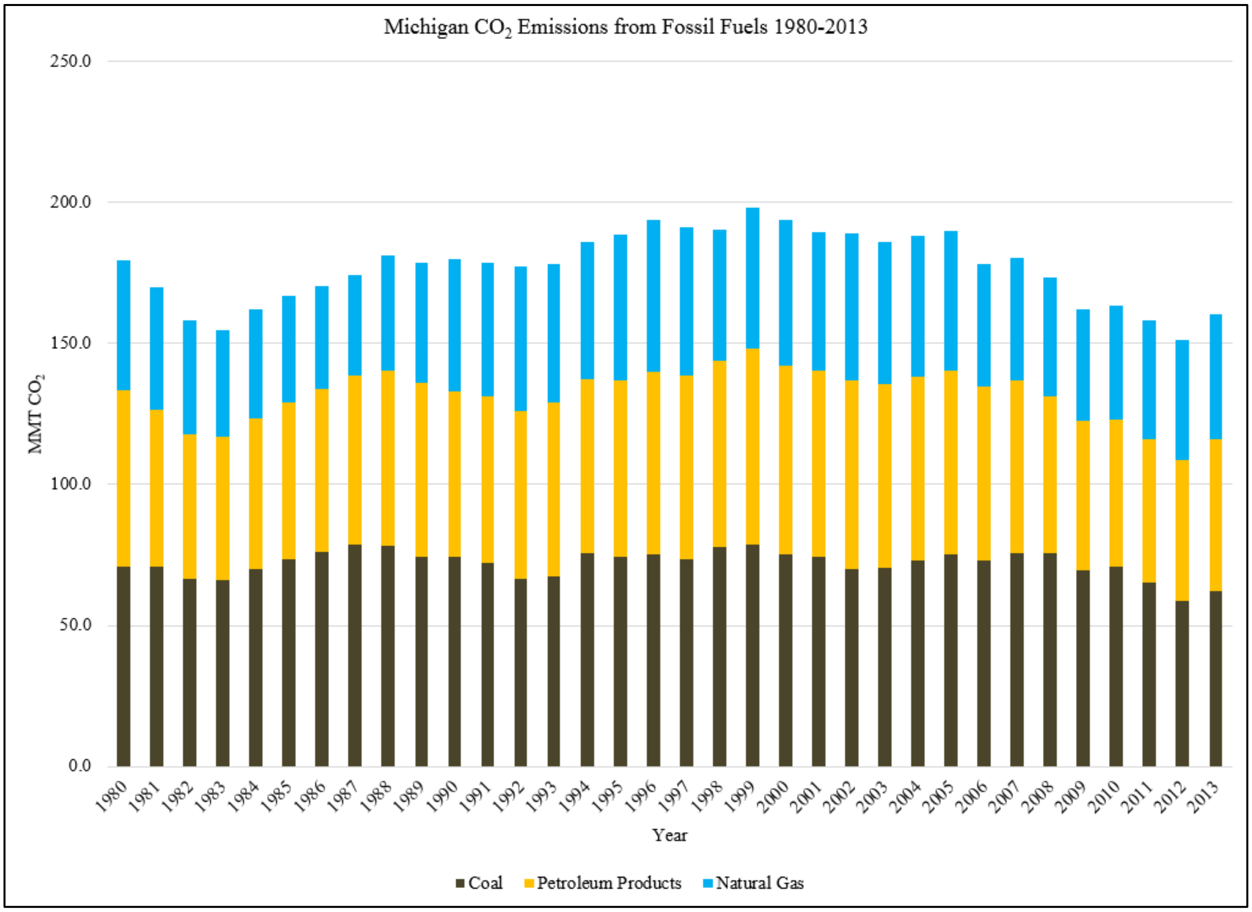

Figure 8.1.14-1: Michigan CO_2 Emissions from Fossil Fuels by Fuel Type 1980-2013

Source: (EIA, 2015e)

The majority of Michigan's GHG emissions are from 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. Other major GHGs emitted in Michigan are CH_4, hydrofluorocarbons, NO_x, sulfur hexafluoride (SF_6) and perfluorocarbons (PFCs) (MDEQ, 2008) (USEPA, 2015x).

The Michigan Department of Environmental Quality (MDEQ) commissioned Center for Climate Strategies to prepare a 1990 baseline inventory to 2025 forecast of Michigan's GHG emissions, which was most recently updated in June 2008 (MDEQ, 2008). Total GHG emissions for Michigan were calculated to be 220.7 MMT CO_2e in 1990 and by 2005 had increased to 248 MMT CO_2e in 2005. The report forecasted total GHG emissions to increase to 278.0 CO2e in 2010, 291.6 MMT CO2e by 2020, and 292.0 MMT CO2e by 2025, 32 percent above the 1990 baseline (MDEQ, 2008). For comparison, total U.S. GHG emissions were 6,673 million metric tons (14.7 trillion pounds) in 2013 (USEPA, 2015x). Michigan's gross (i.e., total emitted) GHG emissions have increased slower than the national average (MDEQ, 2008).

Before 1957, Michigan used to be a large producer of oil, however now the state produces less than 1 percent of the United States' total. Michigan has many petroleum pipelines that cross through the state from Canada, Chicago, Wisconsin, Ohio, and Illinois. There is one refinery in Detroit which now processes crude oil from Canada. The main use of petroleum in the state is for motor gasoline. (MDEQ, 2008)

With over 10,000 wells, Michigan also used to be a large producer of natural gas (MDEQ, 2015r). Production peaked in 1997, but is now slowly declining even though the state's consumption is still above the nation's average. Natural gas is generally used within the residential sector for home heating. Although Michigan relies on coal for electricity, production stopped in 1949 and it is now imported from Wyoming and Montana and other nearby states. Michigan is also using wind as its renewable resource for electricity generation and has more than 20 utility wind farms (MDEQ, 2008) (EIA, 2015h).

Overall, Michigan's GHG emissions are increasing at a slower pace than the nation's average however, CCS predicts that by 2025, gross emissions will increase 32 percent above 1990 levels. (MDEQ, 2008) (EIA, 2015h)

8.1.14.4. 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 characteristics (NWS, 2011a).

The entirety of Michigan falls into 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). In addition, there are many thunderstorms during summer months. Michigan has two sub-climate categories described in the following paragraphs.

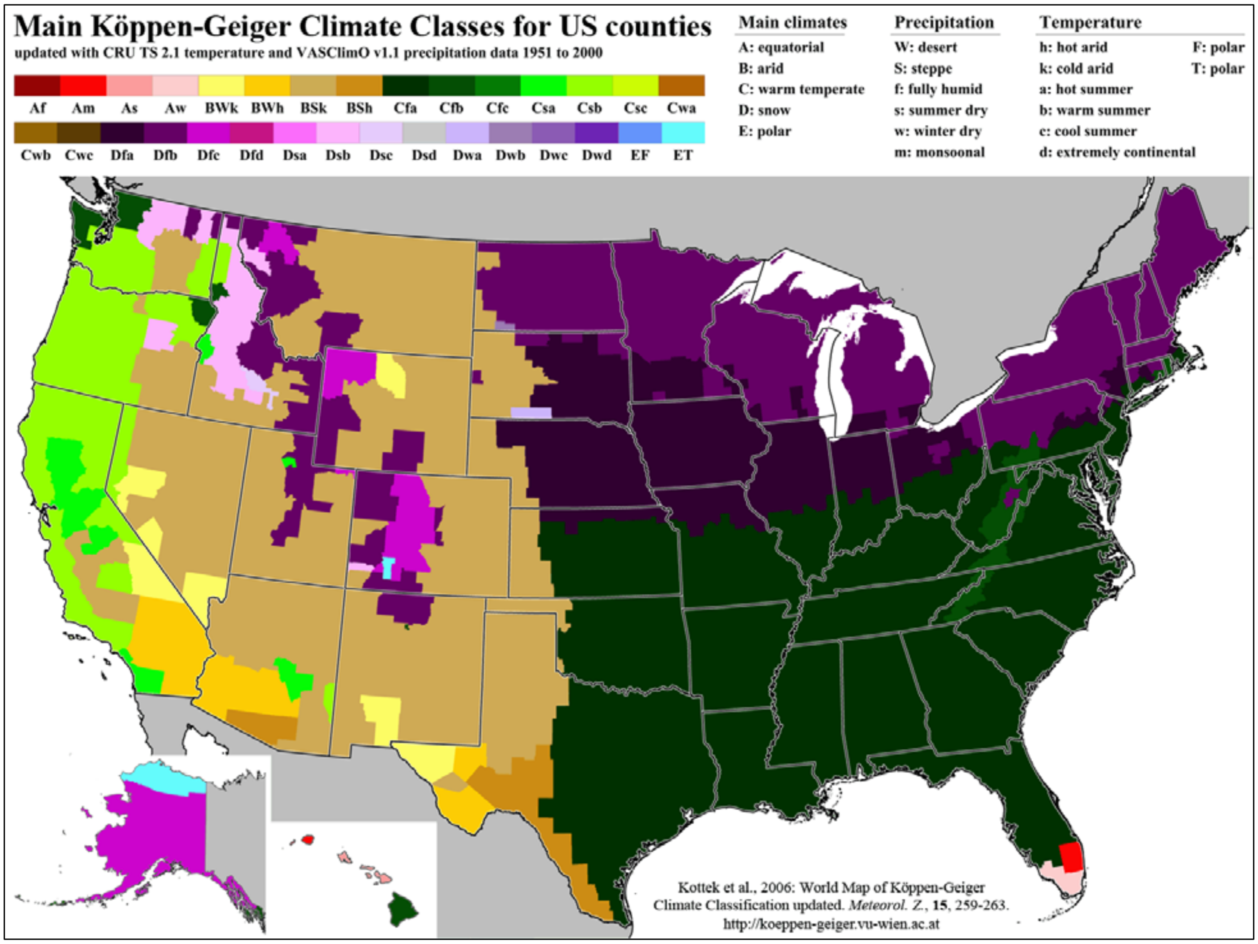

Figure 8.1.14-2: Köppen-Geiger Climate Classes for U.S. Counties

Source: (Kottek, 2006)

Dfa – The Köppen-Geiger climate classification system classifies small portions of southeastern and southwestern Michigan 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, 2016)

Dfb – The Köppen-Geiger climate classification system classifies the remainder of Michigan as Dfb. Climates classified as Dfb are fully humid climates, with warm summers and snowy winters. The secondary climate classification in this zone (f) indicates substantial precipitation during all seasons. The tertiary climate classification in this zone (b) indicates that at least four months out of the year average above 50 °F. (NWS, 2011a) (NWS, 2016)

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

Air Temperature

The highest temperature to occur was on July 13, 1936 with a record of 112 °F in Stanwood (SCEC, 2015). The lowest temperature to occur was on February 9, 1934 with a record of negative 51 °F in Vanderbilt (SCEC, 2015).

Dfa – Detroit, the capital of Michigan, is located within the climate classification zone Dfa. The average annual temperature in Detroit is approximately 50.4 °F; 27.9 °F during winter months; 71.7 °F during summer months; 48.7 °F during spring months; and 52.8 °F during autumn months (NOAA, 2015b).

Dfb – Grand Rapids, located in western Michigan is within the Dfb climate classification zone. The average annual temperature in Grand Rapids is approximately 49.1 °F; 26.8 °F during winter months; 70.6 °F during summer months; 47.4 °F during spring months; and 51.3 °F during autumn months (NOAA, 2015b).

Precipitation

Statewide, annual precipitation varies from 28 inches in the east-central and northeastern regions, to over 38 inches in western and southwestern regions. February is typically the state's driest month, while August and September are the wettest. Approximately 60 percent of the state's total rainfall occurs between May and October. Thunderstorms occur an average of 40 times per year in the south, compared to approximately 25 in the Upper Peninsula. "Months without any precipitation are rare across the state" (Andresen, 2015). The greatest 24-hour precipitation to occur was on August 31, 1914 with a total of 9.78 inches in Bloomingdale (SCEC, 2015). (Andresen, 2015)

With regards to snowfall, Michigan "experiences some of the heaviest seasonal snowfall totals and length of snow-cover duration in the U.S. east of the Rocky Mountains" (Andresen, 2015). Maximum average snowfall amounts can total over 220 inches, occurring along Lake Superior and the Upper Peninsula. Northwestern Michigan also receives abundant snowfall, with averages that can reach or exceed 150 inches. "Annual snowfall totals decrease rapidly from northwest to southeast across the state, with totals of less than 40 inches found in southeastern sections of the Lower Peninsula, where lake-effect snowfall is relatively light" (Andresen, 2015). Snowfall attributed to the lake effect is approximately 60 percent in the north and only 10 percent in the southeast. The greatest 24-hour snowfall accumulation occurred on December 2, 1985 with a record of 32 inches in Herman (SCEC, 2015). (Andresen, 2015)

Dfa – Detroit, the capital of Michigan, is located within the climate classification zone Dfa. The average annual temperature in Detroit is approximately 50.4 °F; 27.9 °F during winter months; 71.7 °F during summer months; 48.7 °F during spring months; and 52.8 °F during autumn months (NOAA, 2015b).

Dfb – Grand Rapids, located in western Michigan is within the climate classification zone Dfb. The average annual temperature in Grand Rapids is approximately 49.1 °F; 26.8 °F during winter months; 70.6 °F during summer months; 47.4 °F during spring months; and 51.3 °F during autumn months (NOAA, 2015b). Traverse City, located in northern Michigan, is also within the

Dfb climate classification zone. The average annual temperature in Traverse City is 45.4 °F; 23.7 °F during winter months; 66.8 °F during summer months; 42.5 °F during spring months; and 48.4 °F during autumn months (NOAA, 2015b).

Severe Weather Events

Severe flooding in Michigan is uncommon, "with the greatest likelihood occurring in late winter or early spring, when sudden warming and rain may be combined with snowmelt" (Andresen, 2015). In 2013, heavy precipitation resulted in approximately 100 flooding and eight flash flooding events statewide. In total, these flooding events resulted in approximately $140 million in damages. The most significant flooding occurred across lower central Michigan. In 2014, Michigan "experienced the most damaging severe weather event in its history" (MCSWA, 2015c). On August 11, approximately four to six inches of rain fell across Wayne, Macomb, and Oakland counties in a short three to four hour period. This excessive, localized, rainfall affected approximately 115,000 homes and businesses, and caused approximately $1.8 billion damages. (MCSWA, 2014) (MCSWA, 2015c)

Mild droughts are relatively common to Michigan, however, droughts that reach severe conditions are infrequent, and generally only last a short time. Evenly dispersed annual rainfall, coupled with relatively low evapotranspiration rates, "help to reduce periods of drought that are experienced in other areas of the upper Midwest" Michigan area (Andresen, 2015).

Tornadoes in Michigan are common, with storms occurring most frequently between late July and early June. On average, 15 tornadoes occur per year throughout the state (MCSWA, 2014). The deadliest and most destructive tornado to occur in Michigan was on May 21, 2001 when 19 tornadoes touched down in the state. The second deadliest and most destructive tornado occurred on July 2, 1997 when 16 tornadoes touched down in the state, killing seven people and resulting in over $135 million in damages. The strongest tornado to occur during these outbreaks was an F3 tornado in Genesee County, with winds reaching between 158 and 206 miles per hour (mph). Since this storm in 1997, only two other F3 tornadoes have been recorded in Michigan; Potterville in 2007 and Dexter in 2012. (Torregrossa, 2014)

In 2013, several injuries resulted from severe thunderstorm winds. In addition, flooding, severe thunderstorms, and tornadoes "were responsible for about $277 million in damages," compared to approximately $210 million in damages in 2012 (MCSWA, 2014). In 2014, Michigan experienced 13 tornadoes across the state, in addition to severe thunderstorm wind, hail, and flooding. In total, one person was killed, 13 were injured, and over $2 billion in damages was reported. A combination of these events resulted in the "most damaging severe weather season in Michigan's history" (MCSWA, 2014) (MCSWA, 2015c).

8.1.15. Human Health and Safety

8.1.15.1. 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 is evaluated in Section 8.1.1, Infrastructure.

8.1.15.2. 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 Michigan, this resource area is regulated by Michigan Occupational Safety and Health Administration (MIOSHA) under Michigan Department of Licensing and Regulatory Affairs (MILARA), MDEQ, and Michigan Department of Health and Human Services (MIHHS). Federal OSH regulations apply to workers through either OSHA, or stricter state-specific plans that must be approved by OSHA. Michigan's State Plan is an OSHA-approved "State Plan," which has adopted most OSHA regulations, but has a unique child labor standard, and applies to private, state, and local employees (OSHA, 2015a). Occupational safety and health regulations are enforced at the private, state, and local level by MIOSHA and at the federal level by OSHA. Public health is regulated by the MIHHS.

Federal laws relevant to protecting occupational and public health and safety are summarized in Appendix C, Environmental Laws and Regulations. Table 8.1.15-1 below summarizes the major Michigan laws relevant to the state's occupational health and safety, hazardous materials, and hazardous waste management programs.

Table 8.1.15-1: Relevant Michigan Human Health and Safety Laws and Regulations

State Law/ Regulation	Regulatory Agency	Applicability
Michigan Administrative Code: R 408.40101-408.49102	Michigan Occupational Safety and Health Administration (MIOSHA)	Establishes Michigan's construction safety standards.
Michigan Statute: R 408.1001-408.1094	MIOSHA	Establishes the Michigan Occupational Safety and Health Act to ensure job safety, health protection, and safe and healthful working conditions for Michigan employees.
Michigan Administrative Code: R 325.2401-325.77115	MIOSHA	Establishes Michigan's occupational health standards to protect the health of workers in various industries.
Michigan Administrative Code: Part 11	MIOSHA	Establishes requirements for recording and reporting of occupational injuries and illnesses.
Michigan Administrative Code: Part 42, 92, and 430	MIOSHA	Establishes hazard communication standards for construction industry, general industry, and occupational health.
Michigan Statute: 125.2651-125.2672	MDEQ	Establishes the Brownfield Redevelopment Refinancing Act to promote the revitalization, redevelopment, and reuse of brownfield properties.
Michigan Statute: 324.20101-324.20142	MDEQ	Establishes environmental remediation requirements for contaminated sites, including brownfields and hazardous waste sites.
Michigan Statute: 324.63501-324.63549	MDEQ	Establishes coalmine reclamation requirements and procedures, including for abandoned mine lands (AML).
Michigan Statute: 29.1-29.34	MILARA, Bureau of Fire Services	Regulates the Aboveground Storage Tank Program for the storage and handling of flammable and combustible liquids with flash point less than 200ºF degrees and liquefied petroleum gases compressed natural gas for vehicular fueling, gaseous and liquefied hydrogen.

8.1.15.3. 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 in 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. 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 – Installation of underground utilities, building foundations, and work in utility manholes[121] are examples of when trenching or confined space work is necessary. Installation of telecommunication activities involves laying conduit and limited trenching (generally 6 to 12 inches in width) would occur. Confined space work can involve poor atmospheric conditions, requiring ventilation and rescue equipment. Additionally, when inside a confined space, worker movement is restricted and may prevent a rapid escape or interfere with proper work posture and ergonomics.

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

Energized equipment and existing utilities – Electrical shock from energized equipment and utilities is an elevated risk at telecommunication sites due to the amount of electrical energy required for powering communication equipment and broadcasting towers. Telecommunication cables are often co-located with underground and overhead utilities, which can further increase occupational risk during earth-breaking and aerial work.

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

[121] Manholes may be used for telecommunications activities, especially in cities and urban areas, depending on the location of other utilities. In cities, power, water, and telecommunication lines are often co-located; if access is through a manhole in the street, that access will be used.

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

Hazardous materials and hazardous waste – Work at telecommunication sites may require the storage and use of hazardous materials such as fuel sources for backup power generators and compressed gases used for welding and metal cutting (new towers only). In some cases, telecommunication sites require use of potentially hazardous products (e.g., herbicides). Secondary hazardous materials (e.g., exhaust fumes) may be a greater health risk than the primary hazardous material (e.g., diesel fuel). Furthermore, the use of hazardous materials creates down-stream potential to generate hazardous waste. While it is unlikely that any FirstNet activities would involve the generation or storage of hazardous waste, older existing telecommunication structures and sites could have hazardous materials present, such as lead-based paint (exterior and interior) on outdoor structures or asbestos tiles and insulation in equipment sheds. The general public, unless a telecommunication work site allows unrestricted access, are typically shielded from hazardous materials and hazardous wastes that are components of telecommunication site work.

Aquatic environments – Installation of telecommunication lines may include laying, burying, or boring lines under 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.

Outdoor elements – Weather conditions have the potential to quickly and drastically reduce safety, and increase hazards at telecommunication work sites. Excessive heat and cold conditions impact judgement, motor skills, hydration, and in extreme cases may lead to hyper- or hypothermia. Precipitation, such as rain, ice, and snow, create slippery climbing conditions and wet or muddy ground conditions. Lightning strikes are risks to telecommunication workers climbing towers or working on top of buildings.

Telecommunication Worker Occupational Health and Safety

The 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 5,170 telecommunication equipment installers and repairers, and 1,480 telecommunication line installers and repairers (Figure 8.1.15-1) working in Michigan (Bureau of Labor Statistics, 2015a).[122] In 2013, the most recent year data are available, Michigan had 4.0 cases of nonfatal occupational injuries or illnesses in the telecommunications industry per 100 full-time workers (Bureau of Labor Statistics, 2013a). By comparison, there were 1.9 nonfatal occupational injury cases nationwide in both 2012 and 2013 per 100 100 full-time workers in the telecommunications industry (Bureau of Labor Statistics, 2013b).

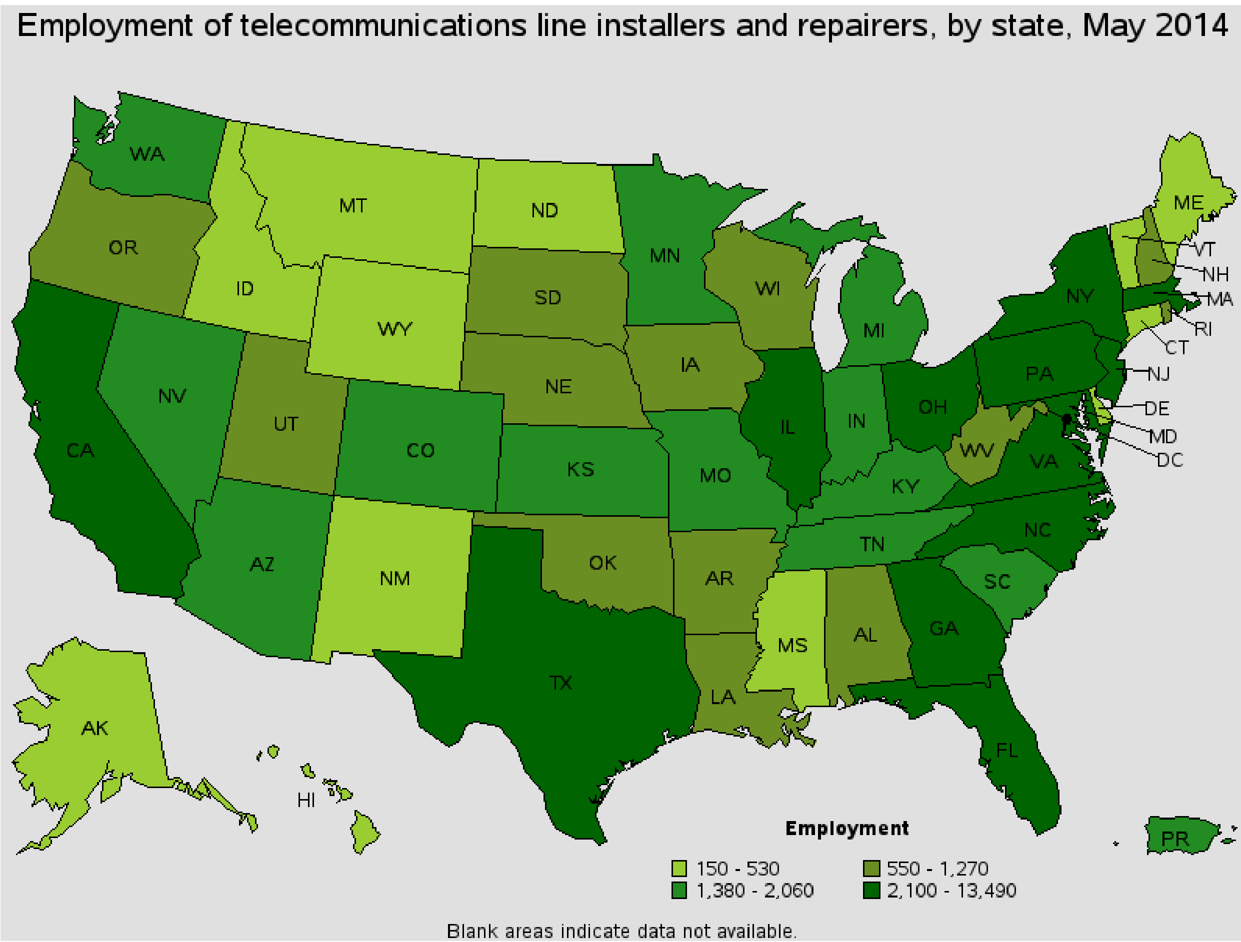

Figure 8.1.15-1: Number of Telecommunication Line Installers and Repairers Employed per State, May 2014

[122] 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.

Source: (Bureau of Labor Statistics, 2015b)

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; 7 due to slips, trips, or falls; and 3 due to unknown causes), with an hours-based fatal injury rate of 7.9 per 100,000 full-time equivalent workers (Bureau of Labor Statistics, 2013c). This represents 45 percent of the broader information industry fatalities (40 total), and less than 1 percent of occupational fatalities (4,585 total). Michigan had one fatality in 2012 within the telecommunications industry (NAICS code 517), but has not had any fatalities in the telecommunications occupations since 2003, when data are first available. By comparison, within the broader installation, maintenance and repair occupations (SOC code 49-0000), there were 115 fatalities in Michigan between 2003 and 2014, with the highest fatality year being 13 fatalities in 2012 (Bureau of Labor Statistics, 2015c).

Public Health and Safety

The general public is unlikely to encounter occupational hazards at telecommunication sites due to limited access. Michigan has not recorded incidents of injuries from the public to these sites, but MIHHS collects fatal injury and mortality data among the general public (Michigan Department of Health and Human Services, 2015a). 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, in Michigan, between 1999 and 2013, there were 237 fatalities due to a fall from, out of, or through a building or structure; 55 fatalities due to being caught, crushed, jammed or pinched in or between objects; and 53 fatalities due to exposure to electric transmission lines (CDC, 2015a). Among the general public, trespassers entering telecommunication sites would be at the greatest risk for exposure to health and safety hazards.

8.1.15.4. Environmental Setting: Contaminated Properties at or Near Telecommunication Sites

Existing and surrounding land uses, including landfills or redeveloped brownfields, near telecommunication sites have the potential to impact human health and safety. Furthermore, undocumented environmental practices of telecommunication site occupants, including practices before current environmental laws, could result in environmental contamination, affecting the quality of soil, sediments, groundwater, surface water, and air.

Contaminated property is typically classified by the federal environmental remediation or cleanup programs that govern them, such as sites administered through the Superfund Program[123] or listed on the National Priorities List (NPL), as well as the Resource Conservation

[123] 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, 2011a).

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.

Michigan's Remediation and Redevelopment Division administers the Superfund Program, and is managed under MDEQ (MDEQ, 2015w). As of November 2015, Michigan had 101 RCRA Corrective Action sites,[124] 674 brownfield sites, and 67 proposed or final Superfund/NPL sites (USEPA, 2015r). Based on a September 2015 search of USEPA Cleanups in My Community (CIMC) database, there are three Superfund sites (Allied Paper, Inc. in Kalamazoo, MI; Gratiot County Golf Course in St. Louis, MI; and Velsicol Chemical Corporation in St. Louis, MI) (USEPA, 2015s) and no RCRA Corrective Action sites (USEPA, 2015v) in Michigan where contamination has been detected at an unsafe level, or a reasonable human exposure risk still exists.

Brownfield sites in Michigan may be enrolled in a variety of programs managed by MDEQ, Remediation and Redevelopment Division, including the Brownfield Redevelopment Program (MDEQ, 2015aa). One example of a brownfield site is the Northville Garage project area in Northville, MI. The 0.45-acre site was originally a dry cleaners and gas station, which contaminated the soil with dry cleaning solvents and petroleum products. Using Brownfield Redevelopment Grant funding from MDEQ, the city excavated contaminated soil, removed underground storage tanks, and installed an impermeable vapor barrier and passive soil vapor ventilation system. The owner then renovated the property into a restaurant. (MDEQ, 2015d)

In addition to contaminated properties, certain industrial facilities are permitted to release toxic chemicals into the air, water, or land. One such program is the Toxics Release Inventory (TRI), administered by the USEPA under the Emergency Planning and Community Right to Know Act (EPCRA) of 1986. The Toxic Release Inventory database is a measure of the industrial nature of an area and the over-all chemical use, and can be used to track trends in releases over time. The "releases" do not necessarily equate to chemical exposure by humans or necessarily constitute to quantifiable health risks because the releases include all wastes generated by a facility – the majority of which are disposed of via managed, regulated processes that minimize human exposure and related health risks (e.g., in properly permitted landfills or through recycling facilities). According to EPA's 2013 TRI fact sheet, Michigan had 790 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, Michigan released 69.4 million pounds of toxic chemicals through onsite and offsite disposal, transfer, or other releases, largely from petroleum and chemicals industries. This accounted for 1.7 percent of nationwide

[124] Data gathered using USEPA's CIMC search on December 2, 2015, for all sites in Michigan, where cleanup type equals 'RCRA Hazardous Waste – Corrective Action,' and excludes sites where cleanup phase equals 'Construction Complete' (i.e., no longer active) (USEPA, 2015r).

TRI releases, ranking Michigan 25 of 56 U.S. states and territories based on total releases per square mile. (USEPA, 2016d)

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 12, 2015, Michigan had 189 permitted major discharge facilities registered with the USEPA Integrated Compliance Information System (USEPA, 2015w).

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 8.1.15-2 provides an overview of potentially hazardous sites in Michigan.

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 287 USEPA-regulated telecommunications sites in Michigan (USEPA, 2015p). These sites are regulated under one or more environmental programs including NPDES compliance, Superfund/NPL status, and TRI releases.

According to BLS data, Michigan had one occupational fatality in 2011 within the installation, maintenance, and repair occupations (SOC code 49-0000) from exposure to "harmful substances or environments," although this was not specific to telecommunications (Bureau of Labor Statistics, 2015c). 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 (Bureau of Labor Statistics, 2015d). 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 (Bureau of Labor Statistics, 2014).

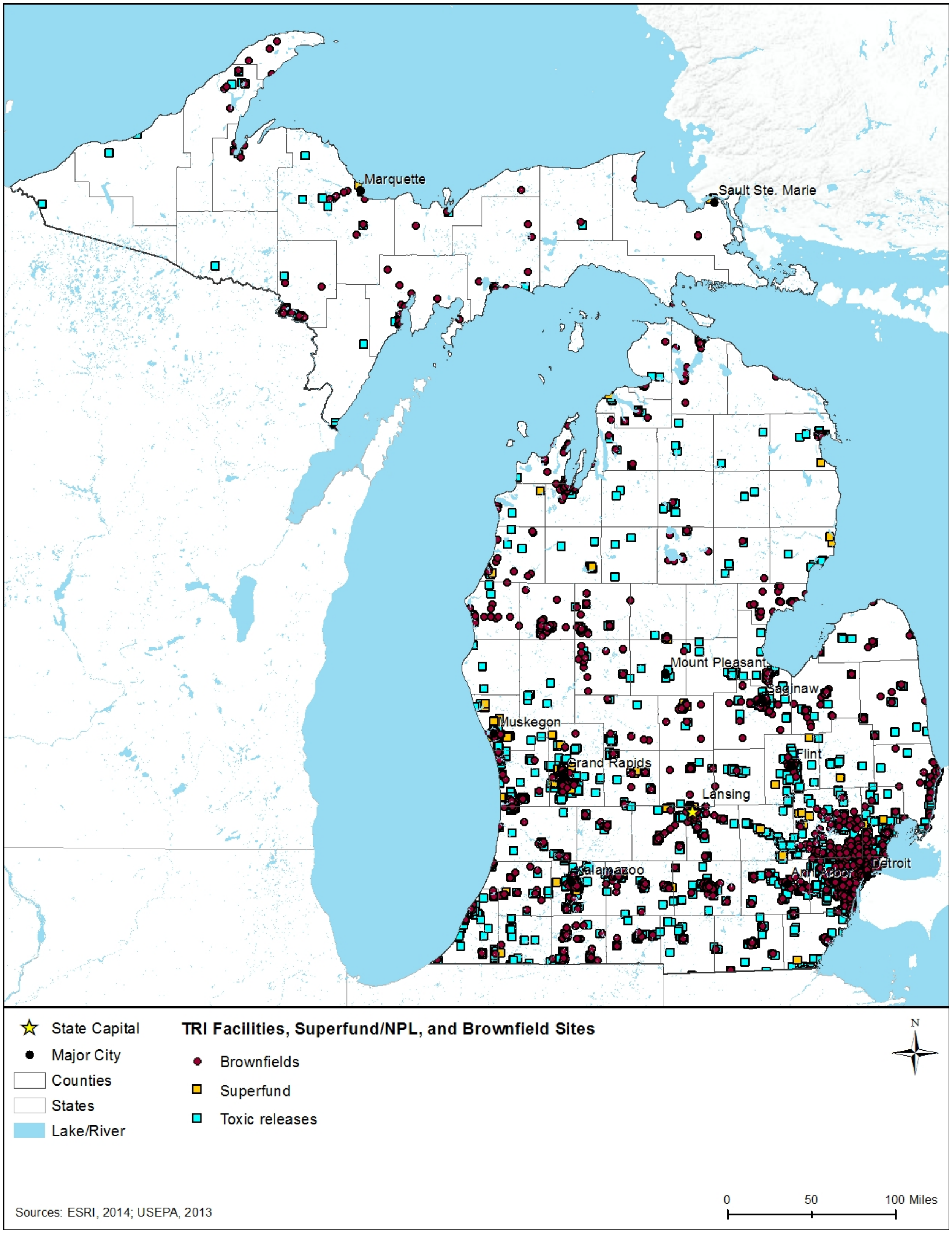

Figure 8.1.15-2: TOXMAP Superfund/NPL and TRI Facilities in Michigan (2013)

Source: (NIH, 2015b)

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 MIHHS, Division of Environmental Health, Toxicology and Response Section conducts public health assessments at contaminated sites under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR) to identify and assess human exposure risks (Michigan Department of Health and Human Services, 2015b). Public health assessments, consultations, and advisories for documented hazardous waste sites are publicly available through the MIHHS, Division of Environmental Health, Toxicology and Response Section's Public Safety and Environmental Health website (Michigan Department of Health and Human Services, 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. In 2009, the most recent data available, there were no injuries or fatalities due to reported acute toxic substance release incidents (CDC, 2015b).

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

Another health and safety hazard in Michigan includes surface and subterranean mines. In 2014, the Michigan mining industry ranked 10th for non-fuel minerals (primarily iron ore, portland cement, nickel concentrates, sand, gravel, and crushed stone), generating a value of $2.8B (USGS, 2014j). 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 (BLM, 2015).

Spotlight on Michigan Superfund Sites: Velsicol Chemical Corporation

The 54-acre Velsicol Chemical Corporation site (Figure 8.1.15-3) in St. Louis, MI (Gratiot County), was an industrial facility that produced various chemical compounds from 1936 to 1977, and was added to the NPL on September 8, 1983. The site closed in 1977, and decommissioned due to poor waste management, site-wide contamination, and potential risks to public health and the environment. Onsite investigations discovered groundwater and soil contaminated from chlorinated compounds, polybrominated biphenyls, and metals. Water and sediment in the adjacent Pine River was also contaminated by discharges from the facility. In 1988, MIHHS and ATSDR conducted a Preliminary Health Assessment and determined that fish consumption from Pine River and exposure to river sediments presented a potential human health risk. As a result, a Pine River fish consumption advisory has been in effect since 1974. (USEPA, 2012e)

The USEPA, MDEQ, and Velsicol began cleanup and remediation activities in 1983 by constructing a wall and cap containment system, excavating contaminated soil from the burn area, disposing of water from the containment system, and removing contaminated sediment from Pine River. In 1999, the USEPA discovered that the wall and cap was failing and leaking contaminants (USEPA, 2012e). Additionally, the Five Year Review in 2012 revealed failing containment systems and soil contamination in the adjacent residential areas, which added to human health risks. Since the 2012 review, USEPA and MDEQ have conducted additional investigations, feasibility studies, and cleanup activities at nearby residential areas and are working to replace the St. Louis, MI, drinking water supply. Residential area cleanup is expected to be completed by the end of 2015, and cleanup at the contaminated site is scheduled to begin in 2016. (USEPA, 2016f)

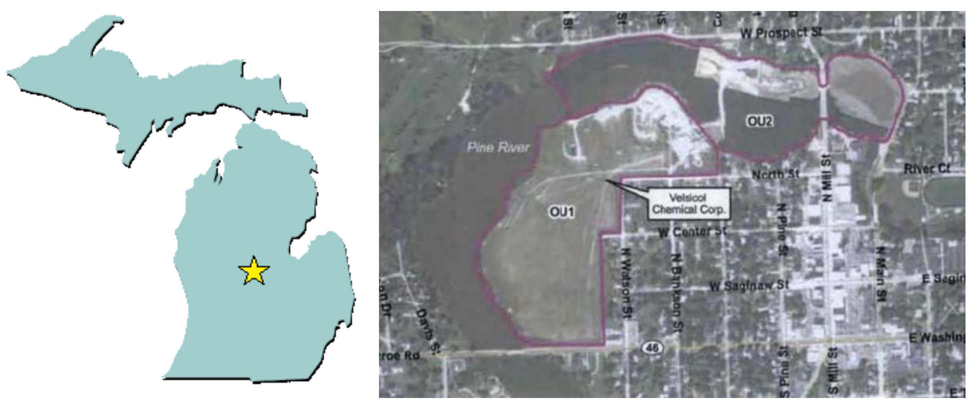

Figure 8.1.15-3: Velsicol Chemical Corporation Site Map, St. Louis, MI

Source: (USEPA, 2011b)

Figure 8.1.15-4: High Priority Abandoned Mine Lands in Michigan (2015)

Source: (U.S. Department of the Interior, Office of Surface Mining Reclamation and Enforcement, 2015b)

In Michigan, the federal Office of Surface Mining Reclamation and Enforcement (OSMRE) Appalachian Region's Technical Support Division is responsible for managing AML health and safety hazards through the Federal Reclamation Program. Michigan does not currently have active coalmining operations; however, multiple abandoned coalmines exist. Since 1980, OSMRE has abated human health and safety issues at AMLs, including extinguishing an eight-acre coalmine fire (U.S. Department of the Interior, Office of Surface Mining Reclamation and Enforcement, 2015a). Figure 8.1.15-4 shows the distribution of High Priority (Priority 1, 2 and adjacent Priority 3) AMLs in Michigan, 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, Michigan had 44 Priority 1 and 2 AMLs, with 10 unfunded problem areas (U.S. Department of the Interior, Office of Surface Mining Reclamation and Enforcement, 2014).

Telecommunication Worker Occupational Health and Safety

Telecommunications sites may be on or near AMLs or mine 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 mines present additional health and safety risks to the general public, by generating toxic combustible gases, which can penetrate the surface through ground fractures, potentially seeping into residential structures. Additionally, mine fires can consume enough sub-surface material, that risk of subsidence increases. As a result, AMLs and coalmine fires in particular, can result in evacuations of entire communities (U.S. Department of the Interior, Office of Surface Mining Reclamation and Enforcement, 2015c).

8.1.15.6. Environmental Setting: Natural and Manmade Disaster Sites

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

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 telecommunications capabilities. 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 effort 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, MIOSHA 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 263 NRC-reported incidents for Illinois in 2015 with known causes, 11 incidents were attributed to natural disaster (e.g., natural phenomenon), while 252 incidents were attributed to manmade disasters (e.g., derailment, dumping, equipment failure, operator error, over pressuring, transport accident, or trespasser) or other indeterminate causes (USCG, 2015). For example, from August 11-13, 2014, heavy rainfall and flooding damaged more than 150,000 homes and businesses in Detroit, MI. Michigan State Police dive teams rescued people from vehicles stranded on flooded roads (MCSWA, 2015b). More than 22,000 DTE Energy (Detroit's major utility provider) customers experienced electric power interruptions (DOE, 2014). Such incidents present unique, hazardous challenges to telecommunication workers responding during natural or manmade disasters.

Public Health and Safety

Hazards present during natural and manmade disasters are often far-reaching, affecting large geographic areas and affecting all populations living within the area. Similar to telecommunication workers, the general public faces risks during these types of disasters, such as compromised transportation infrastructure and utilities, potential for exposure to unknown chemical and biologic hazards, and inadequate medical support. In 2014, Michigan had one weather-related fatality due to lightning and 19 non-fatal injuries. By comparison, 384 weather-related fatalities and 2,203 injuries were reported nationwide the same year. (NWS, 2015)

Spotlight on Michigan Natural Disaster Sites: December 2013 Lower Michigan Ice Storm

On December 21, 2013, the Lower Michigan area experienced significant amounts of freezing rain, sleet, ice pellets, and snow (Figure 8.1.15-5) (NWS, 2013). The areas around Grand Rapids, Lansing, and Flint, MI, bared the worst of the storm, with downed trees and widespread power outages affecting for 300,000 customers (MCSWA, 2015a).

During the 10-day restoration period, Lansing Board of Water & Light (BWL) reported servicing 2,400 downed lines totaling 5 miles. Icy conditions created dangerous conditions for utility workers and other responders (Lansing Board of Water & Light, 2014). Total utility damage was $60M (MCSWA, 2015a).

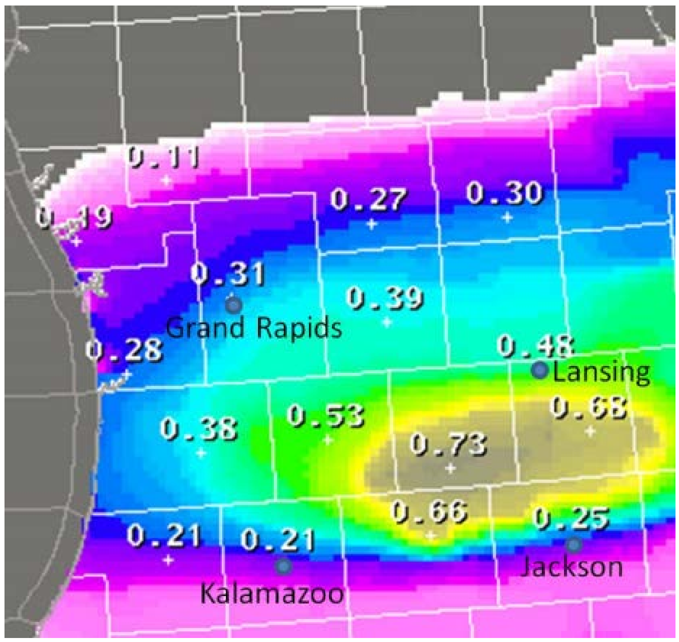

Figure 8.1.15-5: 24-Hour Ice Accumulation near Lansing, MI, Ending 4pm 12/22/2013

Source: (NWS, 2013)

8.2. 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 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.

8.2.1. Infrastructure

8.2.1.1. Introduction

This section describes potential impacts to infrastructure in Michigan associated with construction, 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, Best Management Practices and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

8.2.1.2. Impact Assessment Methodology and Significance Criteria

The impacts of the proposed action on infrastructure were evaluated using the significance criteria presented in Table 8.2.1-1. As described in Section 8.2, 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 8.2.1-1: 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	Impact Level: Less than Significant with BMPs and Mitigation Measures Incorporated	Impact Level: Less than Significant	Impact Level: 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 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

8.2.1.3. 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 8.2.1-1, 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 negligible impacts during deployment or operation phases. During deployment and system optimization, existing services would 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, local health officials, and public safety officials to communicate during emergency response situations. Based on the impact significance criteria presented in Table 8.2.1-1, 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 8.2.1-1, 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 likely be using a different spectrum for communications. FirstNet has exclusive rights to use of the assigned spectrum, and only designated public safety organizations would be authorized to connect to FirstNet's network. Depending on the use patterns of FirstNet's spectrum, such spectrum use may be over-built or under-utilized.[125] 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 exact 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 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. The MPSC regulates electricity utilities, while the Michigan DEQ manages water, wastewater, and solid waste; coordination with these state agencies may be necessary depending on the project-specific implementation plans.

[125] 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.

8.2.1.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

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

Activities Likely to Have No Impacts

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

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be no impacts to infrastructure resources since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes or disruption of transportation, telecommunications, or utility services.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber would have no impacts on infrastructure resources because there would be no ground disturbance and no interference with existing utility, transportation, or communications systems.
  - 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. Impacts to infrastructure resources associated with the construction of landings and/or facilities on shore or the banks of water bodies that accept the submarine cable are addressed below, and depend on the proximity of such infrastructure to the landing site.
  - 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 infrastructure. The section below addresses potential impacts to infrastructure if construction of new boxes, huts, or other equipment is required near or adjacent to local infrastructure assets.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the use of portable devices that use satellite technology would not impact infrastructure resources because

there would be no change to the built or natural environment from the use of portable equipment. Installation of satellite-enabled equipment would not be expected to have any impacts to infrastructure resources, given that construction activities would occur on existing structures, would not be expected to interfere with existing equipment, and transportation capacity and safety, and access to emergency services would not be impacted.

- Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the nationwide public safety broadband network (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),[126] 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 use 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.
  - Collocation on Existing Aerial Fiber Optic Plant: Similar to new build activities (above), collocation on existing aerial fiber optic plant could include installation of new or replacement towers requiring ground disturbance.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore or inland bodies of water would not impact infrastructure resources because there would be no local infrastructure to impact, other than harbor operations. However, impacts to infrastructure resources could potentially occur as result of the construction of landings

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

and/or facilities on shores or the banks of water bodies that 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 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 utilized but launched from existing paved surfaces,

it is anticipated that there would be no impacts to infrastructure resources because there would be no disturbance of the natural or built environment.

In general, the abovementioned activities could potentially impact infrastructure resources in different ways, resulting in both potentially negative and potentially positive impacts. Potential negative impacts to infrastructure associated with deployment could include temporary disruption of various types of transportation corridors temporary impacts on existing or new telecommunications sites, and more permanent, although likely minor, impacts on utilities, if new infrastructure requires tie-in to the electric grid. These impacts are expected to be less than significant as the deployment activities will likely be of short duration (generally a few hours to a few months depending on the activity), would be regionally based around the on-going phase of deployment, and minor. Additional BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures, may be implemented as appropriate to further 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. Additional BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

8.2.1.5. Alternatives Impact Assessment

The following section assesses potential impacts to infrastructure associated with the Deployable Technologies Alternative and the No Action Alternative.[127]

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to infrastructure as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts to infrastructure even if deployment requires expansion of infrastructure, such as paving of previously unpaved surfaces or other new infrastructure built to support deployment. This is primarily due to the small amount of paving or new infrastructure that might have to be constructed to accommodate the deployables. The site-specific location of deployment would need to be considered, and any local infrastructure assets (transportation, telecommunications, or utilities) would need to be considered, planned for, and managed accordingly to try and avoid any negative impacts to such resources. Beneficial impacts could be realized, as deployable technologies are used when other infrastructure is impaired in some way; so deployable technologies could provide continuity of service during emergency events.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be no impacts to infrastructure resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment, as part of routine maintenance or inspection occurs off an established access roads or utility ROWs, or if additional maintenance-related construction activities occur within public road and utility ROWs, less than significant impacts could occur to transportation systems or utility services due to the limited amount of new infrastructure needed to accommodate the deployables. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency,

[127] As mentioned above and in Section 8.2.1.2, Proposed Action Infrastructure, the Preferred Alternative includes implementation of deployable technologies.

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

8.2.2. Soils

8.2.2.1. Introduction

This section describes potential impacts to soil resources in Michigan 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, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

8.2.2.2. Impact Assessment Methodology and Significance Criteria

The impacts of the proposed action on soil resources were evaluated using the significance criteria presented in Table 8.2.2-1. The categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Table 8.2.2-1: 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

Given the nature of this programmatic evaluation, and because the proposed action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to soil resources addressed in this section are presented as a range of possible impacts.

8.2.2.3. 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 Michigan and other states with similar geography and weather patterns is the erosion of construction site soils to natural waterways, where the sediment could impair water and habitat quality, and potentially affect aquatic plants and animals (USDA NRCS, 2000). Areas exist in Michigan that have steep slopes (i.e., greater than 20 percent) or where the erosion potential is medium to high, including locations with Aqualfs, Aquents, Aquepts, Aquods, Aquolls, Hemists, Orthods, Psamments, Rendolls, Saprists, Udalfs, Udepts, and Udolls (see Section 8.1.2.4, Soil Suborders and Figure 8.1.2-2).

Based on the impact significance criteria presented in Table 8.2.2-1, building of some of FirstNet's network deployment sites could cause potentially significant erosion at locations with highly erodible soil and steep grades.

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 8.2.2-1, 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 8.1.2.3, Soil Suborders).

Soils with the highest potential for compaction or rutting were identified by using the STATSGO2 database (see Section 8.1.2.4, Soil Suborders). The most compaction susceptible soils in Michigan are hydric soils with poor drainage conditions, which include Aquents, Aquepts, Aquolls, Hemists, and Saprists. These suborders constitute approximately 24.0 percent of Michigan's land area,[128] and are found across the state, particularly along coastal areas (see Figure 8.1.2-2). 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 8.2.2-1, 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.

8.2.2.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

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

Activities Likely to Have No Impacts

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

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Installation of fiber optic cable in existing conduit through existing hand-holes, pulling vaults, junction boxes, huts, and points of presence (POP) structures, and therefore 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

[128] 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.

would be through existing hand holes, pulling vaults, junction boxes, huts, and similar existing structures.

- Satellites and Other Technologies
    - Satellite-Enabled Devices and Equipment: Deployment of temporary or portable equipment that use satellite technology, including COWs, COLTs, SOWs, satellite phones, and video cameras would not impact soil resources because those activities would not require ground disturbance.
    - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact soil resources, it is anticipated that this activity would have no impact on soil resources.

Activities with the Potential to Have Impacts

Implementation of the Preferred Alternatives could include potential deployment-related impacts to soil resources resulting from ground disturbance activities, including soil erosion, topsoil mixing, and soil compaction and rutting. The types of deployment activities that could be part of the Preferred Alternative and result in potential impacts to soil resources include the following:

- Wired Projects
    - New Build – Buried Fiber Optic Plant: New fiber optic cable installation usually requires trenching, plowing (including vibratory plowing), or directional boring, as well as construction of hand holes, pulling vaults, junction boxes, huts, and POP structures that require ground disturbance. Impacts from fiber optic plant installation and structure construction, as well as associated grading and restoration of the disturbed ground when construction is completed, could result in soil erosion, topsoil mixing, or soil compaction and rutting.
    - New Build – Aerial Fiber Optic Plant: Installation of new utility poles, and replacement/upgrading of existing poles and structures could potentially impact soil resources resulting from ground disturbance for pole/structure installation (soil erosion and topsoil mixing), and heavy equipment use from bucket trucks operating on existing paved or dirt roads (soil compaction and rutting). Potential impacts to soils are anticipated to be small-scale and short-term.
    - Collocation on Existing Aerial Fiber Optic Plant: Topsoil removal, soil excavation, and excavated material placement during the replacement of poles and structural hardening could result in soil erosion and topsoil mixing. Heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in soil compaction and rutting.
    - New Build – Submarine Fiber Optic Plant: Installation of fiber optic plants in limited nearshore and inland bodies of water could potentially impact soil resources at and near the landings or facilities on shore to accept submarine cable. Soil erosion and topsoil mixing could potentially occur as result of grading, foundation excavation, or other ground disturbance activities. Perceptible soil compaction and rutting could potentially

occur due to heavy equipment use during these activities depending on the duration of the construction activity.

- Installation of Optical Transmission or Centralized Transmission Equipment: Installation of optical transmission equipment or centralized transmission equipment, including associated new utility poles, hand holes, pulling vault, junction box, hut, and POP structure installation, would require ground disturbance that could potentially impact soil resources. Potential impacts to soils resulting from soil erosion, topsoil mixing, soil compaction, and rutting are anticipated to be small-scale and short-term.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures, such as generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads, or access roads could result in impacts to soil resources. Land/vegetation clearing, excavation activities, landscape grading, and other ground disturbance activities during the installation of new wireless towers and associated structures or access roads could result in soil erosion or topsoil mixing, and heavy equipment use during these activities could result in soil compaction and rutting.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to soils. However, if additional power units, 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 activities could result in soil erosion and topsoil mixing. Heavy equipment use associated with these activities may result in soil compaction and rutting. In addition, implementation of deployable technologies themselves could result in soil compaction and rutting if deployed in unpaved areas. Where technologies such as COWs, COLTs, and SOWs are deployed on existing paved surfaces, there would be no impacts to soil resources because there would be no ground disturbance.

In general, the abovementioned activities could potentially involve land/vegetation clearing, topsoil removal, excavation, excavated material placement, trenching or directional boring, construction of access roads, and other impervious surfaces, landscape grading, and heavy equipment movement. Potential impacts to soil resources associated with deployment of this infrastructure could include soil erosion, topsoil mixing, or soil compaction and rutting. These impacts are expected to be less than significant as the activity would likely be short term, localized to the deployment locations, and would return to normal conditions as soon as revegetation occurs, often by the next growing season. It is expected that heavy equipment would utilize existing roadways and utility rights-of-way for deployment activities. 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 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. 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.

8.2.2.5. Alternatives Impact Assessment

The following section assesses potential impacts to soils associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to soil resources as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts to soil resources if deployment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. In addition, impacts to soils could occur on paved surfaces if the acceptable load of the surface is exceeded. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in soil erosion and topsoil mixing. Heavy equipment use associated with these activities may result in soil compaction and rutting. In addition, implementation of deployable technologies themselves could also result in soil compaction and rutting if deployed in unpaved areas. However, these potential impacts are expected to be less than significant due to the small scale and short term nature of the deployment. 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 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. 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 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 8.1.2, Soils.

8.2.3. Geology

8.2.3.1. Introduction

This section describes potential impacts to Michigan geology resources 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, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

8.2.3.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on geology resources were evaluated using the significance criteria presented in Table 8.2.3-1. As described in Section 8.2, 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 8.2.3-1: 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 activity could be located within a high-risk earthquake hazard zone or active fault.	Effect that is potentially significant, but with mitigation is less than significant.	Low likelihood that a Proposed Action activity could be located within an earthquake hazard zone or active fault.	No likelihood of a Proposed Action activity being located in an earthquake hazard zone or active fault.
	Geographic Extent	Hazard zones or active faults are highly prevalent within the state/territory.		Earthquake hazard zones or active faults occur within the state/territory, but may be avoidable.	Earthquake hazard zones or active faults do not occur within the state/territory.
	Duration or Frequency	NA		NA	NA
Volcanic Activity	Magnitude or Intensity	High likelihood that a Proposed Action activity could be located near a volcano lava or mud flow area of influence.	Effect that is potentially significant, but with mitigation is less than significant.	Low likelihood that a Proposed Action activity could be located near a volcanic ash area of influence.	No likelihood of a Proposed Action activity located within a volcano hazard zone.
	Geographic Extent	Volcano lava flow areas of influence are highly prevalent within the state/territory.		Volcano ash areas of influence occur within the state/territory, but may be avoidable.	Volcano hazard zones do not occur within the state/territory.
	Duration or Frequency	NA		NA	NA
Landslide	Magnitude or Intensity	High likelihood that a Proposed Action activity 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 activity could be located within a landslide area.	No likelihood of a Proposed Action activity located within a landslide hazard area.

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	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.
	Duration or Frequency	NA		NA	NA
Land Subsidence	Magnitude or Intensity	High likelihood that a Proposed Action activity could be located within an area with a hazard for subsidence (e.g., karst terrain).	Effect that is potentially significant, but with mitigation is less than significant.	Low likelihood that a Proposed Action activity could be located within an area with a hazard for subsidence.	Proposed Action activity located outside an area with a hazard for subsidence.
	Geographic Extent	Areas with a high hazard for subsidence (e.g., karst terrain) are highly prevalent within the state/territory.		Areas with a high hazard for subsidence occur within the state/territory, but may be avoidable.	Areas with a high hazard for subsidence do not occur within the state/territory.
	Duration or Frequency	NA		NA	NA
Potential Mineral and Fossil Fuel Resource Impacts	Magnitude or Intensity	Severe, widespread, observable impacts to mineral and/or fossil fuel resources.	Effect that is potentially significant, but with mitigation is less than significant.	Limited impacts to mineral and/or fossil resources.	No perceptible change in mineral and/or fossil fuel resources.
	Geographic Extent	Regions of mineral or fossil fuel extraction areas are highly prevalent within the state/territory.		Mineral or fossil fuel extraction areas occur within the state/territory, but may be avoidable.	Mineral or fossil fuel extraction areas do not occur within the state/territory.
	Duration or Frequency	Long-term or permanent degradation or depletion of mineral and fossil fuel resources.		Temporary degradation or depletion of mineral and fossil fuel resources.	NA
Potential Paleontological	Magnitude or Intensity	Severe, widespread, observable impacts to	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**
Resources Impacts		paleontological resources.			
	Geographic Extent	Areas with known paleontological resources are highly prevalent within the state/territory.		Areas with known paleontological resources occur within the state/territory, but may be avoidable.	Areas with known paleontological resources do not occur within the state/territory.
	Duration or Frequency	NA		NA	NA
Surface Geology, Bedrock, Topography, Physiography, and Geomorphology	Magnitude or Intensity	Substantial and measurable degradation or alteration of surface geology, bedrock, topography, physiographic characteristics, or geomorphological processes.	Effect that is potentially significant, but with mitigation is less than significant.	Minor degradation or alteration of surface geology, bedrock, topography that do not result in measurable changes in physiographic characteristics or geomorphological processes.	No degradation or alteration of surface geology, bedrock, topography, physiographic characteristics, or geomorphologic processes.
	Geographic Extent	State/territory.		State/territory.	NA
	Duration or Frequency	Permanent or long-term changes to characteristics and processes.		Temporary degradation or alteration of resources that is limited to the construction and deployment phase.	NA

NA = Not Applicable

8.2.3.3. Description of Environmental Concerns

Environmental concerns regarding geology can be viewed as two distinct types, those that would potentially provide impacts to the Proposed Action, such as seismic hazards, landslides, and those that would be impacts from the Proposed Action, such as land subsidence, mineral and fossil fuel resources, paleontological resources, surface geology, bedrock, topography, physiography, and geomorphology. These concerns and their impacts on geology are discussed below.

Seismic Hazard

As discussed in Section 8.1.3.8, Michigan is not at risk to significant earthquake events. As shown in Figure 8.1.3-5, southern Michigan is more susceptible to earthquakes than the remainder of the state, though no earthquake over magnitude 4.6 on the Richter scale has ever occurred in the state. Equipment that is exposed to earthquake activity is subject to misalignment, alteration, or, in extreme cases, destruction; all of these activities could result in connectivity loss. Given the potential for minor earthquakes in or near Michigan, some amount of infrastructure could be subject to earthquake hazards, in which case BMPs and mitigation measures (see Chapter 19) could help avoid or minimize the potential impacts.

Volcanic Activity

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

Landslides

As discussed in Section 8.1.3.8, the majority of Michigan is at low to moderate risk of experiencing landslide events. Based on the significance criteria presented in Table 8.2.3-1, potential impacts to landslides from deployment or operation of the Proposed Action would have less than significant impacts; however, landslide impacts to the Proposed Action could be potentially significant if FirstNet's deployment locations were within areas in which landslides are highly prevalent. Equipment that is exposed to landslides is subject to misalignment, alteration, or, in extreme cases, destruction; all of these activities could result in connectivity loss. The highest potential for landslides in Michigan is found along the shores of the state's Great Lakes, including the cities of Detroit, Saginaw, and Sault St. Marie. To the extent practicable, FirstNet would avoid deployment in areas that are susceptible to landslide events. However, given that several of Michigan's major cities, are in or near areas that experience landslides with moderate to high frequency, some amount of infrastructure could be subject to landslide hazards, in which case BMPs and mitigation measures (see Chapter 19) would help avoid or minimize the potential impacts.

Land Subsidence

As discussed in Section 8.1.3.8 and shown in Figure 8.1.3.7, portions of Michigan are vulnerable to land subsidence due to mine collapse and karst topography. Based on the significance criteria presented in Table 8.2.3-1, 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 mine collapse or karst topography, is subject to misalignment, alteration, or, in extreme cases, destruction. All of these activities could result in connectivity loss. To the extent practicable, FirstNet would avoid deployment in known areas of abandoned mines or karst topography. However, where infrastructure is subject to subsidence hazards, BMPs and mitigation measures, as discussed in Chapter 19, would help avoid or minimize the potential impacts.

Potential Mineral and Fossil Fuel Resource Impacts

As discussed in Section 8.1.3.7 and shown in Figure 8.1.3-4, portions of Michigan contain mineral and fossil fuel resources. 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 8.2.3-1, 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

As discussed in Section 8.1.3.6, fossils are abundant throughout parts of Michigan. Based on the impact significance criteria presented in Table 8.2.3-1, impacts to paleontological resources could be potentially significant if FirstNet's buildout/deployment locations Potential impacts to fossil resources should be considered on a site-by-site basis. 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. BMPs and mitigation measures (see Chapter 19) may help avoid or minimize potential impacts.

Surface Geology, Bedrock, Topography, Physiography, and Geomorphology

Equipment installation and construction activities that degrade or alter surface geology, bedrock, or topography could cause measurable changes in physiographic characteristics of an area's geology, topography, physiography, or geomorphology. Based on the impact significance criteria presented in Table 8.2.3-1, impacts would be less than significant if 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.

8.2.3.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

Implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities have the potential to be impacted by geologic hazards, some activities could result in potential impacts to geology, and other activities would have no impacts. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

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

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. In most cases, there would be no impacts to geologic resources since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts on 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 likely to impact geologic resources, it is anticipated that this activity would have no impact on geologic resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to geologic resources, or resulting from geologic hazards due to implementation of the Preferred Alternative, would encompass a range of impacts that could occur as a result of ground disturbance activities, including loss of mineral and fuel resources and paleontological resources. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to geologic resources, or impacts from geologic hazards, include the following:

- Wired Projects
    - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POP, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to geologic resources due to associated ground disturbance, such as impacts to fuel and mineral resources or paleontological resources. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
    - New Build – Aerial Fiber Optic Plant: Installation of new utility poles, and associated use of heavy equipment during construction, could result in potential impacts to geologic resources due to associated ground disturbance. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
    - Collocation on Existing Aerial Fiber Optic Plant: Replacement of utility poles and structural hardening, and associated use of heavy equipment during construction, could result in potential impacts to geologic resources due to associated ground disturbance. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
    - New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water is not expected to impact geologic resources, including marine paleontological resources. However, where landings and/or facilities for submarine cable are installed at locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
    - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts and require ground disturbance in locations that are susceptible to geologic hazards (e.g., land subsidence, landslides, or earthquakes), it is possible that they could be affected by that hazard.
- Wireless Projects
    - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to geologic resources. Land/vegetation clearing, excavation activities, landscape grading, and other ground disturbance activities during the installation of new wireless towers and associated structures or access roads could result in erosion or 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 are needed, 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 activities would not require ground disturbance. However, where equipment is permanently installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that they could be affected by that hazard. The use of portable satellite-enabled devices would not impact geologic resources nor would it be affected by geologic hazards because there would be no ground disturbance nor any impact to the built or natural environment.

In general, the abovementioned activities could potentially involve ground disturbance resulting from land/vegetation clearing, topsoil removal, excavation, excavated material placement, trenching or directional boring, construction of access roads and other impervious surfaces, landscape grading, and heavy equipment movement. Potential impacts to geological resources associated with deployment could include minimal removal of bedrock or mineral resources, or adverse impacts to installed equipment resulting from geologic hazards (e.g., seismic hazards, landslides, and land subsidence). Specific FirstNet Proposed Actions are likely to be small scale; correspondingly, disturbance to geologic resources for those types of Proposed Actions with the potential to impact geologic resources is also expected to be small scale. These potential impacts are expected to be less than significant. 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, 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, landslides, and land subsidence. However, potential impacts would be anticipated to be less than significant as it is anticipated that deployment locations would avoid, as practicable and feasible, locations that are more likely to be affected by potential seismic activity, landslides, or land subsidence. 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.

8.2.3.5. 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. 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 explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be no impacts to geologic resources (or from geologic hazards) associated with routine inspections of the Preferred Alternative.

The operation of the Deployable Technologies Alternative could be affected by to geologic hazards including seismic activity, landslides, and land subsidence. However, potential impacts would be anticipated to be less than significant as the deployment would be temporary and likely would attempt to avoid locations that was subject to increased seismic activity, landslides, and land subsidence. 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 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 8.1.3, Geology.

8.2.4. Water Resources

8.2.4.1. Introduction

This section describes potential impacts to water resources in Michigan 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, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

The impacts of the Proposed Action on water resources were evaluated using the significance criteria presented in Table 8.2.4-1. As described in Section 8.2, 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 8.2.4-1: 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*	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

*Since public safety infrastructure is considered a critical facility, Proposed Action activities should avoid the 500-year floodplain wherever practicable, per the Executive Orders on Floodplain Management (EO 11988 and EO 13690).

NA = Not Applicable

8.2.4.2. 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. Proposed Actions in watersheds of impaired waters may be subject to heightened permitting requirements. For example, the CWA requires states to assess and report on the quality of waters in their state. Section 303(d) of the CWA requires states to identify impaired waters. For these impaired waters, states must consider the development of a Total Maximum Daily Load (TMDL) or other strategy to reduce the input of the specific pollutant(s) restricting waterbody uses, in order to restore and protect such uses.

Generally, Michigan's lakes, reservoirs, and bays have good water quality (see Table 8.1.4-2, Figure 8.1.4-3). Designated uses of the impaired lakes, reservoirs, and bays include fishing, and primary and secondary contact recreation. Atmospheric deposition of PCBs and mercury have resulted in fish consumption advisories for many species in Michigan's Great Lakes, inland lakes, reservoirs, and impoundments. Groundwater quality within the state is generally good. (USEPA, 2015i) (MDEQ, 2014b)

Deployment activities could 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 (e.g., CWA, SDWA), or local regulations, cause a threat to the human environment, biodiversity, or ecological integrity through water degradation, or cause a sediment water quality violation from local construction, or otherwise substantially degrade water quality. Therefore, based on the impact significance criteria presented in Table 8.2.4-1, 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 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 Michigan 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 Michigan aquifers, there is little potential for groundwater contamination within a watershed or multiple watersheds. Thus, it is unlikely that the majority of FirstNet's deployment locations would result in a drinking quality violation, or otherwise substantially degrade groundwater quality or aquifer, and based on the impact significance criteria presented in Table 8.2.4-1, 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 8.2.4-1, floodplain degradation impacts would be potentially less than significant since the majority of FirstNet's likely deployment activities, on the watershed or subwatershed level, would occur inside the 500-year floodplain, would use minimal fill, would not substantially increase impervious surfaces, structures would not impede or redirect flood flows or impact floodplain hydrology, and would not occur during flood events with the exception of deployable technologies which may be deployed in response to an emergency. Additionally, any effects would likely be temporary, lasting no more than one season or water year,[129] or occur only during an emergency.

Examples of activities that would have less than significant impacts include:

- Construction of any structure in the 500-year floodplain that is built above base flood pursuant to floodplain management regulations.
- Land uses that include pervious surfaces such as gravel parking lots.
- Land uses that do not change the flow of water or drainage patterns.
- Limited clearing or grading activities.

Implementation of BMPs and mitigation measures could help reduce any risk of additional impacts to floodplain degradation (see Chapter 19).

Drainage Pattern Alteration

Flooding and erosion from land disturbance could change drainage patterns. Stormwater 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 8.2.4-1, 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 (LID) 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.

[129] 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)

Flow Alteration

Flow alteration refers to the modification of flow characteristics, relative to natural conditions. Human activities may change the amount of water reaching a stream, divert flow through artificial channels, or alter the shape and location of streams. Surface water and groundwater withdrawals could alter flow by reducing water volumes in streams. Withdrawals may return to the surface/groundwater system at a point further downstream, be removed from the watershed through transpiration by crops, lawns or pastures, or be transferred to another watershed altogether (e.g., water transferred to a different watershed for drinking supply). Altered flow could increase flooding and introduce more erosion and potential for pollution. Alternatively, if water is diverted from its normal flow, the opposite may occur; wetlands and streams may not receive as much water as necessary to maintain the ecology and previous functions.

Activities that do not impact discharge or stage of waterbody (stream height) are not anticipated to have an impact on flow, according to Table 8.2.4-1. Proposed Actions 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 Proposed Actions 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 activities would not likely alter flow characteristics or change the hydrologic regime, impacts would be less than significant impacts to flow alteration. BMPs and mitigation measures could be implemented to further reduce impacts.

Changes in Groundwater or Aquifer Characteristics

As described in Section 8.1.4.7, approximately 45 percent of public drinking water supply in Michigan (MDEQ, 2013). According to MDEQ, “for many communities, groundwater is the only possible source of fresh water for drinking” (Hillsdale County Community Center, 2015). Generally, the water quality of Michigan’s aquifers is suitable for drinking and daily water needs. Groundwater is an important natural resource used by industrial, commercial, agricultural, and residential uses for manufacturing, irrigation, and drinking water purposes. Once a groundwater supply is exhausted or contaminated, it is very expensive, and sometimes impossible, to replace. Water supply demand from the deployment activities is unlikely to exceed safe and sustainable withdrawal capacity rate of the local supply or aquifer.

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 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.

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 Proposed Action, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to water resources and others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of no impacts to potentially significant impacts depending on the deployment scenario or site-specific conditions. The impact on the water resources that could be affected would depend on the watershed, duration (chronic or short-term) and frequency (many years or a few months) the resource would be used, and the water resource's current use.

Activities Likely to Have No Impacts

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

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be no impacts to water resources since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts on water resources because there would be no ground disturbance.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use

satellite technology would not impact water resources because those activities would not require ground disturbance.

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

Potential deployment-related impacts to water resources because of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including impaired water quality. The types of deployment activities that could be part of the Preferred Alternative and result in potential impacts to water resources include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to water resources. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites. The amount of impact depends on the land area affected, installation technique, and location. Trenching would not be expected to occur near or below the existing water table (depth to water). Implementing BMPs and mitigation measures could reduce impact intensity.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water would impact water resources from a short-term increase in suspended solids in the water. Site-specific impact assessment could be required for shoreline environments prior to installation to fully assess potential impacts to lake or river coastal environments.
  - New Build – Aerial Fiber Optic Plant: Potential impacts would be similar to Buried Fiber Optic Plant. Ground disturbance activities could cause impacts to water quality from increased suspended solids and potential groundwater impacts from trenching activities are not expected. If a new roadway were built, additional impervious surface would not be expected to impact water resources or the overall amount of runoff and nonpoint pollution.
  - Collocation on Existing Aerial Fiber Optic Plant: Replacement of poles or structural hardening could result in ground disturbance that could cause impacts to water quality from increased suspended solids that could occur during the replacement of poles and structural hardening.
  - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required grading or other ground disturbance to install small boxes or huts, or access roads, there could potentially be direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids

running off construction sites. The amount of impact depends on the land area affected, installation technique, and location. Trenching would not be expected to occur near or below the existing water table (depth to water). If installation of transmission equipment would occur in existing boxes or huts and require no ground disturbance, there would be no impacts to water resources.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security lighting, electrical feeds, and concrete foundations and pads) or access roads could result in potential direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites. The amount of impact depends on the land area affected, installation technique, and location. Trenching would not be expected to occur near or below the existing water table (depth to water). Implementing BMPs and mitigation measures could reduce impact intensity. If a new roadway were built, any additional impervious surface would not be expected to impact water resources orthe 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 additional power units are needed, 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 would likely be less than significant due to the limited geographic scale of individual activities and would likely return to baseline conditions once revegetation of disturbed areas is complete. BMPs 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, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities, and are expected to have no impacts as there would be no ground disturbing activity and it is likely routine maintenance activities would be conducted along exiting roads and utility rights-of way. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. Impacts to surface and groundwater quality from routine operations and maintenance, such as herbicide application to control vegetation, are not expected. 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.

8.2.4.3. Alternatives Impact Assessment

The following section assesses potential impacts to water resources associated with the Deployable Technologies Alternative and the No Action Alternative.[130]

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 the wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to water resources as a result of implementation of this alternative could be as described below.

[130] As mentioned above and in Section 2.1.3, Proposed Action Infrastructure, the Preferred Alternative includes implementation of deployable technologies.

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts to water resources if those activities if the deployment occurred on paved surfaces. Some staging or launching/landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving, however, these activities would be isolated and short term, and would likely return to baseline conditions once revegetation was complete. Additionally, project activities could result in direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites. The amount of potential impact depends on the land area affected, installation technique, and location. 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. The activities could also result in indirect impacts on water quality if fuels leak into surface or groundwater.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Deployable Technologies Alternative would consist of routine maintenance and inspection of the deployable technologies. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. The water resources impacts would depend on the watershed, duration (chronic or short-term) and frequency (many years or a few months) the resource would be used, and the water resource's current use (sole source for drinking water, considered exceptional value for recreation, or provides critical habitat for a species).

It is anticipated that there would be less than significant impacts to water resources associated with routine inspections of the Deployable Technologies Alternative, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors and near waterbodies, the resulting ground disturbance could increase sedimentation in waterbodies, 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. 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 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 8.1.4, Water Resources.

8.2.5. Wetlands

8.2.5.1. Introduction

This section describes potential impacts to wetlands in Michigan 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, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

8.2.5.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on wetlands were evaluated using the significance criteria presented in Table 8.2.4-1. As described in Section 8.2, 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 8.2.5-1: Impact Significance Rating Criteria for Wetlands

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Direct wetland loss (fill or conversion to non-wetland)	Magnitude or Intensity	Substantial loss of high-quality wetlands (e.g., those that provide critical habitat for sensitive or listed species, are rare or a high-quality example of a wetland type, are not fragmented, support a wide variety of species, etc.); violations of Section 404 of the CWA.	Effect that is potentially significant, but with mitigation is less than significant.	Impacts to lower quality wetlands (e.g., not rare or unique, that have low productivity and species diversity, and those that are already impaired or impacted by human activity).	No direct loss of wetlands.
	Geographic Extent/Context	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Chronic and long term changes not likely to be reversed over several years or seasons.		Periodic and/or temporary loss reversed over 1-2 growing seasons with or without active restoration.	NA
Other direct effects: vegetation clearing; ground disturbance; direct hydrologic changes (flooding or draining); direct soil changes; water quality	Magnitude or Intensity	Substantial and measurable changes to hydrological regime of the wetland impacting salinity, pollutants, nutrients, biodiversity, ecological integrity, or water quality; introduction and establishment of invasive species to high quality wetlands.	Effect that is potentially significant, but with mitigation is less than significant.	Impacts to lower quality wetlands affecting the hydrological regime including salinity, pollutants, nutrients, biodiversity, ecological integrity, or water quality; introduction and establishment of invasive species to high quality wetlands.	No direct impacts to wetlands affecting vegetation, hydrology, soils, or water quality.
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA

Type of Effect	Effect Characteristics	Impact Level: Potentially Significant	Impact Level: Less than Significant with BMPs and Mitigation Measures Incorporated	Impact Level: Less than Significant	Impact Level: No Impact
degradation (spills or sedimentation)	Duration or Frequency	Long-term or permanent alteration that is not restored within 2 growing seasons, or ever.		Periodic and/or temporary loss reversed over 1-2 growing seasons with or without active restoration.	NA
Indirect effects: [2] change in function(s)[3] change in wetland type	Magnitude or Intensity	Changes to the functions or type of high quality wetlands (e.g., those that provide critical habitat for sensitive or listed species, are rare or a high-quality example of a wetland type, are not fragmented, support a wide variety of species, etc.).	Effect that is potentially significant, but with mitigation is less than significant.	Impacts to lower quality wetlands (e.g., not rare or unique, that have low productivity and species diversity, and those that are already impaired or impacted by human activity).	No changes in wetland function or type.
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Long-term or permanent.		Periodic and/or temporary loss reversed over 1-2 growing seasons with or without active restoration.	NA

[1] "Magnitude" is defined based on the type of wetland impacted, using USACE wetland categories (USACE 2014). Category 1 are the highest quality, highest functioning wetlands.

[2] Indirect effects are those resulting from direct effects, but they occur elsewhere in space and/or time. Includes indirect hydrologic effects (wetting or drying) that in turn alters wetland function or type.

[3] Wetland functions include hydrologic, ecological, geomorphic, and social functions typically assessed for wetlands as part of USACE compensatory mitigation planning. Typical functions assessed may include flood attenuation, bank stabilization, water quality, organic matter input/transport, nutrient processing, wildlife habitat, T/E species habitat, biodiversity, recreational/social value.

NA = Not Applicable

8.2.5.3. Description of Environmental Concerns

Potential Direct Wetland Loss (Fill or Conversion to Non-Wetland)

Construction-related impacts from several of the deployment activities have the potential for direct wetland impacts such as filling, draining, or conversion to a non-wetland. Examples include placement of fill in a wetland to construct a new tower, trenching through a wetland or directly connected waterway to install a cable, and placement of a structure (tower, building) within the wetland.

Wetlands regulate the quality and quantity of surface and groundwater supplies, reduce flood hazards by serving as retention basins for surface runoff, and maintain water supplies after floodwaters subside. If wetlands were filled, the entire area may be at risk for increased flooding. There could be a loss of open space to be enjoyed by the community, and decreased wildlife populations may be observed due to displacement and increased noise, light, and other human disturbance. To the extent practicable or feasible, FirstNet and/ or their partners would avoid filling wetlands or altering the hydrologic regime so that wetlands would not be lost or converted to non-wetlands. Loss of high and low-quality wetlands would be less than significant given the amount of land disturbance associated with the Proposed Action locations (generally less than an acre) and the short time-frame of deployment activities. Additionally, 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 more than 6.6 million acres of wetlands throughout Michigan (USFWS, 2014a). Palustrine (freshwater) wetlands are found on river and lake floodplains across the state, although more abundant in northern Michigan, particularly the Upper Peninsula, as shown in in Figure 8.1.5-1.

Based on the impact significance criteria presented in Table 8.2.5-1, the deployment activities would most likely have less than significant direct impacts on wetlands. Additionally, the deployment activities would be unlikely to violate applicable federal, state, and local regulations. In Michigan, as discussed in Section 8.1.5.4, Wetlands, there are no regulated high quality wetlands.

Potential Other Direct Effects

Direct impacts consist of altering the chemical, physical, or biological components of a wetland to the extent that changes to the wetland functions occur. However, direct impacts would not result in a loss of total wetland acreage. Changes, for example, could include conversion of a forested wetland system to a non-forested state through chemical, mechanical, or hydrologic manipulation; altered hydrologic conditions (increases or decreases) such as stormwater discharges or water withdrawals that alter the functions of the wetlands.

Based on the impact significance criteria presented in Table 8.2.5-1, 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 Proposed Action locations (generally less than an acre) and the short time-frame of deployment activities and the application of federal, state, and local wetlands regulations. Additionally, site-specific locations will be subject to an environmental review to help ensure environmental concerns are addressed. Potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures (see Chapter 19).

Examples of activities that could have other direct effects to wetlands in Michigan 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 parameter, such as the acidic conditions of sphagnum bogs and alkaline conditions of calcareous fens.
- 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:[131] Change in Function(s)[132] 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 Proposed Action locations (generally less than an acre) and the short time-frame of deployment activities and the application of federal, state, and local wetlands regulations. Additionally, site-specific locations will be subject to an environmental review to help ensure environmental concerns are addressed. Potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures (see Chapter 19). Examples of functions related to wetlands in Michigan 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 could lower flood peaks by providing detention of storm flows. Correspondingly, disturbance of the wetlands (e.g., dredging or filling) could proportionately reduce water storage function.
- Bank Stabilization: By reducing the velocity and volume of flow, wetlands provide erosion control, floodwater retention, and reduce stream sedimentation.
- Water Quality: Water quality impacts on wetland soils could eventually threaten a wetland's existence. Where sediment inputs exceed rates of sediment export and soil consolidation, a wetland would gradually become filled.
- Nutrient Processing: Wetland forests retain ammonia during seasonal flooding. Wetlands absorb metals in the soils and by plant uptake via the roots. They also allow metabolism of oxygen-demanding materials and reduce fecal coliform populations. These pollutants are often then buried by newer plant material, isolating them in the sediments.
- Wildlife Habitat: Impacts on wetland hydrology and water quality affect wetland vegetation. While flooding could harm some wetland plant species, it promotes others. Shifts in plant communities because of hydrologic changes could have impacts on the preferred food supply and animal cover.
- Recreational Value: Wetlands provide recreation opportunities for people, such as hiking, bird watching, and photography.
- Groundwater Recharge: Wetlands retain water, allowing time for surface waters to infiltrate into soils and replenish groundwater.

According to the significance criteria defined in Table 8.2.4-1, impacts to lower quality wetlands (e.g., not rare or unique, that have low productivity and species diversity, and those that are

[131] 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.
[132] 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.

already impaired or impacted by human activity), would be considered potentially less than significant. 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 Proposed Action 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.

8.2.5.4. Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operation activities. To determine the magnitude of potential impacts of site-specific activities, wetland delineations would be required to determine the exact location of all wetlands, including high quality wetlands, as well as a functional assessment by an experienced wetland delineator.

Deployment Impacts

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

Activities Likely to Have No Impacts

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

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be no impacts to wetlands since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to wetlands because there would be no ground disturbance.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures 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 limited nearshore and inland bodies of water would potentially impact wetlands found along shorelines. Additional Proposed Action-specific environmental reviews would be required to assess potential impacts to wetland environments, including coastal environments.
  - New Build – Aerial Fiber Optic Plant: Potential impacts would be similar to Buried Fiber Optic Plant. Any ground disturbance could cause direct and indirect impacts wetlands, depending on the proximity to wetlands and type of wetlands that could be affected.
  - Collocation on Existing Aerial Fiber Optic Plant: Any ground disturbance could cause direct and indirect impacts to wetlands from increased suspended solids and runoff from activities, depending on the proximity to wetlands and type of wetlands that could be affected.
  - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required grading or other ground disturbance to install small boxes or hunts, or access roads, there could potentially be direct and indirect impacts to wetlands. The amount of impact from a temporary increase in the amount of suspended solids running off construction sites and into wetlands, depends on the land area affected, installation technique, and location. If trenching were to occur near

wetlands, it could cause impacts on wetlands. Implementing BMPs and mitigation measures could reduce impact intensity.

- Wireless Projects
    - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could potentially cause direct and indirect impacts to wetlands. The activities could cause a temporary increase in the amount of suspended solids running off construction sites and into wetlands, depending on their proximity. The amount of impact depends on the land area affected, installation technique, and proximity to wetlands, and wetland type. If trenching were to occur near wetlands, it could cause impacts on wetlands. Implementing BMPs and mitigation measures could reduce impact intensity.
    - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to wetlands. However, if additional power units are needed, 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 reduce impact intensity.
    - Deployable Technologies: Implementation of deployable technologies could result in potential impacts to wetlands if deployment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. The amount of impact depends on the land area affected, installation technique, and location. Implementing BMPs and mitigation measures could reduce impact intensity. The activities could also result in other direct impacts on wetlands if fuels leak into nearby waterbodies or wetlands. Deployment of drones, balloons, or blimps piloted aircraft could have other direct impacts on wetlands if fuels spill or other chemicals seep into nearby waterbodies or wetlands.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or underwater cables; installation of security/safety lighting and fencing; and deployment of aerial platforms. Depending on the deployment activity for this infrastructure, potential impacts to wetlands may occur. The amount of impact depends on the land area affected, installation technique, proximity to wetlands, and type of wetland that could be affected (e.g., high quality). Any ground disturbance could cause direct and indirect impacts wetlands, depending on the proximity to wetlands and type of wetlands that could be affected. These impacts are expected to be less than significant due to the small about of land disturbance (generally less than one acre) and the short timeframe of deployment activities. To minimize any potential impacts to wetlands, BMPs and mitigation measures would be implemented in compliance with any issued federal, state, and local permits. 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, 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. 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.

8.2.5.5. 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. 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, 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. In addition, the presence of new access roads could increase the overall amount of impervious surface in the area, and increase runoff effects on wetlands, 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 wetlands from construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 8.1.5, Wetlands.

8.2.6. Biological Resources

8.2.6.1. Introduction

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

8.2.6.2. 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 8.2.8-1. As described in Section 8.2, 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 8.2.6.3, 8.2.6.4, and 8.2.6.5, respectively, are presented as a range of possible impacts.

Refer to Section 8.2.6.6 for impact assessment methodology and significance criterial associated with threatened and endangered species in Michigan.

Table 8.2.6-1: Impact Significance Rating Criteria for Terrestrial Vegetation, Wildlife, Fisheries, and Aquatic Habitats

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Direct Injury/Mortality	Magnitude or Intensity	Population-level or sub-population injury /mortality effects observed for at least one species depending on the distribution and the management of said species. Events that may impact endemics, or concentrations during breeding or migratory periods. Violation of various regulations including: Marine Mammal Protection Act (MMPA), Magnuson Stevens Fishery Conservation And Management Act (MSFCMA), Migratory Bird Treaty Act (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 Michigan for at least one species. Anthropogenic [a] disturbances that lead to exclusion from nutritional or habitat resources, or direct injury or mortality of endemics or a significant portion of the population or sub-population located in a small area during a specific season.		Effects realized at one location when population is widely distributed, and not concentrated in affected area.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within one to three years.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Vegetation and Habitat Loss, Alteration, or Fragmentation	Magnitude or Intensity	Population-level or sub-population effects observed for at least one species or vegetation cover type, depending on the distribution and the management of the subject species. Impacts to terrestrial, aquatic, or riparian habitat or other sensitive natural community vital for feeding, spawning/breeding, foraging, migratory rest stops, refugia, or cover from weather or predators. Violation of various regulations including: MMPA, MSFCMA, MBTA, and BGEPA.	Effect that is potentially significant, but with BMPs and mitigation measures is less than significant.	Habitat alteration in locations not designated as vital or critical for any period. Temporary losses to individual plants within cover types, or small habitat alterations take place in important habitat that is widely distributed and there are no cover type losses or cumulative effects from additional Proposed Actions.	Sufficient habitat would remain functional to maintain viability of all species. No damage or loss of terrestrial, aquatic, or riparian habitat from Proposed Action would occur.
	Geographic Extent	Regional effects observed within Michigan 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: MMPA, MSFCMA, MBTA, and BGEPA.	Effect that is potentially significant, but with BMPs and mitigation measures is less than significant.	Individual injury/mortality observed but not sufficient to affect population or sub-population survival. Partial exclusion from resources in locations not designated as vital or critical for any given species or life stage, or exclusion from resources that takes place in important habitat that is widely distributed. Anthropogenic disturbances are measurable but minimal as determined by individual behavior and propagation, and the potential for habituation or adaptability is high given time.	No stress or avoidance of feeding or important habitat areas. No reduced population resulting from habitat abandonment.
	Geographic Extent	Regional or site specific effects observed within Michigan for at least one species. Behavioral reactions to anthropogenic disturbances depend on the context, the time of year age, previous experience, and activity. Anthropogenic disturbances that lead to startle responses of large groupings of individuals during haulouts, resulting in injury or mortality.		Effects realized at one location.	NA

Type of Effect	Effect 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
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within one to three years.	NA
Effects to Migration or Migratory Patterns	Magnitude or Intensity	Population-level or sub-population effects observed for at least one species depending on the distribution and the management of said species. Temporary or long-term loss of migratory pattern/path or rest stops due to anthropogenic activities. Violation of various regulations including: MMPA, MSFCMA, MBTA, and BGEPA.	Effect that is potentially significant, but with 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 Proposed Actions.	No alteration of migratory pathways, no stress or avoidance of migratory paths/patterns due to Proposed Action
	Geographic Extent	Regional effects observed within Michigan for at least one species. Anthropogenic disturbances that lead to exclusion from nutritional or habitat resources during migration, or lead to changes of migratory routes for endemics or a significant portion of the population or sub-population located in a small area during a specific season.		Effects realized at one location when population is widely distributed, and not concentrated in affected area.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within one to three years.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Reproductive Effects	Magnitude or Intensity	Population or sub-population level effects in reproduction and productivity over several breeding/spawning seasons for at least one species depending on the distribution and the management of said species. Violation of various regulations including: MMPA, MSFCMA, MBTA, and BGEPA.	Effect that is potentially significant, but with BMPs and mitigation measures is less than significant.	Effects to productivity are at the individual rather than population level. Effects are within annual variances and not sufficient to affect population or sub-population survival.	No reduced breeding or spawning success.
	Geographic Extent	Regional effects observed within Michigan 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

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	Chronic and long-term effects not likely to be reversed over several breeding/spawning seasons for at least one species.		Temporary, isolated, or short-term effects that are reversed within one breeding season.	NA
Invasive Species Effects	Magnitude or Intensity	Extensive increase in invasive species populations over several seasons.	Effect that is potentially significant, but with 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 Proposed Action sites from machinery or human activity.
	Geographic Extent	Regional impacts observed throughout Michigan.		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

[a] 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, 2016g)

NA = Not Applicable

8.2.6.3. Terrestrial Vegetation

Impacts to terrestrial vegetation occurring in Michigan 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 8.2.6-1, 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.

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

Indirect Injury/Mortality

Indirect effects are effects that are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable (40 CFR 1508.8[b]). Indirect injury/mortality 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. Michigan's Natural Resources Environmental Protection Act (Part 413 of Act 451) established the list of prohibited and restricted species, which is regularly amended by Invasive Species Orders. This is intended to help control invasive species with the greatest potential to impact the state's 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. Even if natives are not completely eliminated, the ecosystem often becomes much less diverse.

The potential to introduce invasive plants within construction zones and during long-term site maintenance 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 would help to minimize or avoid the potential for introducing invasive plant species during implementation of the Proposed Action.

Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure.

Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to terrestrial vegetation resources and others would not. In addition, 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,[133] 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 on terrestrial vegetation because there would be no ground disturbance.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures, attaching equipment to satellite launches for other purposes, and the use of portable devices that use satellite technology would not impact terrestrial vegetation because those activities would not require ground disturbance.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact biological resources, it is anticipated that this activity would have no impact on terrestrial vegetation.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to terrestrial vegetation as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct injury/mortality; vegetation and habitat loss, alteration, or fragmentation; indirect injury/mortality; and invasive species effects. The types of infrastructure development scenarios

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

or 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 limited nearshore and inland bodies of water would not impact terrestrial vegetation. However, impacts to terrestrial vegetation could potentially occur as a result of the construction of landings and/or facilities on shore to accept submarine cables could potentially occur as a result of land clearing, excavation activities, and heavy equipment use. Effects could include direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects. 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. 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 above-mentioned deployment impacts. The terrestrial vegetation that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected.

It is anticipated that there would be no impacts to terrestrial vegetation associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. Site maintenance, including mowing or herbicides, may result in less than significant effects due to the small-scale of expected activities. These potential impacts could result from accidental spills from maintenance equipment or release of herbicides and because these areas would not be allowed to revert to a more natural state. If usage of heavy equipment or land clearing activities occurs off established roads or corridors as part of routine maintenance or inspections, direct or indirect injury/mortality to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species could occur to terrestrial vegetation, however impacts are expected to be less than significant due to the small scale of expected activities. 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 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.

<u>Deployment Impacts</u>

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. 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 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 Proposed Action 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. 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 8.1.6.3, Terrestrial Vegetation.

8.2.6.4. Wildlife

Impacts to amphibians and reptiles, terrestrial mammals, birds, and terrestrial invertebrates occurring in and near Michigan's offshore environment (i.e., less than two miles from the edge of the coast) are discussed in this section.

Description of Environmental Concerns

Direct Injury/Mortality

Direct injury/mortality effects are physical injuries, extreme physiological stress, or death of an individual organism from interactions associated with the Proposed Action. The most common direct injuries are entanglement, vehicle or vessel strike, problems associated with accidental ingestion, and injuries incurred by sensitive animals from disturbance events.

Based on the impact significance criteria presented in Table 8.2.6-1, less than significant impacts would be anticipated given the anticipated small size and nature of the majority of the proposed deployment activities. Although anthropogenic disturbances may be measurable (although minimal) for some FirstNet Proposed Actions, impacts to individual behavior of animals would be short-term and direct injury or mortality impacts at the population-level or sub-population effects would not likely be observed.

Terrestrial Mammals

Vehicle strikes are common sources of direct mortality or injury to both small and large mammals in Michigan. 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 bats, and particularly maternity colonies are present at a site location, removal of trees during land clearing activities could result in direct injury/mortality if bats are utilizing them as roost trees or for rearing young. The scale of this impact would be expected to be small scale and would be dependent on the location and type of deployment activity, and the amount of tree removal. Site avoidance measures could be implemented to avoid disturbance to bats.

Birds

Mortalities from collisions or electrocutions with man-made cables and wires are environmental concerns for avian species and violate MBTA and BGEPA. Generally, collision events occur to "poor" fliers (e.g., ducks), night-migrating birds, heavy birds (e.g., swans and cranes), and birds that fly in flocks; while species susceptible to electrocution are birds of prey, ravens, and thermal soarers, typically having large wing spans (Gehring, 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, 1997). Direct injury/mortality are not anticipated to be widespread or affect populations due to the small scale of likely FirstNet actions.

Direct mortality and injury to birds of Michigan are not likely to be widespread or affect populations of species as a whole; individual species impacts may be realized depending on the nature of the deployment activity. If siting considerations and BMPs and mitigation measures are implemented (Chapter 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

The majority of Michigan's amphibian and reptile species are widely distributed throughout Michigan. However, Michigan does serve as the northern, southern, or eastern limit for some native amphibians and reptiles. 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.

Terrestrial Invertebrates

The terrestrial invertebrate populations of Michigan 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. Areas in the Long Island or Great Lakes areas of Michigan have experienced extensive land use changes from urbanization and agriculture. However, a large portion of the state is forested and remains relatively unfragmented, particularly in the Adirondacks and Catskills areas.

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 Michigan's wildlife species below.

Terrestrial Mammals

Mammals occupy a wide range of habitats throughout Michigan and may experience localized effects of habitat loss or fragmentation. Removal or loss of vegetation may impact large mammals (e.g., gray wolf) 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) that utilize these areas for roosting, foraging, sheltering, and for rearing their young. Loss of habitat or exclusions from these areas would be avoided or minimized by implementing BMPs and mitigation measures.

Birds

The direct removal of migratory bird nests is prohibited under the MBTA. The USFWS and the MDNR 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.

The degree to which habitat exclusion affects birds depends on many factors. The impact to passerine[134] 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, would help to avoid or minimize the potential impacts to birds from exclusion of resources, as appropriate.

Reptiles and Amphibians

Important habitats for Michigan's amphibians and reptiles typically consist of wetlands and, in some cases, as with the copperbelly water snake, 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 to avoid or minimize the potential impacts.

Filling or draining of wetland breeding habitat (see Section 8.2.4, Water Resources) and alterations to ground or surface water flow from development associated with the Proposed Action may also have effects on Michigan's amphibian and reptile populations, though BMPs and mitigation measures would help to avoid or minimize the potential impacts.[135]

Terrestrial Invertebrates

Habitat loss and degradation are the most common causes of invertebrate species' declines; however, habitat for many common terrestrial invertebrates is generally assumed to be abundant and widely distributed across the state, therefore no significant effects to terrestrial invertebrates are expected. Impacts to sensitive invertebrate species are discussed below in Section 8.2.6.6, Threatened and Endangered Species and Species of Concern.

Indirect Injury/Mortality

Indirect injury/mortality impacts vary depending on the species, time of year and duration of deployment, though BMPs and mitigation measures 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 result to roosting bats from noise, light, or human disturbance causing them to leave their roosting locations or excluding them from their summer roosting/maternity colony

[134]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.
[135] See Section 8.2.5, Wetlands, for a discussion of BMPs for wetlands.

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 Proposed Action 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 (Hill, 1997). The majority of FirstNet deployment activities would be short-term in nature, therefore repeated disturbances would not occur. Depending on the Proposed Action type and location, individual species may be disturbed resulting in less than significant impacts.

Reptiles and Amphibians

Changes in water quality and quantity, especially during the breeding seasons, could cause stress resulting in lower productivity. The majority of FirstNet deployment activities would be short-term in nature, therefore repeated disturbances would be unlikely to occur. Depending on the Proposed Action type and location, individual species may be disturbed resulting in less than significant impacts.

Terrestrial Invertebrates

Terrestrial invertebrates could experience chronic stress, either by changes in habitat composition or competition for resources, resulting in lower productivity. Due to the large number of invertebrates distributed throughout 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 Michigan's amphibians and reptiles, terrestrial mammals, birds, and terrestrial invertebrates are described below.

Terrestrial Mammals

Large animals (e.g., gray wolf) have well-defined territories. Territory knowledge is passed on from one generation to the next and includes important feeding and denning areas. Small mammals (e.g., bats) also have migratory routes that include spring and fall roosting areas between their summer maternity roosts and hibernacula.[136] Any clearance, drilling, and construction activities needed for network deployment, including noise associated with these

[136] A location chosen by an animal for hibernation.

activities, has the potential to divert mammals from these migratory routes. Impacts could vary depending on the species, time of year of construction/operation, and duration, but are generally expected to be less than significant. Implementation of BMPs and mitigation measures could help to further avoid or minimize the potential impacts.

Birds

Because many birds have extremely long migrations, protection efforts for critical sites along migratory routes must be coordinated over vast distances often involving many different countries. For example, as a group, shorebirds migrating through Michigan undertake some of the longest-distance migrations of all animals. Michigan is located within the Mississippi Flyway, which spans more than 2,300 miles from the Arctic tundra to the Caribbean. Michigan has 103 IBAs including breeding range,[137] migratory stop-over, feeding, over-wintering areas, and a variety of habitats such as hardwood forests; peatlands; swamp, pond, bog, and wetland areas; native prairie grasslands; shorelines; grasslands, sage brush, and wetland/riparian[138] areas (National Audubon Society, 2014). Many migratory routes are passed from one generation to the next. Impacts could vary (e.g., mortality of individuals or abandonment of stopover sites by whole flocks) depending on the species, time of year of construction/operation, and duration, and impacts are expected to be less than significate. BMPs and mitigation measures could help to further avoid or minimize effects to migratory pathways.

Reptiles and Amphibians

Several species of mole salamanders and the wood frog are known to seasonally migrate in Michigan. These amphibians often travel by the hundreds on their migration pathway that often crosses roadways. Mole salamanders are typically found in burrows in the forest floor (DNR, 2016d). Wood frogs use diverse vegetation types from grassy meadows to open forests. After they emerge from dormancy, wood frogs migrate up 900 feet to breeding pools, where they breed rapidly in early spring in permanent or ephemeral water (Homan). However, Berven and Grudzien (Berven, 1990) found that a small percentage of juvenile wood frogs can migrate over 1.5 miles from natal ponds, suggesting juveniles may be capable of migrating relatively long distances. In Michigan, the mole salamanders and wood frog are known to migrate up to 0.25 mile. Mortality and barriers to movement could occur as result of the Proposed Action (Calhoun, 2007).

Species that use streams as dispersal or migratory corridors may be impacted if these waterways are restricted or altered, but impacts are expected to be less than significant. BMPs and mitigation measures could help to further avoid or minimize the potential impacts.

[137] Breeding range: "The area utilized by an organism during the reproductive phase of its lifecycle and during the time that young are reared" (USEPA, 2015m).
[138] 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, 2015m).

Terrestrial Invertebrates

The proposed deployment activities would be expected to be short-term or temporary in nature. No effects to migratory patterns of Michigan'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 dens for gray wolves or summer maternity roosts for bats, has the potential to negatively affect body condition and reproductive success of mammals in Michigan. For example, gray wolves use the same dens and caves year after year.

Disturbance from deployment and operations could also result in the abandonment of offspring leading to reduced survival, although these activities are expected to be small scale and impacts are expected to be less than significant. Reproductive effects as a result of displacement and disturbance could be minimized through the use of BMPs and mitigation measures.

Birds

Impacts due to Proposed Action deployment and operations could include abandonment of the area and nests due to disturbance. Disturbance (visual and noise) may displace birds into less suitable habitat and thus reduce survival and reproduction. These impacts could be particularly pronounced in IBAs within the state if birds temporarily avoid those areas, since they provide essential habitat for various life stages (Hill, 1997). The majority of FirstNet deployment or operation activities are likely to be small scale in nature. BMPs and mitigation measures, as defined through consultation with USFWS, if required, could help to avoid or minimize any potential impacts.

Reptiles and Amphibians

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

Reproductive effects to sub-populations of amphibians and reptiles may occur through the direct loss of vernal pools as breeding habitat if deployment activities occur near breeding pools, alter water quality through sediment infiltration, or obstruction of natural water flow to pools, though BMPs 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. Michigan's Natural Resources Environmental Protection Act (Part 413 of Act 451) established the list of prohibited and restricted species, which is regularly amended by Invasive Species Orders. This list includes birds, amphibians, mammals, and terrestrial invertebrates, to help control invasive species with the greatest potential to impact the state's biodiversity.

Potential invasive species effects to Michigan's wildlife are described below.

Terrestrial Mammals

In Michigan, Feral Swine adversely impact several native large and small mammals, including bear, turkey, waterfowl, and deer. They feed on young mammals, destroy native vegetation resulting in erosion and water resource concerns, and could carry/transmit disease to livestock and humans (DNR, 2015q). This, in turn, could seriously reduce native populations of animals and lead to the degradation of their habitat.

FirstNet deployment activities are not expected to introduce terrestrial mammal species to Proposed Action sites as these activities are temporary and would not provide a mechanism for transport of invasive terrestrial mammals to Proposed Action sites from other locations.

Birds

Invasive plant and pest species directly alter the landscape or habitat to a condition that is more favorable for an invasive species, and less favorable for native species and their habitats. For example, in Michigan, mute swans (*Cygnus olor*) 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 water quality from increased fecal coliform loading in the water, and declines in submerged aquatic vegetation that support native fish and other wildlife (Swift, Clarke, Holevinski, & Cooper, 2013). Although FirstNet deployment activities could result in short-term or temporary changes to specific Proposed Action 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 Proposed Action sites as part of the deployment activities.

Reptiles and Amphibians

Although FirstNet 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 operations.

Terrestrial Invertebrates

Terrestrial invertebrate populations are susceptible to invasive plant species that may change or alter the community composition of specific plants on which they depend. Effects from invasive plant species to terrestrial invertebrates would be similar to those described for habitat loss and degradation.

Invasive insects pose a large threat to forest and agricultural resources. (USFS, 2015e) Species such as the Asian longhorn beetle and emerald ash borer are of particular concern in Michigan and 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 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,[139] 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

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

unlikely to produce measurable changes in wildlife behavior. It is anticipated that effects to wildlife would be temporary and would not result in any perceptible change.
    - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts on wildlife resources because there would be no ground disturbance.
- Satellites and Other Technologies
    - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact wildlife because those activities would not require ground disturbance.
    - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact wildlife resources, it is anticipated that this activity would have no impact on wildlife resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to wildlife resources as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct injury/mortality; vegetation and habitat loss, alteration, or fragmentation; effects to migratory patterns; indirect injury/mortality; reproductive effects; and invasive species effects. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to wildlife resources include the following:

- Wired Projects
    - New Build – Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to wildlife resources. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct injury/mortalities of wildlife that are not mobile enough to avoid construction activities (e.g., reptiles, small mammals, and young individuals), that utilize burrows (e.g., ground squirrels), or that are defending nest sites (such as ground-nesting birds). Disturbance, including noise, associated with the above activities involving heavy equipment or land clearing could result in habitat loss, effects to migration patterns, indirect injury/mortality, reproductive effects, and invasive species effects. 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 limited nearshore and inland bodies of water and construction of landings and/or facilities on the shore to accept submarine cables could potentially impact wildlife (see Section 8.2.4, 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 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.

- 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 above-mentioned 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 Proposed Actions; 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 Proposed Action 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. 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 above-mentioned 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, which 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. Site maintenance that might include accidental spills from maintenance equipment or pesticide runoff near fish habitat are anticipated 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. 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 than less than significant given the short-term nature and limited geographic scope for individual 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, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Alternatives Impact Assessment

The following section assesses potential impacts to wildlife resources associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to wildlife resources as a result of implementation of this alternative could be as described below.

<u>Deployment Impacts</u>

As described above, implementation of deployable technologies could result in less than significant impacts from direct and indirect injury or mortality events, changes in migratory patterns, disturbance, or displacement. Greater frequency and duration of deployments could change the magnitude of impacts depending on species, life history, and region of 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. 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.

<u>Operational Impacts</u>

As described above, operational activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be less than significant impacts because deployable activities are expected to be temporary and likely affecting only a small number of wildlife. The impacts could vary greatly among species and geographic region. 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 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 8.1.6.4, Terrestrial Wildlife.

8.2.6.5. Fisheries and Aquatic Habitats

Impacts to fisheries and aquatic habitats occurring in and near Michigan's offshore environment are discussed in this section.

Description of Environmental Concerns

Direct Injury/Mortality

Direct injury/mortality effects are physical injuries, extreme physiological stress, or death of an individual organism from interactions associated with the Proposed Action. The most common direct injuries are entanglement, vessel strike, problems associated with accidental ingestion, and injuries incurred by sensitive animals from disturbance events (USEPA, 2012d).

Based on the impact significance criteria presented in Table 8.2.6-1, less than significant impacts would be anticipated given the size and nature of the majority of proposed deployment activities. Although anthropogenic disturbances may be measurable (although minimal) for some FirstNet Proposed Actions, 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.

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 8.4.2.4, Water Resources) could help to minimize or avoid potential impacts.

Effects to Migration or Migratory Patterns

Migration is the regular movement of animals from one region to another and back again. Migratory patterns vary by species and sometimes within the same species. For example, restrictions or alterations to waterways could alter migration patterns, limit fish passage, or affect foraging and spawning site access. Impacts are 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, though BMPs and mitigation measures could help to further avoid or minimize the potential impacts.

Invasive Species Effects

The potential to introduce invasive plants within construction zones 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. FirstNet deployment activities could result in short-term or temporary changes to specific Proposed Action sites although these sites are expected to return to their natural state in a year or two. Invasive species are not expected to be introduced to Proposed Action 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. Michigan's Natural Resources Environmental Protection Act (Part 413 of Act 451) established the list of prohibited and restricted species, which is regularly amended by Invasive Species Orders. These are intended to help control invasive species with the greatest potential to impact the state's biodiversity.

Potential Impacts of the Preferred Alternative

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

Deployment Impacts

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

Activities Likely to Have No Impacts

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

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance, including noise, associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that effects to 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 on fisheries and aquatic habitats because there would be no ground disturbance.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact fisheries and aquatic habitats because those activities would not require ground disturbance.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact fisheries, it is anticipated that this activity would have no impact on the aquatic environment.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to fisheries and aquatic habitats as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct injury/mortality; vegetation and habitat loss, alteration, or fragmentation; effects to migratory patterns; indirect injury/mortality; reproductive effects; and invasive species effects. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to fisheries and aquatic habitats include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to fisheries and aquatic habitats. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities, particularly if they occur adjacent to water resources that support fish, could result in habitat loss, alteration and fragmentation; indirect injury/mortality; and invasive species effects. 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 fisheries and aquatic habitats if activities occur near water resources that support fish. Impacts may vary depending on the number or individual poles installed or if access roads or stream crossings are needed, but could include habitat loss, alteration and fragmentation; indirect injury/mortality; and invasive species effects.
  - Collocation on Existing Aerial Fiber Optic Plant: Land clearing and excavation during replacement of poles and structural hardening, if conducted near water resources that support fish, could result in habitat loss, alteration and fragmentation; indirect injury/mortality; and invasive species effects.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water and construction of landings and/or facilities on the shore to accept submarine cables could result in direct injury/mortalities of fisheries and aquatic invertebrates that are not mobile enough to avoid construction activities (e.g., mussels), that utilize burrows (e.g., crayfish), or that are defending nest sites (some fish). Disturbance, including noise, associated with the above activities could result in habitat loss, effects to migration patterns, indirect injury/mortality, reproductive effects, and invasive species effects.
  - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required construction of access roads, trenching, and/or land clearing, particularly near water resources that support fish, such disturbance could result in habitat loss, alteration and fragmentation; indirect injury/mortality, and invasive species effects.
- Wireless Projects

- New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to fisheries and aquatic habitats, if such actions were deployed near water resources. Land/vegetation clearing, excavation activities, landscape grading, and other disturbance activities during the installation of new wireless towers and associated structures or access roads, particularly if they occur near waterbodies, could result in habitat loss or indirect injury/mortality, and invasive species effects, although highly unlikely. Refer to section 2.4, Radio Frequency Emissions, for more information on RF emissions.
- Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower which would not result in impacts to fisheries and aquatic habitats However, if new power units, replacement towers, or structural hardening are required, impacts would be similar to new wireless construction. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.
- Deployable Technologies: Implementation of deployable technologies including COWs, COLTs, or SOWs could result in habitat loss, alteration and fragmentation; indirect injury/mortality, and invasive species effects if new access roads or other ground disturbing activities are necessary that generate erosion, sedimentation, or water quality impacts. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.
- Deployment of drones, balloons, blimps, aerostats, 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 above-mentioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or underwater cables; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to fisheries and aquatic habitats associated with deployment of this infrastructure could include direct injury/mortality, habitat loss, indirect injury/mortality, effects to migration, reproductive effects, and effects of invasive species depending on the ecoregion, the species' phenology, and the nature and extent of the habitats affected. These impacts are anticipated to be less than significant due to the small scale of deployment activities and the limited number of aquatic species expected to be impacted. 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 above-mentioned 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 near fish habitat may result in less than significant effects to fisheries and aquatic habitats, due to accidental spills from maintenance equipment or pesticide runoff.

Fisheries and aquatic habitat could still be affected by the reduction in habitat quality associated with habitat fragmentation from the presence of access roads, transmission corridors, and support facilities. These features could also continue to disrupt movements of fish passage. In addition, the presence of new access roads and transmission line ROWs near water resources that support fish may increase human use of the surrounding areas, which could increase disturbance to fisheries and aquatic habitats resulting in effects to migratory pathways, indirect injury/mortalities, reproductive effects, as well as the potential introduction and spread of invasive species as explained above. Fisheries and aquatic habitat may also be impacted if increased access leads to an increase in the legal or illegal take of biota. However, impacts are expected to be less than significant due to the small scale of expected activities with the potential to affect fisheries and aquatic habitat. As a result of the small scale, only a limited number of individuals are anticipated to be impacted, furthermore, habitat impacts would also be minimal in scale. 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 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. 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

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. 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 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 8.1.6.5, Fisheries and Aquatic Habitats.

8.2.6.6. Threatened and Endangered Species and Species of Conservation Concern

This section describes potential impacts to threatened and endangered species in Michigan and Michigan’s offshore environment associated with deployment and operation of the Proposed Action and alternatives BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 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 8.2.6-2. 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 8.2.6-2: Impact Significance Rating Criteria for Threatened and Endangered Species

Type of Effect	Effect Characteristic	Impact Level		
		May Affect, Likely to Adversely Affect	**May Affect, Not Likely to Adversely Affect**	**No Effect**
Injury/Mortality of a Listed Species	Magnitude or Intensity	As per the ESA, this impact threshold applies at the individual level so applies to any mortality of a listed species and any impact that has more than a negligible potential to result in unpermitted take of an individual of a listed species. Excludes permitted take.	Does not apply in the case of mortality (any mortality unless related to authorized take falls under likely to adversely affect category). Applies to a negligible injury that does not meet the threshold of take due to its low level of effect and/or ability to fully mitigate the effect. Includes permitted take.	No measurable effects on listed species.
	Geographic Extent	Any geographic extent of mortality or any extent of injury that could result in take of a listed species.	Any geographic extent that does not meet the threshold of take due to its low level of effect and/or ability to fully mitigate the effect. Typically applies to one or very few locations.	
	Duration or Frequency	Any duration or frequency that could result in take of a listed species.	Any duration or frequency that does not meet the threshold of take due to its low level of effect and/or ability to fully mitigate the effect. Typically applies to infrequent, temporary, and short-term effects.	
Reproductive Effects	Magnitude or Intensity	Any reduction in breeding success of a listed species.	Changes in breeding behavior (e.g., minor change in breeding timing or location) that are not expected to result in reduced reproductive success.	No measurable effects on listed species.
	Geographic Extent	Reduced breeding success of a listed species at any geographic extent.	Changes in breeding behavior at any geographic extent that are not expected to result in reduced reproductive success of listed species. Typically applies to one or very few locations.	
	Duration or Frequency	Any duration or frequency that could result in reduced breeding success of a listed species.	Infrequent, temporary, or short-term changes in breeding behavior that do not reduce breeding success of a listed species within a breeding season.	
Behavioral Changes	Magnitude or Intensity	Disruption of normal behavior patterns (e.g., breeding, feeding, or sheltering) that could result in take of a listed species.	Minor behavioral changes that would not result in take of a listed species.	No measurable effects on listed species.

Type of Effect	Effect Characteristic	Impact Level		
		May Affect, Likely to Adversely Affect	**May Affect, Not Likely to Adversely Affect**	**No Effect**
	Geographic Extent	Any geographic extent that could result in take of a listed species.	Changes in behavior at any geographic scale that are not expected to result in take of a listed species. Typically applies to one or very few locations.	
	Duration or Frequency	Any duration or frequency that could result in take of a listed species.	Infrequent, temporary, or short-term changes that are not expected to result in take of a listed species.	
Loss or Degradation of Designated Critical Habitat	Magnitude or Intensity	Effects to any of the essential features of designated critical habitat that would diminish the value of the habitat for the survival and recovery of the listed species for which the habitat was designated.	Effects to designated critical habitat that would not diminish the functions or values of the habitat for the species for which the habitat was designated.	No measurable effects on designated critical habitat.
	Geographic Extent	Effects to designated critical habitat at any geographic extent that would diminish the value of the habitat for listed species. Note that the likely to adversely affect threshold for geographic extent depends on the nature of the effect. Some effects could occur at a large-scale but still not appreciably diminish the habitat function or value for a listed species. Other effects could occur at a very small geographic scale but have a large adverse effect on habitat value for a listed species.	Effects realized at any geographic extent that would not diminish the functions and values of the habitat for which the habitat was designated. Typically applies to one or few locations within a designated critical habitat.	
	Duration or Frequency	Any duration or frequency that could result in reduction in critical habitat function or value for a listed species.	Any duration or frequency that would not diminish the functions and values of the habitat for which the habitat was designated. Typically applies to Infrequent, temporary, or short-term changes.	

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 8.2.6-2, 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 Michigan are described below.

Terrestrial Mammals

Direct mortality or injury to the federally listed (*Myotis sodalis*) and Northern long-eared bat (*Myotis septentrionalis*) could occur if tree clearing activities occurred during the roosting season (i.e., approximately April-November) and bats were present. While Proposed Actions would not likely directly affect winter hibernacula (e.g., caves), human disturbance in and around hibernacula when bats are present could lead to adverse effects to these species as well.

The federally listed Canada Lynx (*Lynx canadensis*) and Gray wolf (*Canis lupus*) are known to occur statewide across Michigan. Direct mortality or injury to either species could occur from vehicle strikes as they are occasionally found along transportation corridors. Entanglement in fences or other barriers could also be a source of mortality or injury to this species. Impacts would likely be isolated, individual events. 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

Three federally listed birds, including the piping plover (*Charadrius melodus*), are known to occur along the shorelines of the Great Lakes. Depending on the Proposed Action types and location, direct mortality or injury to these birds could occur from collisions or electrocutions with manmade cables and wires, vehicle strikes, or by disturbance or destruction of nests during ground disturbing activities. If Proposed Action sites are unable to avoid sensitive areas, BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

Reptiles and Amphibians

The threatened copperbelly water snake (*Nerodia erythrogaster neglecta*) and proposed threatened eastern massasauga rattlesnake (*Sistrurus catenatus catenatus*) are known to occur within wetland and upland wooded areas along the Upper Peninsula. Direct mortality to reptiles could occur in construction zones either by excavation activities or by vehicle strikes. Impacts would likely be isolated, individual events.

Direct mortality or injury could occur from watercraft and vessels strikes but are unlikely as the majority of FirstNet deployment Proposed Actions would not occur in an aquatic environment. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

Invertebrates

Four federally listed freshwater mussels and six endangered terrestrial invertebrates occur in Michigan. Direct mortality or injury could occur to these species if land clearing or excavation activities associated with the Proposed Action occur in an area inhabited by one of these species. Distribution of these species is very limited throughout the state. For example, the Hungerford's crawling water beetle (*Brychius hungerfordi*) is found in only two locations in northern Michigan. BMPs and mitigation measures would help to minimize potential impacts to federally listed species resulting from the Proposed Action.

Plants

Direct mortality to federally listed plants could occur if land clearing or excavation activities associated with the Proposed Action occur in an area inhabited by one of these species. There are eight plant federally listed species known to occur in Michigan, including the Houghton's goldenrod (*Solidago houghtonii*) and Dwarf lake iris (*Iris lacustris*). In general, distribution of these species is very limited throughout the state. For example, the Dwarf lake iris and Houghton goldenrod grow nowhere else in the world but in the Great Lakes. 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, reptiles and amphibians, amphibians, invertebrates, and plants with known occurrence in Michigan 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 Proposed Action activities.

Impacts would be directly related to the frequency, intensity, and duration of these activities. Construction activities in the immediate area around a roost tree could startle federally listed bats causing them to abandon their roost tree. For example, in Missouri after a bulldozer was used to clear brush under the tree, Indiana bats (*Myotis sodalis*) were found to presumably abandon their primary roost site (USFWS, 2007). However, there are other examples of Indiana bats tolerating noise. During studies at the Fort Drum Connector highway project in New York, found a maternity colony along the Interstate unaffected by vehicles traveling back and forth (USFWS, 2009c). 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>

The piping plover and Kirtland warbler are the only federally listed bird species that are known to nest in Michigan. Impacts to piping plover and Kirtland warbler habitat will potentially be due to land clearing or excavation activities directly affecting nesting if deployment activities occur during the breeding/nesting season. In addition, habitat loss or degradation could lead to indirect affects to nesting due to birds having to find new nesting sites. Further, noise, light, or human disturbance within nesting areas could cause piping plovers or roseate terns to abandon their nests, relocate to less desirable locations, or cause stress to individuals reducing survival and reproduction. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

<u>Reptiles and Amphibians</u>

The two federally listed reptiles (copperbelly water snake and eastern massasauga (proposed threatened)) are found in the wetland and upland wooded areas along the Upper Peninsula. Similar to the bird population, habitat loss or degradation could lead to indirect affects to nesting due to snakes having to find new nesting sites. Further, noise, light, or human disturbance within nesting areas could stress to individuals reducing survival and reproduction. Land clearing activities, noise, and human disturbance during the critical 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.

<u>Invertebrates</u>

Changes in water quality and quantity could cause stress resulting in lower productivity for federally listed mussels known to occur in Michigan.

Impacts to wild lupine, the staple food for Karner blue butterflies (*Lycaeides melissa samuelis*) when they are caterpillars (USFWS, 2003b), could result in reduced survival and reproduction.

BMPs and mitigation measures would help to minimize potential impacts to federally listed species resulting from the Proposed Action (see below).

Plants

No reproductive effects to federally listed plants are expected as a result of the Proposed Action as limited pesticides would be used and avoidance measures could be undertaken.

Behavioral Changes

Effects to normal behavior patterns that could lead to disruptions in breeding, feeding, or sheltering, resulting in take of a listed species would be considered potentially significant. Potential effects to federally listed terrestrial mammals, birds, reptiles and amphibians, invertebrates, and plants with known occurrence in Michigan are described below.

Terrestrial Mammals

Noise associated with the installation of cables could impact mammal migration patterns, though impacts are likely to be short-term provided the noise sources are not wide ranging and below Level A and B sound exposure thresholds. It is clear that behavioral responses are strongly affected by the context of exposure and by the animal's experience, motivation, and conditioning.

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 red knot has been found to fly up to 9,300 miles from their breeding and wintering sites and often return to the same stopover sites year and after year in Michigan. Disturbance in stopover, foraging, or breeding areas (visual or noise) or habitat loss/fragmentation could cause stress to individuals causing them to abandon areas for less desirable habitat and potentially reduce over fitness and productivity. Activities related to the Proposed Action, such as aerial deployment or construction activities, could result adverse effects to federally listed birds, though BMPs and mitigation measures would help to avoid or minimize the potential impacts.

Reptiles and Amphibians

Habitat loss or alteration, particularly from fragmentation or invasive species, could adversely affect nesting sites of the copperbelly water snake and eastern massasauga, resulting in reduced survival and productivity though BMPs and mitigation measures would help to avoid or minimize the potential impacts.

Invertebrates

Changes in water quality and quantity, habitat loss or alternation, and introduction of aquatic invasive species could impact food sources for federally listed mussels resulting in lower productivity. Disturbances to wild lupine, especially during the breeding season, in areas known to have Karner blue butterflies could impact survival. BMPs and mitigation measures would help to minimize potential impacts to federally listed species resulting from the Proposed Action (see below).

Plants

No behavioral effects to federally listed plants are expected as a result of the Proposed Action.

Loss or Degradation of Designated Critical Habitat

Effects to designated critical habitat and any of its essential features that could diminish the value of the habitat for the listed species or its survival and recovery would be considered an adverse effect and could be potentially significant. Depending on the species or habitat, the adverse effect threshold would vary for geographic extent. In some cases, large-scale impacts could occur that would not diminish the functions and values of the habitat, while in other cases small-scale changes could lead to potentially significant adverse effects. For example, impacts to designated critical habitat for a listed species that is only known to occur in one specific location geographically. Potential effects to federally listed terrestrial mammals, birds, reptiles and amphibians, invertebrates, and plants with designated critical habitat in Michigan or Michigan's offshore environment are described below.

Terrestrial Mammals

There is Gray wolf critical habitat designated in Isle Royale National Park, which is northern Lake Superior. Land clearing, excavation activities, and other ground disturbing activities on the island could lead to habitat loss or degradation, which could lead to adverse effects to the wolf 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. Additional BMPs and mitigation measures, as defined in Chapter 19, may be implemented as appropriate to further minimize potential impacts.

Birds

No critical habitat has been designated for birds in Michigan. 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

No critical habitat has been designated for reptiles or amphibians in Michigan. Therefore, no effect to threatened and endangered species from the loss or degradation of designated critical habitat is expected as a result of the Proposed Action.

Invertebrates

Critical habitat for the Poweshiek Skipperling has been designated in seven areas within Michigan: Oakland County (four areas), Livingston County (one area), Washtenah County (one area), and Lenawee County (one area). Critical habitat for the Hine's emerald dragonfly has been designated in Alpena, Mackinac, and Presque Isle counties in northern Michigan. Land clearing, excavation activities, and other ground disturbing activities in this region of Michigan could lead to habitat loss or degradation, which could lead to adverse effects to the Poweshiek Skipperling depending on the duration, location, and spatial scale of the associated activities. BMPs and mitigation measures to help mitigate or reduce these impacts are described further below.

No critical habitats have been designated for the other five federally listed invertebrates; therefore, no effect to these federally listed invertebrates from the loss or degradation of designated critical habitat is expected as a result of the Proposed Action.

<u>Plants</u>

No critical habitat has been designated for plants in Michigan. Therefore, no effect to threatened and endangered species from the loss or degradation of designated critical habitat is expected as a result of the Proposed Action.

Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to threatened and endangered species and others would not. In addition, and as explained in this section, the same type of Proposed Action infrastructure could result in a range of no affect to less 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 development scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are expected to have no impacts to threatened and endangered species or their habitat under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance, including noise, associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. Although threatened and endangered species and their habitat could be impacted, it is anticipated that effects to threatened and endangered species would be temporary, infrequent, and likely not conducted in locations designated as vital or critical for any period.

  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts on threatened and endangered species or their habitat because there would be no ground disturbance and very limited human activity.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact threatened or endangered species because those activities would not require ground disturbance.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact protected species, it is anticipated that this activity would have no impact on protected species.

Activities with the Potential to Affect Listed Species

Potential deployment-related effects to threatened and endangered species and their habitats as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential effects to threatened and endangered species include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to threatened and endangered species. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct injury/mortalities of threatened and endangered species that are not mobile enough to avoid construction activities (e.g. reptiles, mollusks, small mammals, and young), that utilize burrows (e.g., ground squirrels), or that are defending nest sites (e.g., ground-nesting birds). Disturbance, including noise, associated with the above activities could result in direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat if BMPs and mitigation measures are not implemented.
  - New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public right-of-ways (ROWs) or private easements as well as the construction of access roads, POPs, huts, or facilitates to house outside plant equipment could result in potential impacts to threatened and endangered species and their habitat. Impacts may vary depending on the number or individual poles installed, but could include direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat.

- Collocation on Existing Aerial Fiber Optic Plant: Land clearing and excavation during replacement of poles and structural hardening could result in direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat to threatened and endangered species. Noise disturbance from heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in reproductive effects or behavior changes.
- New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water and construction of landings and/or facilities on the shore to accept submarine cables could potentially impact threatened and endangered species and their habitat, particularly aquatic species (see Section 8.2.4, Water Resources, for a discussion of potential impacts to water resources). Effects could include direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. If activities occurred during critical time periods, reproductive effects and behavioral changes could occur.
- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts, there would be no impacts to threatened and endangered species or their habitats. If installation of transmission equipment required construction of access roads, trenching, and/or land clearing, such disturbance could result in direct injury/mortality of threatened and endangered species as described for other New Build activities. Reproductive effects, behavioral changes, and loss/degradation of designated critical habitat could also occur as a result of construction and resulting disturbance.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to threatened and endangered species and their habitat. Land/vegetation clearing, excavation activities, landscape grading, and other disturbance activities during the installation of new wireless towers and associated structures or access roads could result in direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. Security lighting and fencing could result in direct injury/mortality, disruption of normal behavior patterns, as well as reproductive effects. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower; FirstNet activities would be infrequent, temporary, or short-term in nature and are unlikely to result in direct injury/mortality or behavioral changes to threatened and endangered species However, if replacement towers, or structural hardening are required, impacts could be similar to new wireless construction. Hazards related security/safety lighting and fencing may produce direct injury/mortality, reproductive effects, and behavioral changes. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.

- Deployable Technologies: Implementation of land-based deployable technologies including COWs, COLTs, or SOWs could result in direct injury/mortalities to threatened and endangered species on roadways. If external generators are used, noise disturbance could potentially result in reproductive effects or behavioral changes to threatened and endangered species. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions. Deployment of drones, balloons, piloted aircraft, or blimps could potentially impact threatened and endangered species by direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. The magnitude of these effects depends on the timing and frequency of deployments.

In general, the above-mentioned 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 identified in Chapter 19, and as defined through consultation with the appropriate resource agency, could help to mitigate or reduce potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operational activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the above-mentioned deployment impacts. The threatened and endangered species that would be affected would depend on the species' phenology and the nature and extent of the habitats affected.

It is anticipated that operational impacts may affect, but are not likely to adversely affect threatened and endangered species due to routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. Site maintenance, including mowing or application of herbicides, may affect, but are not likely to adversely affect, threatened and endangered species, as they would be conducted infrequently and in compliance with BMPs and mitigation measures developed through consultation with the appropriate resource agency.

During operations, direct injury/mortality of threatened and endangered species could occur from collisions and/or entanglements with transmission lines, towers, and aerial platforms. Listed species may be affected, but are not likely to be adversely affected. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, 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, may be implemented as appropriate to further minimize potential impacts.

Alternatives Impact Assessment

The following section assesses potential impacts to threatened and endangered species associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to threatened and endangered species as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies may affect, but is not likely to adversely affect, threatened and endangered species through direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. Greater frequency and duration of deployments could change the magnitude of impacts depending on species, life history, and region of the state. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, 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, may be implemented as appropriate to further 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 effects to threatened and endangered species as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 8.1.6.6, Threatened and Endangered Species and Species of Conservation Concern.

8.2.7. Land Use, Recreation, and Airspace

8.2.7.1. Introduction

This section describes potential impacts to land use, recreation, and airspace resources in Michigan 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, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

8.2.7.2. 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 8.2.7-1. As described in Section 8.2, 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 8.2.7-1: 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

8.2.7.3. 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 right-of-way, easement, or access road. These characteristics, such as the length, width, and location could change the existing land use to another category or result in the short- or long-term loss of the existing land use.

Based on the impact significance criteria presented in Table 8.2.7-1, 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 8.2.7-1, less than significant impacts would be anticipated as any new land use would be small scale and 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 8.2.7-1, 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 8.2.7-1, 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 8.2.7-1, airspace impacts are not likely to change or alter flight patterns or airspace usage.

As drones, balloons, and piloted aircraft would likely only be deployed in an emergency and for a short period of time, FirstNet would not impact airspace resources.

8.2.7.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

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

Activities Likely to Have No Impacts

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

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring alongside the road in utility corridors or within public road rights-of-way.
    - Land Use: See Activities Likely to Have Impacts below.
    - Recreation: See Activities Likely to Have Impacts below.
    - Airspace: No impacts to airspace would be anticipated since the activities would not affect flight patterns or cause obstructions that would require FAA and/or state review based on FAR 14 CFR, Part 77, Safe, Efficient Use, and Preservation of the Navigable Airspace.
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas.
    - Land Use: It is anticipated that there would be no impacts to land use since the activities that would be conducted would not directly or indirectly result in changes to existing and surrounding land uses.
    - Recreation: See Activities Likely to Have Impacts below.
    - Airspace: It is anticipated that there would be no impacts to airspace since the activities would not affect flight patterns or cause obstructions that would require FAA and/or state review based on FAR 14 CFR, Part 77, Safe, Efficient Use, and Preservation of the Navigable Airspace.
  - New Build – Aerial Fiber Optic Plant: Installing new poles and hanging cables on previously disturbed or new (undisturbed) ROWs or easements and the potential construction of access roads.
    - Land Use: See Activities Likely to Have Impacts below.

    - Recreation: See Activities Likely to Have Impacts below.
    - Airspace: Installation of new poles would not have an effect on airspace because utility poles are an average of 40 feet in height and do not intrude into useable airspace.
- Collocation on Existing Aerial Fiber Optic Plant: Installation of new fiber on existing poles would be limited to previously disturbed areas.
    - Land Use: It is anticipated that there would be no impacts to land use since the activities that would be conducted would not directly or indirectly result in changes to existing and surrounding land uses.
    - Recreation: No impacts to recreation would be anticipated since the activities that would be conducted would not cause disruption or loss of access to recreational lands or activities or the enjoyment of those lands or activities.
    - Airspace: No impacts are anticipated to airspace from collocations.
- Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber and installation of new equipment in existing huts.
    - Land Use: It is anticipated that there would be no impacts to land use since the activities would not directly or indirectly result in changes to existing and surrounding land uses.
    - Recreation: Use of existing dark fiber would not impact recreation because it would not impede access to recreational resources.
    - Airspace: Lighting of dark fiber would have no impacts on airspace.
- New Build – Submarine Fiber Optic Plant: Installing cables in limited nearshore and inland bodies of water and the constructing landings and/or facilities on shore to accept submarine cable.
    - Land Use: See Activities Likely to Have Impacts below.
    - Recreation: See Activities Likely to Have Impacts below.
    - Airspace: The installation of cables in limited nearshore and inland bodies of water and construction of landings/facilities would not impact flight patterns or cause obstructions that would require FAA and/or state review based on FAR 14 CFR, Part 77, Safe, Efficient Use, and Preservation of the Navigable Airspace.
- Installation of Optical Transmission or Centralized Transmission Equipment: Installation of transmission equipment would occur in existing boxes or huts. The section below addresses potential impacts to land use, recreation resources, and airspace if deployment of new boxes, huts, or access roads is required.
    - Land Use: See Activities Likely to Have Impacts below.
    - Recreation: See Activities Likely to Have Impacts below.
    - Airspace: No impacts to airspace would be anticipated since the activities would not affect flight patterns or cause obstructions that would require FAA and/or state review based on FAR 14 CFR, Part 77, Safe, Efficient Use, and Preservation of the Navigable Airspace.

- Wireless Projects
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, structure, or building.
    - Land Use: There would be no impacts to existing and surrounding land uses. The potential addition of power units, structural hardening, and physical security measures would not impact existing or surrounding land uses.
    - Recreation: See Activities Likely to Have Impacts below.
    - Airspace: See Activities Likely to Have Impacts below.
- Deployable Technologies
  - Deployable Technologies: These technologies would be used where permanent, fixed infrastructure cannot be deployed due to a variety of factors such as the need to supplement coverage or to avoid or mitigate permanent impacts to sensitive resources or receptors.
    - Land Use: It is anticipated that there would be no impacts to existing or surrounding land uses because these technologies would be temporarily located in areas compatible with other land uses.
    - Recreation: No impacts to recreation are anticipated as deployable technologies would not affect the use or enjoyment of recreational lands.
    - Airspace: Use of land-based deployable technologies (COW, COLT, and SOW) is not expected to result in impacts to airspace, provided antenna masts do not exceed 200 feet Above Ground Level (AGL) or do not trigger any of the other FAA obstruction to airspace criteria.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: Installation of permanent equipment on existing structures and the use of portable devices that use satellite technology.
    - Land Use: It is anticipated that there would be no impacts to existing or surrounding land uses because these technologies would be temporarily located in areas compatible with other land uses.
    - Recreation: It is anticipated that there would be no impacts to recreational uses because these technologies would be temporarily deployed but would not restrict access to, or enjoyment of, recreational lands.
    - Airspace: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact airspace because those activities would not result in changes to flight patterns and airspace usage or result in obstructions to airspace.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact land use, 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.
    - Land Use: Construction activities could temporarily restrict existing and surrounding land uses at isolated locations.
    - Recreation: It is anticipated that plowing, trenching, or directional boring may cause temporary, localized restrictions to recreational land or activities, which may persist during the deployment phase. It is reasonable to anticipate that small reductions in visitation to localized areas may occur during the deployment phase.
    - Airspace: No impacts are anticipated – see previous section.
  - New Build – Aerial Fiber Optic Plant: Installing new poles and hanging cables on previously disturbed or new (undisturbed) ROWs or easements and the potential construction of access roads.
    - Land Use: These activities could result in term potential impacts to land uses. Construction activities could temporarily restrict existing and surrounding land uses at isolated locations. New structures, poles, or access roads on previously undisturbed ROWs or easements could have long-term impacts to existing and surrounding land uses. The magnitude of the impact would depend on the specific location and the compatibility of the new structures with existing and surrounding land uses.
    - Recreation: Deployment activities may cause temporary, localized restricted access to recreation land or activities, which may persist for the duration of the deployment phase. Small reductions to visitation during the deployment phase may be anticipated.
    - Airspace: No effect.
  - New Build – Submarine Fiber Optic Plant: Installing cables in limited nearshore and inland bodies of water and the constructing landings and/or facilities on shore to accept submarine cable.
    - Land Use: 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 Michigan's airports.
    - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower.
        - Land Use: No impacts are anticipated – see previous section.
        - Recreation: Installation of antennas or microwaves to existing towers may cause temporary, localized restricted access to recreation lands or activities during installation, which may cause small reductions in visitation for the duration of installation.
        - Airspace: Collocation of mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, addition of power units, structural hardening,

and physical security measures could result in impacts if located near airports or air navigation facilities.

- Deployable Technologies
  - Deployable Technologies: These technologies would be used where permanent, fixed infrastructure cannot be deployed due to a variety of factors such as the need to supplement coverage or to avoid or mitigate permanent impacts to sensitive resources or receptors.
    - <u>Land Use</u>: No impacts are anticipated – see previous section.
    - <u>Recreation</u>: No impacts are anticipated – see previous section.
    - <u>Airspace</u>: 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 Michigan airports. Potential impacts to airspace (such as SUAs and MTRs) may be possible depending on the planned use of drones, piloted aircraft, untethered balloons, and blimps (e.g., frequency of deployment, altitudes, proximity to airports and airspaces classes/types, length of deployment, etc.). Coordination with the FAA would be required to determine the actual impact and the required certifications. It is expected that FirstNet would attempt to avoid changes to airspace and the flight profiles (boundaries, flight altitudes, operating hours, etc.).
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: The installation of permanent equipment on existing structures and the use of portable devices that use satellite technology.
    - <u>Land Use:</u> No impacts are anticipated – see previous section
    - <u>Recreation</u>: 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.
    - <u>Airspace</u>: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology may impact airspace if equipment creates an obstruction.

In general, the abovementioned activities could potentially involve construction, including the construction of access roads. Potential impacts to land uses associated with deployment of this infrastructure could include temporary restrictions to existing and surrounding land uses in isolated locations. Potential impacts to recreation land and activities could include temporary, localized restricted access and reductions in visitation or duration of recreational activities. Potential impacts to airspace are expected to be less than significant due to the temporary and small-scale nature of deployment activities. Additionally FirstNet (or its network partners), would prepare an OE/AAA for any proposed tower that might affect navigable airways or flight patterns of an airport. 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, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. It is anticipated that there would be no impacts to land use, recreation resources, or airspace associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for temporary, short-term inspections. If routine maintenance or inspection activities would conflict with existing or surrounding land uses, impact recreation resources, or conflict with airspace, impacts could result as explained above. Operation of the Deployable Technologies options of the Preferred Alternative could result in the temporary presence of deployable vehicles and equipment (including airborne equipment), potentially for up to two years in some cases. The degree of change in the visual environment (see Section 8.2.8, 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. 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.

8.2.7.5. 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 if deployment occurs in areas with incompatible land uses. Depending on the location, a single deployable technology may have imperceptible impact, multiple technologies operating in close proximity for longer periods could impact existing and surrounding land uses. There could be impacts to recreation activities during the deployment of technologies if such deployment were to occur within or near designated recreation areas. Enjoyment of activities dependent upon the visibility of wildlife or scenic vistas may be affected, however, impacts would be less than significant due to the temporary nature of likely deployment activities. Also, implementation of deployable technologies could result in less than significant impacts to airspace if deployment triggers any obstruction criterion or result in changes to flight patterns and airspace restrictions, FirstNet (or its partners) would consult with the FAA to determine how to proceed. 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 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 temporary, short-term inspections because there would be no ground disturbance, no airspace activity, and no access restrictions to recreational lands. 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. 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 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 8.1.7, Land Use, Recreation, and Airspace.

8.2.8. Visual Resources

8.2.8.1. Introduction

This section describes potential impacts to visual resources in Michigan associated with deployment and operation of the Proposed Action and alternatives. 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.

8.2.8.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on visual resources were evaluated using the significance criteria presented in Table 8.2.8-1. The categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to visual resources addressed in this section are presented as a range of possible impacts.

Table 8.2.8-1: 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.

8.2.8.3. 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 Michigan, residents and visitors travel to many national monuments, historic sites, and state parks, such as Pictured Rocks National Lakeshore to view its scenic coast and beaches. If lands considered visually significant or scenic were subject to vegetation loss or removal, short- or long-term effects to viewsheds or scenic resources could occur. Bare ground or interruption of a landscape due to vegetation removal could be considered an adverse change in the aesthetic character of scenic resources or viewsheds. New towers or structures constructed within scenic areas could disrupt the perceived aesthetic character or scenery of an area.

Michigan regulates impacts to visual resources for historic properties through their State Historic Preservation Office. The Environmental Review activities of the State Historic Preservation Office protect historic properties through participation in Section 106 of the National Historic Preservation Act to determine if activities of federal or state agencies are harming historic buildings, structures, objects, or sites. 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 8.2.8-1, impacts to the aesthetic character of scenic resources or viewsheds would be considered potentially significant if landscapes were permanently removed or fragmented, or if damage to historic or cultural resources occurred. Given the small scale of likely FirstNet activities, impacts are expected to be less than significant.

Nighttime Lighting

If new towers or facilities were constructed to a height that required lighting, nighttime vistas could be affected in areas where the night skies do not have light disruptions or are within unpopulated areas. If nighttime lighting were necessary for the operation or function of a facility that caused regional impacts or permanent changes to night sky conditions, those effects would be considered potentially significant.

Based on the impact significance criteria presented in Table 3.2.8 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 as a result of new towers. 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.

8.2.8.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

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

Activities Likely to Have No Impacts

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

- Wired Projects
  - Collocation on Existing Aerial Fiber Optic Plant: While the addition of new aerial fiber optic plant to an existing aerial fiber optic transmission system would likely be visible, the change associated with this option is so small as to be essentially imperceptible. This option would involve minimal new nighttime lighting and pole replacement would be limited.
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be no impacts to visual resources since the activities would be conducted at small entry and exit points and are not likely to produce perceptible changes, and would not require nighttime lighting.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts on visual resources because there would be no ground disturbance, would not require nighttime lighting, and would not produce any perceptible changes.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact visual resources since those activities would not require ground disturbance or vegetation removal.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact visual resources, it is anticipated that this activity would have no impact on visual resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to visual resources as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur as a result of ground disturbance, vegetation removal, or installation of permanent structures if development occurs in scenic areas. The types of deployment activities that could be part of the Preferred Alternative and result in potential impacts to visual resources include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to visual resources. The degree of impact would depend on the timing, location, and type of Proposed Action—installation of a hut or POP would be permanent, whereas ground disturbing activities would be short-term. In most cases, development located next to existing roadways would not affect visual resources unless vegetation were removed or excavation occurred in scenic areas.
  - New Build – Aerial Fiber Optic Plant: Construction and installation of new or replacement poles and hanging cables could result in impacts to the aesthetic character of scenic resources or viewsheds depending on the location of the installation. In most cases, development in public rights-of-ways would not affect visual resources unless vegetation were removed or construction occurred in scenic areas. If new lighting were necessary, impacts to night skies could occur. Construction of new roadways could result in linear disruptions to the landscape, surface disturbance, and vegetation removal; all of which could impact the aesthetic character of scenic resources or viewsheds, depending on the location of the installation.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water would not impact visual resources. However, impacts to the aesthetic character of scenic resources or viewsheds could potentially occur as result of the construction of landings and/or facilities on shore to accept submarine cable.
  - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required grading, vegetation removal, or other ground disturbance to install small boxes or huts, or access roads, potential impacts to visual resources could occur but effects would be temporary and localized.
- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to visual resources. Land/vegetation clearing, excavation activities, landscape grading, and other surface disturbing activities during the installation of new wireless towers and associated structures or access roads could result in the degradation of the aesthetic character of scenic resources or viewsheds. Impacts may be experienced by viewers if new towers were located in or near a national park unit or other sensitive area. If new towers were constructed to a height that required aviation lighting, nighttime

vistas could be impacted in areas where the night skies do not have light disruptions or are within unpopulated areas. If nighttime lighting were necessary for the operation or function of a facility, impacts to night sky conditions could occur.

- Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower and would not likely result in additional impacts to visual resources. However, if additional power units are needed, 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 above-mentioned activities could potentially involve land/vegetation clearing, and potential scenic intrusion of towers, poles, roads, infrastructure, and other structures. Potential impacts to visual resources associated with deployment could include interruptions of landscapes, degradation of the aesthetic character of scenic resources or viewsheds, and overall changes in valued scenic resources, particularly for permanent fixtures such as towers or facilities. These impacts are expected to be less than significant due to the temporary and small-scale nature of deployment activities, although certain discrete locations could have potentially greater impacts to night skies or as a result of new towers. 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, 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.

8.2.8.5. 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. 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 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 8.1.8, Visual Resources.

8.2.9. Socioeconomics

8.2.9.1. Introduction

This section describes potential impacts to socioeconomics in Michigan 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, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

8.2.9.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on socioeconomics were evaluated using the significance criteria presented in Table 8.2.9-1. As described in Section 8.2, 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.

8.2.9.3. 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. These effects would reduce the potential for economic losses and thus support investments in property and greater market value for property. Any increases in property values are most likely in areas that have low property values and below average public safety communication services. Increases are less likely in areas that already have higher property value. As discussed in Affected Environment, property values vary considerably across Michigan. Median values of owner-occupied housing units in the 2009–2013 period ranged from over $176,000 in the greater Ann Arbor area, to below $80,000 in the Saginaw area. These figures are general indicators only. Property values are probably both higher and lower in specific localities. Any property value effects of deployment of the NPSBN would occur at a localized level.

Table 8.2.9-1: Impact Significance Rating Criteria for Socioeconomics

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Impacts to real estate (could be positive or negative)	Magnitude or Intensity	Changes in property values and/or rental fees, constituting a significant market shift.	Effect that is potentially significant, but with mitigation is less than significant.	Indiscernible impact to property values and/or rental fees.	No impacts to real estate in the form of changes to property values or rental fees.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Persists during the life of the 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 spending, income, industries, and public revenues.
	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

Some telecommunications infrastructure, such as wireless communications towers, may adversely affect property values, depending on infrastructure location and other characteristics. Researchers believe these negative impacts relate to perceptions of the aesthetics of towers, or fears over electromagnetic radiation. Economists and appraisers have studied this issue and use a statistical analysis methodology known as hedonic pricing, or hedonic modelling, to assess how different attributes of properties such as distance from a tower affect property value (Bond, Sims, & Dent, 2013). Essentially, analysts compare the value of multiple properties while statistically controlling for differences in property attributes, in order to isolate the effect of a specific attribute such as proximity of a communications tower.

A recent literature review examined such studies in the United States, Germany, and New Zealand (Bond, Sims, & Dent, 2013). These studies all focused on residential properties. One study identified a positive effect on price in one neighborhood due to the presence of a wireless communications tower. Most studies identified negative effects on price. Generally, these negative effects were small: an approximately two percent decrease in property price. In one case, the average reduction in price was 15 percent. In all cases, the effects declined rapidly with distance, with some cases showing no effect beyond 100 meters (328 feet) and one case showing effects up to about 300 meters (984 feet).

Based on review of the particulars of each study, the literature review authors hypothesize that many additional factors regarding communications towers, besides distance, may affect property value. These include the type, height, size, and appearance of communication towers; grouping of towers; the level of activity in the property market at the time properties are listed or sold; and the level of negative local media focus on potential health effects of communication towers at the time properties are listed or sold.

Economic Benefits or Adverse Impacts Related to Changes in Spending, Income, Industries, and Public Revenues

Developing the NPSBN may increase economic activity as governments and partner(s) 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.[140] 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.

[140] See generally 47 U.S.C. § 1428, § 1457.

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. This is a positive impact. This direct impact would lead to indirect impacts (as directly impacted businesses purchase supporting goods and services) and induced impacts (as the employees of all affected businesses spend the wages they have earned). Because most FirstNet infrastructure investments would be dispersed across the nation, the business income and wages generated in any particular state or community would generally be small relative to the overall state or community economy, but measurable. Based on the significance criteria above, the business income and wage impacts would be considered positive and less than significant. It is also highly unlikely that these impacts would lead to significant market shifts or other significant changes to local/regional economic structure.

Spending and income generation related to developing the NPSBN would also result in changes to public revenues. Property taxes may change as property values increase or decrease due to the installation of new infrastructure. General and selective sales taxes may change (most likely increase), reflecting expenditures during system development and maintenance. Public utility tax revenues may change. These taxes are a subcategory of selective sales taxes that includes taxes on providers of land and mobile telephone, telegraph, cable, and internet services (U.S. Census Bureau, 2006). These service providers may obtain new taxable revenues from operation of components of the public safety broadband network. In such cases, public utility tax revenues may increase, but they could also remain the same or decrease if providers are granted tax breaks in return for operating portions of the network. Individual and corporate income taxes may change as FirstNet infrastructure development and operation creates new taxable income for involved companies and workers.

FirstNet's partner(s) may be given the right to use excess NPSBN capacity commercially. This would result in additional economic activity and generation of income. In turn, this could have revenue implications for federal and state governments, through taxes on sales and on corporate income generated by commercial use of the network.

FirstNet may have an additional, non-revenue benefit to the public sector. The network is likely to create operational cost savings and increased productivity for public safety personnel.

Impacts to Employment

Private companies and government organizations that receive income from deploying and operating the NPSBN would use portions of that income to hire the employees they need to provide their support to the network. This generation of new employment is a direct, beneficial impact of expenditures on FirstNet. Additional, indirect employment increases would occur as additional businesses hire workers to provide supporting goods and services. For instance, FirstNet partner(s) and their subcontractors and vendors would need engineers and information technology professionals, project managers, construction workers, manufacturing workers, maintenance workers, and other technical and administrative staff. Further employment gains would occur as businesses throughout the economy benefit from consumer spending by wage-earners in direct and indirectly affected businesses.

For the most part, employment gains in any particular state or community would generally be measurable, but small relative to the overall state or community economy. This is because FirstNet infrastructure investments would be dispersed across the nation. Based on the significance criteria above, the employment impacts would be considered positive and less than significant. However, even small employment gains are beneficial, and would be especially welcomed in areas that have high unemployment. As discussed in Affected Environment, unemployment rates (as shown by the unemployment rate map and selected economic indicators table) vary considerably across Michigan. The average annual unemployment rate in 2014 was 7.3 percent, higher than the national rate of 6.2 percent. Counties with unemployment rates below the national average (that is, better employment performance) were located in the southern portion of the state around the Mount Pleasant, Holland, Grand Rapids, South Lyon/Howell, Ann Arbor, and Kalamazoo areas. Most of the remainder of the state had unemployment rates above the national average.

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 9.2.2-1 because they would not constitute a "high level of job creation at the state or territory level."

Changes in Population Number or Composition

In general, changes in population numbers occur when employment increases or decreases to a degree that affects the decisions of workers on where they can find employment; that is, when workers and their families move to or leave an area because of employment opportunities or the lack thereof. As noted above, deployment and operation of the NPSBN is likely to generate new employment opportunities (directly and indirectly), but employment changes would not be large enough in any state to be considered significant. Therefore, it is highly unlikely that the NPSBN would lead to significant changes in population numbers according to the significance criteria table above. Further, it is unlikely that the NPSBN would lead to any measurable changes in population numbers in any geographic areas, with the possible exception of cities where companies that win major NPSBN contracts establish centers for NPSBN deployment and operation activities. Smaller numbers of employees in any area would not produce measurable population changes because population is always in flux due to births, deaths, and in-migration and out-migration for other reasons.

Population composition refers to age, gender, race, ethnicity, and other characteristics of the individuals making up a population. Given the low potential for changes to population numbers, it is highly unlikely that the NPSBN would lead to any changes in population composition.

8.2.9.4. 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 8.1.2, 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. These effects are measurable by economists, even if very small, but their significance is determined by application of the criteria in Table 8.2.9-1.

Activities Likely to Have No Impacts

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

Activities with the Potential to Have Impacts

Potential impacts to socioeconomics for the Preferred Alternative would encompass a range of impacts that could result from deployment activities. The discussion below 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
- 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 Proposed Actions 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 Proposed Actions 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 Proposed Actions 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 Proposed Actions 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 Proposed Actions 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 Proposed Actions would generate temporarily a less than significant number of jobs regionally and statewide.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water, and associated onshore activities at existing or new facilities would have the following types of socioeconomic impacts:
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these Proposed Actions 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 Proposed Actions 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 Proposed Actions 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 Proposed Actions 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 Proposed Actions 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 Proposed Actions 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 Proposed Actions 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 Proposed Actions would generate temporarily a less than significant number of jobs regionally and statewide.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures, such as generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads, or access roads would have the following types of socioeconomic impacts:
    - Impacts to Real Estate – As discussed above, communication towers sometimes have adverse impacts on nearby property values (Bond, Sims, & Dent, 2013). Such impacts, if they occur, would be limited to a small area around each Proposed Action 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 Proposed Actions 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 Proposed Actions would generate temporarily a less than significant number of jobs regionally and statewide.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would include mounting or installing equipment (such as antennas) on an existing facility would have the following types of socioeconomic impacts. While communication towers sometimes have adverse impacts on nearby property values (Bond, Sims, & Dent, 2013), the impacts of existing wireless towers are presumably already factored into property values and would not be affected by the addition of new equipment.
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these Proposed Actions 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 Proposed Actions 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 lot), 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 Proposed Actions 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 Proposed Actions 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 Proposed Actions 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 Proposed Actions would generate temporarily a less than significant number of jobs regionally and statewide.
    - In general, the above-mentioned activities would have less than significant beneficial socioeconomic impacts. To the extent that certain activities could have adverse impacts to property values, those impacts are also expected to be less than significant. S 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.

The discussion above characterized the impacts of each type of activity. The socioeconomic impacts of all activities considered together would also be less than significant, as described above. Even when considered together, the impacts would be very small relative to the total economic activity and property value of any region or the state. In addition, with the possible exception of property values, all deployment impacts would be limited to the construction phase.

Operation Impacts

Activities with the Potential to Have Impacts

As described in Section 8.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of primarily of routine maintenance and inspection of fixed infrastructure. As with deployment activities, all operational activities would have socioeconomic impacts, because all represent economic activity. All operational activities would be conducted by public or private sector employees, and therefore support employment and involve payment of wages. Even if these economic effects are a very small for each operational activity, and not significant across the entire state, they are measurable socioeconomic impacts.

Potential socioeconomic impacts would primarily be beneficial, and generally of these types:

- Changes to Spending, Income, Industries, and Public Revenues – Operational activities would require expenditures, which then generate business income and employee wages, and may result in new public sector revenues such as taxes on sales and income. All such effects would be small in scale relative to the regional and state economy; their impacts would be less than significant.
- Impacts to Employment – Public and private sector organizations responsible for operating the NPSBN would sustain existing employees and/or hire new employees to carry out operational activities. They would generate a less than significant number of jobs regionally and statewide.

The potential negative impacts on property values mentioned above for deployment of new wireless communication towers and deployable technology storage, staging, and launch/landing areas may also apply in the operations phase. The ongoing presence of such facilities has aesthetic and other effects that may reduce nearby property values, relative to values in the absence of such facilities.

These impacts, if they occur, would be less than significant as they would occur within a limited distance of each site, and would be limited to a relatively small number of sites within the region and District. 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.

8.2.9.5. Alternatives Impact Assessment

The following section assesses potential impacts to socioeconomics associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to socioeconomics resulting from implementation of this alternative could be as described below.

Deployment Impacts

As explained above, all deployment activities represent economic activity and thus have socioeconomic impacts. These impacts would primarily be beneficial, such as generation of business income and employee wages, and creation or sustainment of jobs. The impacts would be small for each activity, and therefore less than significant.

Deployable technologies such as COWs, COLTs, and SOWs, along with aerial deployable technologies, would require storage, staging, and launch/landing areas. Development or enlargement of these facilities could have adverse impacts on nearby property values. The potential for such impacts is higher under this alternative than the Preferred Alternative because it is likely that these facilities would be implemented in greater numbers and over a larger geographic extent. These potential impacts are anticipated to be less than significant as described above. 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

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 Michigan. 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 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 8.1.9, Socioeconomics.

8.2.10. Environmental Justice

8.2.10.1. Introduction

This section describes potential impacts to environmental justice in Michigan associated with construction/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, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

8.2.10.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on environmental justice were evaluated using the significance criteria presented in Table 8.2.10-1.

The categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to environmental justice addressed in this section are presented as a range of possible impacts.

Table 8.2.10-1: Impact Significance Rating Criteria for Environmental Justice

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
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

8.2.10.3. Description of Environmental Concerns

Effects associated with other Resource Areas that have a Disproportionately High and Adverse Impact on Low-Income Populations and Minority Populations

EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (Executive Office of the President, 1994), and guidance from CEQ, require federal agencies to evaluate potential human health and environmental effects on environmental justice populations. Specifically, "Such effects may include ecological, cultural, human health, economic, or social impacts on minority communities, low-income communities, or Indian tribes when those impacts are interrelated to impacts on the natural or physical environment." (CEQ, 1997) Thus, effects associated with other resource areas are of interest from an environmental justice perspective. This includes Human Health and Safety, Cultural Resources, Socioeconomics, Noise, Aesthetics and Visual Resources, and other resources.

Potential concerns noted in the impact analyses for these resources include dust, noise, traffic, and other adverse impacts of construction activities. New wireless communication towers sometimes have adverse impacts on nearby property values (Bond, Sims, & Dent, 2013). (See Socioeconomics Environmental Consequences for additional discussion.) The presence and operation of large storage, staging, and launch/landing areas for deployable technologies could raise environmental justice concerns as described below. American Indian tribes are considered environmental justice populations (CEQ, 1997); thus, impacts on tribal cultural resources (for instance, due to construction) could be a concern from an environmental justice perspective.

Impacts are considered environmental justice impacts only if they are both "adverse" and "disproportionately high" in their incidence on environmental justice populations relative to the general population (CEQ, 1997). The focus in environmental justice impact assessments is always, by definition, on adverse effects. However, telecommunications projects, such as those proposed by FirstNet, could have beneficial effects. These effects may include better provision of police, fire, and emergency medical services; improvements in property values; and the generation of jobs and income. These impacts are considered in the Socioeconomics Environmental Consequences.

Construction impacts are localized, and property value impacts of wireless telecommunications projects rarely extend beyond 300 meters (984 feet) of a communications tower (Bond, Sims, & Dent, 2013). In addition, impacts related to deployment are of short duration. The potential for significant environmental justice impacts from the FirstNet deployment activities would be limited. Most, but not all, of the FirstNet operational activities have very limited potential for impacts as these activities are limited in scale and short in their duration.

Before FirstNet deploys Proposed Actions, additional site-specific analyses to identify specific environmental justice populations and assess specific impacts on those populations may be necessary. Such analyses could tier-off the methodology and results of this PEIS. The areas shown in the environmental justice screening map of Affected Environment (Section 8.1.10.4) as having moderate potential or high potential for environmental justice populations would particularly warrant further screening. As discussed in Section 8.1.10.3, Environmental Setting:

Minority and Low-Income Populations, Michigan's population generally has lower percentages of minorities than the nation, and higher rates of poverty than the region or nation. The areas with moderate potential or high potential for environmental justice populations are fairly evenly distributed across Michigan. They occur within the largest population concentrations and in the sparsely populated regions of the state. Further analysis using these data developed for the screening analysis in Section 8.1.10.4, 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, 2015b; USEPA, 2016e).

A site-specific analysis would also evaluate whether an actual environmental justice impact on those populations would be likely to occur. Analysts could use the evaluation presented below under "Activities with the Potential to Have Impacts" as a starting point. Analysts should bear in mind that any such activities that are problematic based on the adverse impact criterion of environmental justice may also have beneficial impacts on those same environmental justice communities.

8.2.10.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 8.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could deploy various types of facilities or infrastructure. Depending on the physical nature and location of FirstNet facilities or infrastructure and the specific action, some activities would result in potential impacts to environmental justice communities and others would not. In addition, and as explained in this section, the same type of proposed action infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure deployment scenarios described in Section 8.1.2, Proposed Action Infrastructure, the following are likely to have no impacts to environmental justice under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Installation of fiber optic cable in existing conduit would be through existing hand holes, pulling vaults, junction boxes, huts, and POP structures. Activities at these small entry points would be limited and temporary and thus are not likely to produce perceptible changes affecting any surrounding communities. Therefore, they would not affect environmental justice communities.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber would be conducted electronically through existing infrastructure,

and therefore would have no impacts on environmental justice. If physical access is required to light dark fiber, it would likely be through existing hand holes, pulling vaults, junction boxes, huts, and similar existing structures, with no resulting impacts on environmental justice communities.

- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the deployment of such devices and equipment would not involve new ground disturbance impacts to environmental justice communities would not occur. Impacts associated with satellite-enabled devices requiring construction activities are addressed below.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact environmental justice 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 temporarily generate noise and dust, or disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water would not impact environmental justice because there would be no ground disturbance or other impacts associated with this activity that would adversely impact communities. Associated onshore activities occurring at existing facilities such as staging of equipment and materials, or connection of cables, would be small in scale and temporary; thus, they would not impact environmental justice communities. Construction of new landings and/or facilities onshore to accept submarine cable could temporarily generate noise and dust, or disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.

  - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts, there would be no adverse impacts on surrounding communities, and thus no potential for environmental justice impacts. Installation of optical transmission equipment or centralized transmission equipment requiring construction of new utility poles, hand holes, pulling vaults, junction boxes, huts, and POP structures could temporarily generate noise and dust, or disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.
- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures, such as generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads, or access roads requires construction activities that could temporarily generate noise and dust, or disrupt traffic. New communication towers sometimes have adverse impacts on nearby property values (Bond, Sims, & Dent, 2013). (See Socioeconomics Environmental Consequences for additional discussion.) If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would include mounting or installing equipment (such as antennas) on an existing facility. This activity would be small in scale, temporary, and highly unlikely to produce adverse human health or environmental impacts on the surrounding community. Thus, it would not impact environmental justice communities. If collocation requires construction for additional power units, structural hardening, and physical security measures, the construction activity could temporarily generate noise and dust and disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.
  - Deployable Technologies: COWs, COLTs, and SOWs and aerial deployable technologies require storage, staging, and (for aerial deployables) launch and landing areas. To the extent such areas require new construction, noise and dust could be temporarily generated, and traffic could be disrupted. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.

In general, the impacts from the above-mentioned activities would be short-term and could potentially involve objectionable dust, noise, traffic, or other localized impacts due to construction activities. In some cases, these effects and aesthetic effects could potentially impact property values, particularly from new towers. These impacts are expected to be less than significant, but are problematic from an environmental justice perspective if they occur disproportionately in environmental justice communities. Since environmental justice impacts occur at the site-specific level, analyses of individual proposed projects would help determine potential impacts to specific environmental justice communities. BMPs and mitigation measures may be required to address potential impacts to environmental justice communities at the site-specific level. 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

Activities to Have No Impacts

As described in Section 8.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of primarily of routine maintenance and inspection of fixed infrastructure. It is anticipated that such activities would not result in environmental justice impacts, as the intensity of these activities would be low (low potential for objectionable effects such as noise and dust) and their duration would be very short. Routine maintenance and inspection would not adversely affect property values, for the same reasons.

Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment activities that involve construction.

Impacts are expected to be less than significant given the short-term nature and limited geographic scope for individual 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, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

8.2.10.5. Alternatives Impact Assessment

The following section assesses potential impacts to environmental justice associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to environmental justice communities resulting from implementation of this alternative could be as described below.

Deployment Impacts

- As explained above, deployable technologies such as COWs, COLTs, and SOWs, along with aerial deployable technologies, could require storage, staging, and launch/landing areas. To the extent such areas require new construction, noise, and dust could be generated temporarily, and traffic could be disrupted. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts. Impacts are expected to be less than significant because they would be temporary in nature. 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

- The ongoing presence of facilities for housing and maintaining deployable technologies may have adverse aesthetic aspects (e.g., large areas of pavement and large numbers of parked vehicles) that could negatively affect the value of surrounding properties. In addition, equipment maintenance activities at such facilities may temporarily generate noise, and operational activities may generate traffic. These effects may be adverse in themselves, and may impact property values. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts. Impacts are expected to be less than significant as operations are expected to be temporary in nature. 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 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 8.1.10, Environmental Justice.

8.2.11. Cultural Resources

8.2.11.1. Introduction

This section describes potential impacts to cultural resources in Michigan 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, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

8.2.11.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on cultural resources were evaluated using the significance criteria presented in Table 8.2.11-1. As described in Section 8.2, 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 8.2.11-1: 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	Impact Level: Mitigated Adverse Effect[1]	Impact Level: Effect, but Not Adverse	Impact Level: No Effect
	Duration or Frequency	Long-term or permanent loss of character defining attributes of a single or many historic properties.		Infrequent, temporary, or short-term changes to character defining attributes of a single or many historic properties.	No direct or indirect effects to historic properties.
Loss of access to historic properties	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	Adverse effect that has been procedurally mitigated through Section 106 process.	Effects to a non-contributing portion of a single or many historic properties.	No segregation or loss of access to historic properties.
	Geographic Extent	Any area surrounding historic properties that would cause segregation or loss of access to a single or many historic properties.		Any area surrounding historic properties that could cause segregation or loss of access to a single or many historic properties.	No segregation or loss of access to historic properties.
	Duration or Frequency	Long-term or permanent segregation or loss of access to a single or many historic properties.		Infrequent, temporary, or short-term changes in access to a single or many historic properties.	No segregation or loss of access to historic properties.

[1] Whereas mitigation measures for other resources discussed in this PEIS may be developed to achieve an impact that is "Less than Significant with Mitigation Incorporated," historic properties are considered to be "non-renewable resources," given their very nature. As such, any and all unavoidable adverse effects to historic properties, per Section 106 of the NHPA (as codified in 36 CFR Part 800.6), would require FirstNet to consult with the SHPO/THPO and other consulting parties, including Indian tribes and Native Hawaiian Organizations, to develop appropriate mitigation.

[2] Per NHPA, a "historic property" is defined as any district, archaeological site, building, structure, or object that is either listed or eligible for listing in the NRHP. Cultural resources present within a project's APE are not historic properties if they do not meet the eligibility requirements for listing in the NRHP. Sites of religious and/or cultural significance refer to areas of concern to Indian tribes and other consulting parties that, in consultation with the respective party(ies), may or may not be eligible for listing in the NRHP. These sites may also be considered TCPs. Therefore, by definition, these significance criteria only apply to cultural resources that are historic properties, significant sites of religious and/or cultural significance, or TCPs. For the purposes of brevity, the term historic property is used here to refer to either historic properties, significant sites of religious and/or cultural significance, or TCPs.

8.2.11.3. 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 8.2.11-1, 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 Michigan, some deployment activities may be in these areas, in which case BMPs (see below) would help avoid or minimize the potential impacts.

Indirect Effects to Historic Properties (i.e., visual, noise, vibration, atmospheric)

The potential for indirect effects to historic properties would be present during deployment of the proposed facilities/infrastructure and during trenching, grading, and/or foundation excavation activities. Indirect effects include the introduction of visual, noise, atmospheric, and/or vibration effects that diminish a property's historic integrity. The greatest likelihood of potentially significant impacts from indirect effects would be from the deployment of equipment in areas that would cause adverse visual effects to historic properties. To the extent practicable, FirstNet would attempt to minimize activities in areas within or adjacent to historic districts or properties.

Loss of Character Defining Attributes of Historic Properties

Deployment of FirstNet equipment has the potential to cause the loss of character defining attributes of historic properties; such attributes are the features of historic properties that define their NRHP eligibility. Examples of such impacts would be the loss of integrity of archaeological sites through ground disturbing activities, and direct impacts to historic buildings from equipment deployment that adversely alter historic architectural features. Significant impacts such as these could be avoided or minimized through BMPs (see Chapter 19).

Loss of Access to Historic Properties

The deployment of equipment requiring a secure area has the potential to cause the loss of access to historic properties. The highest potential for this type of significant impact would be from the deployment of equipment in secure areas that impact the access to sites of cultural importance to Native Americans. It is anticipated that FirstNet would identify potential impacts to such areas through the NHPA consultation process, and would minimize deployment activities that would cause such loss of access.

8.2.11.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

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

Activities Likely to Have No Impacts

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

- Wired Projects
    - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be no impacts to cultural resources since the activities that would be conducted at these small entry and exit points are not likely to produce impacts. Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts on cultural. If required, and if done in existing huts with no ground disturbance, installation of new associated equipment would also have no impacts to cultural resources because there would be no ground disturbance and no perceptible visual changes.
- Satellites and Other Technologies
    - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact cultural resources because those activities would not require ground disturbance or create perceptible visual effects.
    - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact cultural resources, it is anticipated that this activity would have no impact on cultural resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to cultural resources as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur as a result of ground disturbance activities, including destruction of cultural or historic artifacts. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to cultural resources include the following:

- Wired Projects
    - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POP, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to cultural resources. Soil disturbance and heavy equipment use associated with plowing, trenching, or directional boring as well as land/vegetation clearing, excavation activities, and landscape grading associated with construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in the disturbance of archaeological sites, and the associated structures could have visual effects on historic properties.
    - New Build – Aerial Fiber Optic Plant: Ground disturbance during the installation of new utility poles and the use of heavy equipment during the installation of new utility poles and hanging of cables could result in the disturbance of archaeological sites, and the associated structures could have visual effects on historic properties.
    - New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water could impact cultural resources, as coastal areas of 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 a result of the construction of landings and/or facilities on shore to accept submarine cable, which could result in the disturbance of archaeological sites and historical sites (archaeological deposits tend to be associated with bodies of water and have high probabilities for archaeological deposits, and Michigan as numerous maritime archaeological sites associated with 19th century expansion), and the associated structures could have visual effects on historic properties.
    - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts and require no ground disturbance, there would be no impacts to cultural resources. If installation of transmission equipment required grading or other ground disturbance to install small boxes or huts, or access roads, there could potentially be impacts to cultural resources. Ground disturbance could impact archaeological sites, and the associated structures could have visual effects on historic properties.
    - Collocation on Existing Aerial Fiber Optic Plant: Soil excavation and excavated material placement during the replacement of poles and structural hardening could result in direct and indirect effects to cultural resources, although any effects to access would be short-term. Heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in direct and indirect effects to cultural resources.

- Wireless Projects
  - New Wireless Communication Towers: Deployment of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to historic properties. Land/vegetation clearing, excavation activities, landscape grading, and other ground disturbance activities during the deployment of new wireless towers and associated structures or access roads, could result in the disturbance of archaeological sites. The deployment of new wireless communication towers and their associated structures could result in visual impacts to historic properties or the loss of access to historic properties.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower could result in impacts to historic properties. Ground disturbance activities could result in the disturbance of archaeological sites, and the deployment of collocated equipment could result in visual impacts or physical damage to historic properties, especially in urban areas such as Michigan 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 above-mentioned activities could potentially involve ground disturbance, construction of access roads and other impervious surfaces, landscape grading, and heavy equipment movement. Potential impacts to cultural resources associated with deployment could include physical damage to or destruction of historic properties, indirect impacts including visual effects, the loss of access to historic properties, or the loss of character-defining features of historic properties. These activities could affect, but not adversely affect, cultural resources as the potential adverse effects would be temporary and limited to the area near individual Proposed Action deployment site. Additionally, some equipment proposed to be installed on or near properties that are listed or eligible for listing on the NRHP could potentially be removed. Additionally as appropriate, FirstNet would engage in consultation as required under Section 106 of the NHPA. 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, 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.

8.2.11.5. Alternatives Impact Assessment

The following section assesses potential impacts to cultural resources associated with the Deployable Technologies Alternative and the No Action Alternative.[141]

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to cultural resources as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in impacts to cultural resources if deployment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in impacts to archaeological sites. These activities could affect, but not adversely affect, cultural resources due to the limited amount of expected ground disturbing activities and the short-term nature of deployment activities. However, in the event that land/vegetation clearing is required, FirstNet would engage in consultation as required under Section 106 of the NHPA. 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 explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the deployment

[141] As mentioned above and in Section 2.1.3, Proposed Action Infrastructure, the Preferred Alternative includes implementation of deployable technologies.

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. 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 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 8.1.11, Cultural Resources.

8.2.12. Air Quality

8.2.12.1. Introduction

This section describes potential impacts to Michigan's air quality from 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, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

8.2.12.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on Michigan's air quality were evaluated using the significance criteria presented in Table 8.2.12-1. As described in Section 8.2, 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 Michigan's air quality addressed in this section are presented as a range of possible impacts.

Table 8.2.12-1: Impact Significance Rating Criteria for Air Quality

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. Proposed Actions 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. Proposed Actions 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

8.2.12.3. 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 Michigan that are in maintenance or nonattainment for one or more criteria pollutants, particularly, ozone is a state-wide issue (see Section 8.1.12, Air Quality and Figure 8.1.12-1). The majority of the counties in Michigan are designated as maintenance areas for one or more of the following pollutants: $PM_{10,}$ $PM_{2.5}$, SO_2, and ozone (Table 8.1.12-4); counties located in the northern portion of the state are designated nonattainment or maintenance for two NAAQS pollutants (Table 8.1.12-5).

Based on the significance criteria presented in Table 8.2.12-1, 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 Michigan; however, NAAQS exceedances are not anticipated. Given that nonattainment areas are present throughout Michigan (Figure 8.1.12-1), 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.

8.2.12.4. Potential Impacts of the Preferred Alternative

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

Deployment and Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementing the Preferred Alternative could result in deploying various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to air quality and others would not. The potential impacts could range from no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

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

- Wired Projects
    - Use of Existing Conduit – New Buried Fiber Optic Plant: Activities associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit. Gaining access to the conduit and installing the cable may result in minor disturbance at entry and exit points, however this activity would be temporary and infrequent, and is not expected to produce any perceptible changes in air emissions.
    - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up dark fiber would require no construction and have no short- or long-term emissions to air quality because it would create minimal new sources of emissions.
- Satellites and Other Technologies
    - Satellite Enabled Devices and Equipment: The duration of construction activities associated with installing permanent equipment on existing structures would most likely be short-term. It is anticipated that insignificant concentrations of criteria pollutants would be emitted during installment of this equipment from the use of machinery. Deployment and operation of satellite-enabled devices and portable equipment are expected to have minimal to no impact on ambient air quality concentrations.
    - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact air quality resources, it is anticipated that this activity would have no impact on those resources.

Activities with Potential Impacts to Air Quality

Construction, deployment, and operation activities related to the Preferred Alternative could impact air quality by generating various quantities of criteria and air pollutant emissions. It is expected that such impacts would be less than significant due to the shorter duration and localized nature of the activities. The types of infrastructure deployment scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to air quality include the following:

- Wired Projects
    - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber as well as land/vegetation clearing, excavation activities, and landscape grading could result in fugitive dust and products of combustion from the use of vehicles and heavy equipment.

  - New Build – Aerial Fiber Optic Plant: The use of heavy equipment during the installation of new poles and hanging cables, as well as constructing access roads, POP huts, or other associated facilities to house plant equipment could result in products of combustion from the use of vehicles and machinery, as well as fugitive dust emissions from site preparation.
  - Collocation on Existing Aerial Fiber Optic Plant: Excavation equipment used during pole replacement, and other heavy equipment used for structural hardening or reinforcement, could result in products of combustion from the use of vehicles and heavy equipment, as well as fugitive dust from site preparation.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water could generate products of combustion from vessels used to lay the cable. In addition, the construction of landings and/or facilities on shore to accept submarine cable could result in products of combustion and fugitive dust from heavy equipment used for grading, foundation excavation, or other ground disturbing activities.
  - Installation of Optical Transmission or Centralized Transmission Equipment: Emissions associated with the installation of optical transmission or centralized transmission equipment would be limited to the short-term, temporary use of vehicle and construction equipment. Long-term impacts are unlikely, as the power requirements for optical networks are relatively low.
- Wireless Projects
  - New Wireless Communication Towers: Activities associated with installing new wireless towers and associated structures (e.g., generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in products of combustion. Operating vehicles and other heavy equipment, running generators while conducing excavation activities, and landscape grading to install new wireless towers and associated structures or access roads could result in products of combustion and fugitive dust.
  - Collocation on Existing Wireless Tower, Structure, or Building: Vehicles and equipment used to mount or install equipment, such as antennas or microwave dishes, on an existing tower could impact air quality. If 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 activities could also result in increased air emissions.
  - Deployable Technologies: The type of deployable technology used would dictate the types of air pollutants generated. For example, mobile equipment deployed via heavy trucks could generate products of combustion from the internal combustion engines associated with the vehicles and onboard generators. These units may also generate fugitive dust depending on the type of road traveled during deployment (i.e., paved versus unpaved roads). Aerial platforms (e.g., UASs or other aircraft) would generate pollutants during all phases of flight.

In general, the pollutants of concern from the abovementioned activities would be products of combustion from burning fossil fuels in internal combustion engines and fugitive dust from site preparation activities and vehicles traveling on unpaved road surfaces. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the construction impacts. These impacts are anticipated to be less than significant due to the limited nature of the deployment. 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, 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. 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.

8.2.12.5. Alternatives Impact Assessment

The following section assesses potential impacts to air quality associated with the Deployable Technologies Alternative and the No Action Alternative.[142]

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:

[142] As mentioned above and in Section 8.2.1.2, Proposed Action Infrastructure, the Preferred Alternative includes implementation of deployable technologies.

Deployment and Operation Impacts to Air Quality

Implementing deployable technologies could result in products of combustion from mobile equipment deployed via heavy trucks using internal combustion engines associated with the vehicles and onboard generators. While a single deployable vehicle may have an insignificant impact, multiple vehicles operating for longer periods, in close proximity, may have a greater cumulative impact, although this is expected to be less than significant based on the defined significance criteria, since activities would be temporary and short-term. These vehicles may also produce fugitive dust if traveling on unpaved roads. Some staging or landing areas (depending on the type of technology) may require excavation, site preparation, and paving. Heavy equipment used for these activities could emit products of combustion as a result of burning fossil fuels in internal combustion engines. The deployment and operation of aerial technology is anticipated to generate pollutants during all phases of flight, except for balloons. The concentrations and associated impacts would be dictated by the products of combustion from ground support vehicles, as well as the duration of ground support operations and travel between storage and deployment locations. Additionally, routine maintenance and inspections of the deployable technologies are anticipated to be less than significant, given that these activities are of low-intensity and short duration.

No Action Alternative

Under the No Action Alternative, FirstNet would not deploy the NPSBN and there would be no impact to ambient air quality. By not deploying NPSBN, FirstNet would avoid generating emissions from construction, installation, or operation of wired, wireless, or deployable infrastructure or technologies; satellites; and other technologies.

8.2.13. Noise

8.2.13.1. Introduction

This section describes potential noise impacts from construction, deployment, and operation of the Proposed Action and alternatives in Michigan. 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.

8.2.13.1 Impact Assessment Methodology and Significance Criteria

The noise impacts of the Proposed Action were evaluated using the significance criteria presented in Table 8.2.13-1. As described in Section 8.2, 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 Michigan addressed in this section are presented as a range of possible impacts.

8.2.13.3. 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 8.2.13-1, 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.

Table 8.2.13-1: 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). Proposed Action 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 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.

NA = Not Applicable

8.2.13.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementing the Preferred Alternative could result in deploying various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential noise impacts and while others would not.

In addition, the same type of Proposed Action Infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

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

- Wired Projects
    - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. Noise generated by equipment required to install fiber would be infrequent and of short duration, and is not expected to create perceptible impacts.
    - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up dark fiber would require no construction or installation activities, and therefore would have no noise impacts.
- Satellites and Other Technologies
    - Satellite Enabled Devices and Equipment: The duration of construction activities associated with installing permanent equipment on existing structures would most likely be short-term. It is anticipated that insignificant levels of noise would be emitted during installment of this equipment. Noise caused by these construction and installation activities would be similar to other construction activities in the area, such as the installation of cell phone towers or other communication equipment. Deployment and operation of satellite-enabled devices and equipment are expected to have minimal to no impact on the noise environment.
    - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact noise resources, it is anticipated that this activity would have no impact on those resources.

Activities with the Potential for Noise Impacts

Construction, deployment, and operation activities related to the Preferred Alternative could create noise impacts from either the construction or operation of the infrastructure. The types of infrastructure deployment scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to air quality include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber as well as land/vegetation clearing, excavation activities, and landscape grading could result in high noise levels from the use of heavy equipment and machinery.
  - New Build – Aerial Fiber Optic Plant: The use of heavy equipment during the installation of new poles and hanging cables, as well as constructing access roads, POP huts, or other associated facilities to house plant equipment would be short-term and could result in increased noise levels from the use of vehicles and machinery.
  - Collocation on Existing Aerial Fiber Optic Plant: Excavation equipment used during potential pole replacement, and other heavy equipment used for structural hardening or reinforcement, could result in temporary increases in noise levels from the use of heavy equipment and machinery.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Installation of new associated huts or equipment, if required, could result in short-term and temporarily higher noise levels if the activity required the use of heavy equipment for grading or other purposes.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water could generate noise if vessels are used to lay the cable. In addition, the construction of landings and/or facilities on shore to accept submarine cable could result in short-term and temporarily increased noise levels to local residents and other noise sensitive receptors from heavy equipment used for grading, foundation excavation, or other ground disturbing activities.
  - Installation of Optical Transmission or Centralized Transmission Equipment: Noise associated with the installation of optical transmission or centralized transmission equipment would be limited to the short-term, temporary use of vehicle and construction equipment. Long-term impacts are unlikely, as the noise emissions from optical networks are relatively low. Heavy equipment used to grade and construct access roads could generate increased levels of noise over baseline levels temporarily
- Wireless Projects
  - New Wireless Communication Towers: Activities associated with installing new wireless towers and associated structures (e.g., generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in localized construction noise. Operating vehicles, other heavy equipment, and generators would be used on a short-term and could increase noise levels.

- Collocation on Existing Wireless Tower, Structure, or Building: Vehicles and equipment used to mount or install equipment, or to grade or excavate additional land on sites for installation of equipment, such as antennas or microwave dishes on an existing tower, could impact the local noise environment temporarily.
- Deployable Technologies: The type of deployable technology used would dictate the types of noise generated. For example, mobile equipment deployed via heavy trucks could generate noise from the internal combustion engines associated with the vehicles and onboard generators. With the exception of balloons, aerial platforms (e.g., UASs or other aircraft, except balloons) generate noise during all phases of flight, including takeoff, landing, and flight operations over necessary areas that could impact the local noise environment.

In general, noise from the abovementioned activities would be products of site preparation, installation, and construction activities, as well as additional construction vehicles traveling on nearby roads and localized generator use. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the construction impacts. These impacts are expected to be less than significant due to the temporary duration of deployment activities. Additionally, pre-existing noise levels achieved after some months (typically less than a year but could be a few hours for linear activities such as pole construction). 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

Operation activities associated with the Preferred Alternative would be less than significant and for routine maintenance and inspection of the facilities because of the temporary nature of the activities which would not create new permanent sources of noise. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that potential noise impacts would be similar to or less than those described for the deployment activities. If usage of vehicles or heavy equipment as part of routine maintenance or inspections or onsite generator use occurs, potential noise impacts could result as explained above. 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.

8.2.13.5. Alternatives Impact Assessment

The following section assesses potential noise impacts associated with the Deployable Technologies Alternative and the No Action Alternative.[143]

[143] As mentioned above and in Section 8.2.1.2, Proposed Action Infrastructure, the Preferred Alternative includes implementation of deployable technologies.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific 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 noise levels. Several vehicles traveling together could also create short-term noise impacts on residences or other noise-sensitive receptors as they pass by. With the exception of balloons, the deployment of aerial technology is anticipated to generate noise during all phases of flight. Aerial technologies would have the highest level of noise impact if they are required to fly above residential areas, areas with a high concentration of noise-sensitive receptors (i.e., schools or churches), or over national parks or other areas where there is an expectation of quiet and serenity on their way to their final destinations. Residences near deployment areas for aerial technologies (i.e., airports or smaller airfields) could also be affected during takeoff and landing operations. Additionally, routine maintenance and inspections of the deployable technologies are anticipated to be less than significant, given that these activities are of low-intensity and short duration. 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

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. 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, 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.

8.2.14. Climate Change

8.2.14.1. Introduction

This section describes potential impacts to climate and climate change-vulnerable resources in Michigan 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, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

8.2.14.2. 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 8.2.14-1. As described in Section 8.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to climate and climate change-vulnerable resources addressed in this section are presented as a range of possible impacts.

CEQ requires the consideration of climate change from two perspectives. The first is the potential for impacts on climate change through GHG emissions resulting from the Proposed

Action or alternatives. The second is related to the implications and possible effects of climate change on the environmental consequences of the Proposed Action or alternatives. This extends to the impacts of climate change on facilities and infrastructure that would be part of the Proposed Action or alternatives (CEQ, 2014).

CEQ has established the significance criteria for GHG emissions at 25,000 MT CO_2e on an annual basis, with the requirement that if projected emissions exceed this threshold, a GHG emissions quantitative analysis is warranted (CEQ, 2014). Although 25,000 MT is a very small fraction (one 266,920th) of the total U.S. emissions of 6,673 million metric tons (MMT) in 2013 (USEPA, 2015j), the sum of additional emissions as a consequence of the deployment of FirstNet, combined with multiple new sources of CO_2 and other GHGs from other projects and human activities, could be significant.

CEQ guidance for the consideration of effects of climate change on the environmental consequences of the proposed action is more general. In addition to the consideration of climate change's effects on environmental consequences, it also includes the impact that climate change may have on the Proposed Actions themselves (CEQ, 2014). Proposed Actions 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 8.2.14-1: Impact Significance Rating Criteria for Climate

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Contribution to climate change through GHG emissions	Magnitude or Intensity	Exceedance of 25,000 metric tons of CO_2e/year, and global level effects observed.	Effect that is potentially significant, but with mitigation is less than significant.	Only slight change observed.	No increase in greenhouse gas emissions or related changes to the climate as a result of 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

8.2.14.3. Proposed Actioned 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 ºF) is Proposed Actioned to increase by mid-century (2041 – 2070) as compared to a 1971 – 2000 baseline in the Midwest with the number of hottest days increasing by 10 to 20 days per year in Michigan 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 Michigan, the frost-free season under a high emissions scenario is expected to extend greater than 25 days longer than the baseline years in the majority of the state. (USGCRP, 2014a)

Michigan is surrounded by two great lakes, Lake Michigan, and Lake Huron. The Great Lakes have recorded higher water temperatures and less ice cover as a result of changes in regional climate. Due to the reduction in ice cover, the temperature of surface waters in Lake Superior during the summer increased 5.2 °F. And, these 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

Figures 8.2.14-1 and 8.2.14-2 illustrate the anticipated temperature changes for low and high GHG emission scenarios for Michigan from a 1969 to 1971 baseline.

Dfa – Figure 8.2.14-1 shows that by mid-century (2040 to 2059), temperatures in the entire state of Michigan 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 Michigan would increase by approximately 6° F. (USGCRP, 2009)

Figure 8.2.14-2 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 Dfa region of Michigan, temperatures would increase by approximately 9 or 10 °F depending on the portion of the region. (USGCRP, 2009)

Dfb – Temperatures in this region are expected to increase by mid-century (2040 to 2059) and by the end of the century (2080 to 2099) at the same rate as the Dfa region under both low and high emissions scenarios. (USGCRP, 2009)

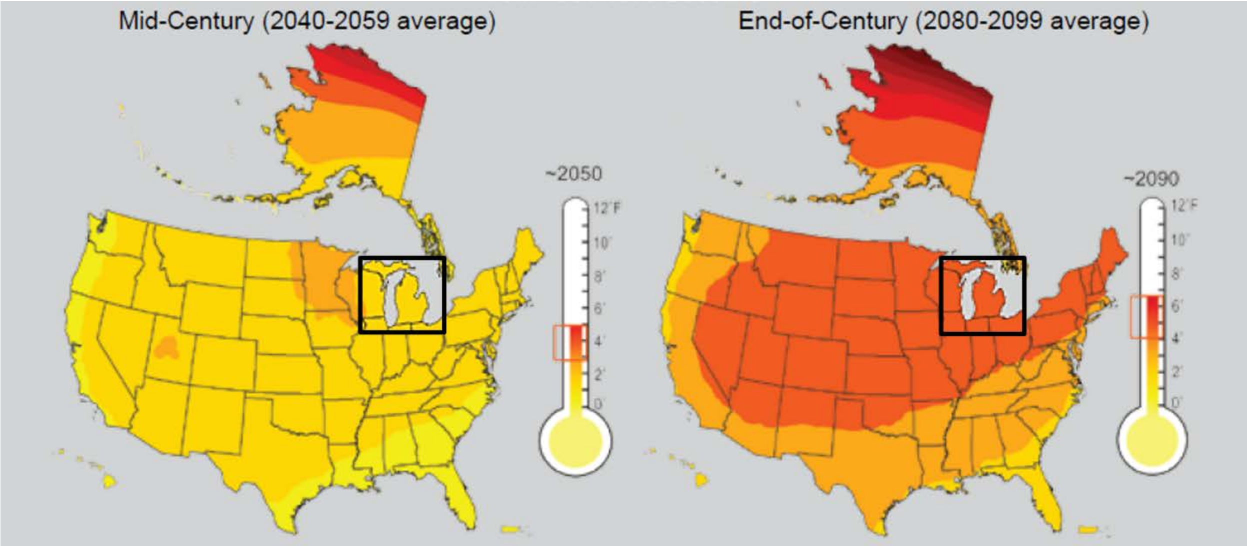

Figure 8.2.14-1: Michigan Low Emission Scenario Projected Temperature Change

Source: (USGCRP, 2009)

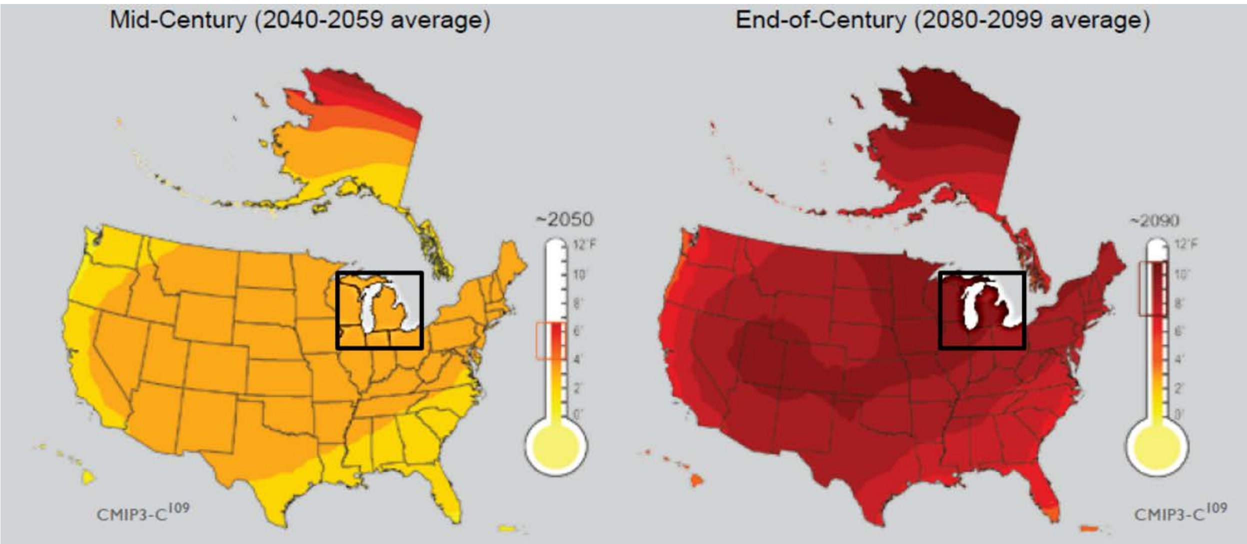

Figure 8.2.14-2: Michigan High Emission Scenario Projected Temperature Change

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 can 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)

Figures 8.2.14-3 and 8.2.14-4 show predicted seasonal precipitation change for an approximate 30-year period of 2071 to 2099 compared to a 1970 to 1999 approximate 30-year baseline. Figure 8.2.14-3 show 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 8.2.14-4 shows a high emissions scenario, which assumes continued increases in emissions, with associated large increases in warming and major precipitation changes. (Note: white areas in the figures indicate that the changes are not projected to be larger than could be expected from natural variability.) (USGCRP, 2014b)

Dfa – Figure 8.2.14-3 shows that in a rapid emissions reduction scenario in the 30-year period for 2071 to 2099, precipitation would increase by 10 percent in winter, spring, and fall in the Dfa region of Michigan. However, there are no expected changes in precipitation in summer other than fluctuations due to natural variability. (USGCRP, 2014b)

Figure 8.2.14-4 shows that if emissions continue to increase, winter and spring precipitation could increase as much as 30 percent over the period 2071 to 2099. In summer, precipitation in this scenario could increase as much as 10 percent or may remain constant depending on the portion of the region. Fall precipitation is expected to increase 10 percent. (USGCRP, 2014b)

Dfb – Under a low emissions scenario, precipitation in winter and spring in the Dfb region is anticipated to increase 10 percent. There are no expected changes in precipitation in summer or fall other than fluctuations due to natural variability. (USGCRP, 2014b)

Winter precipitation is expected to increase 30 percent under a high emissions scenario in the Dfb region of Michigan. In this scenario precipitation in spring is expected to increase 20 or 30 percent depending on the portion of the region. There are no expected changes to summer precipitation. In fall, precipitation is anticipated to increase 10 percent. (USGCRP, 2014b)

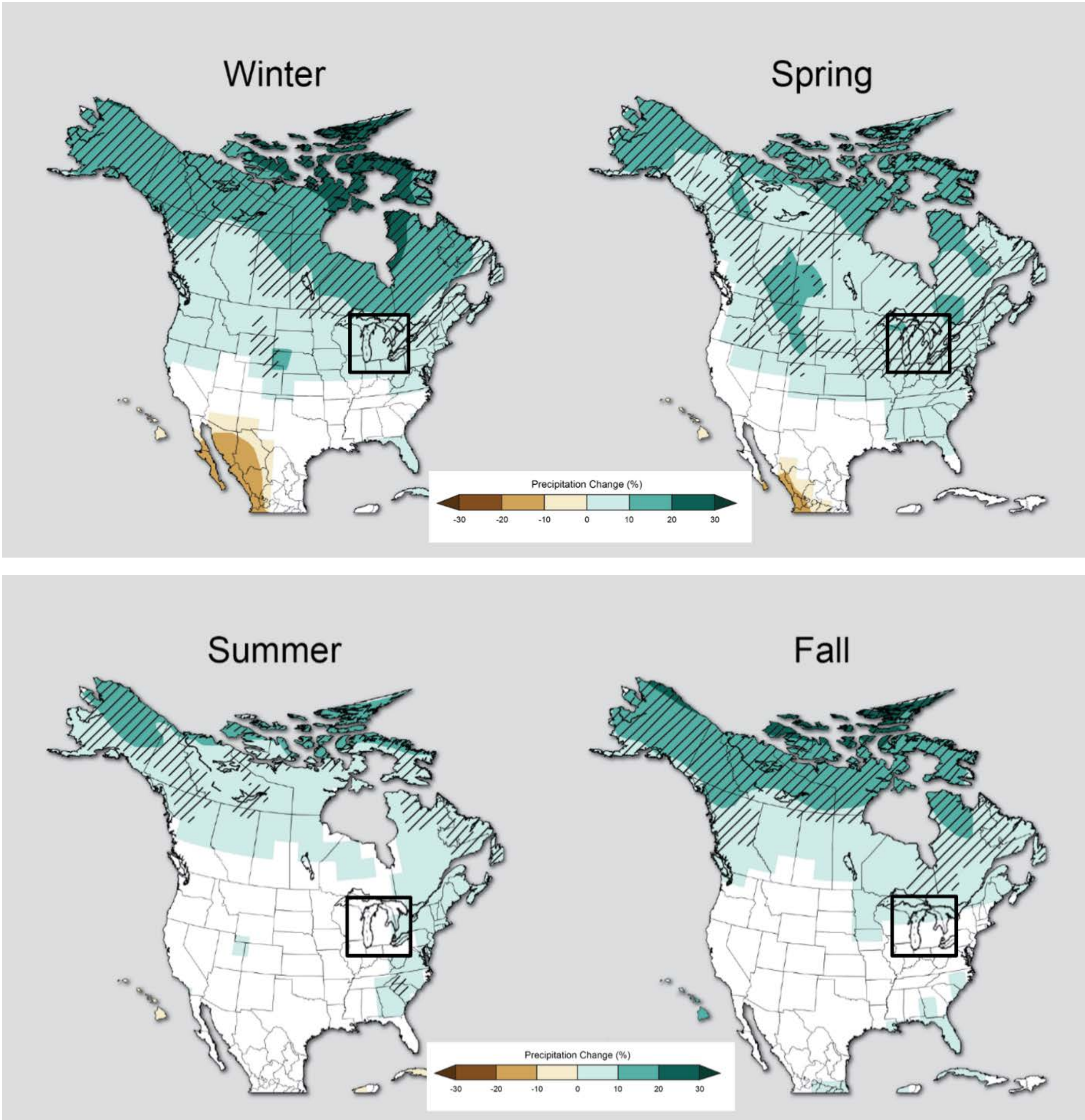

Figure 8.2.14-3: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a Low Emissions Scenario

Source: (USGCRP, 2014b)

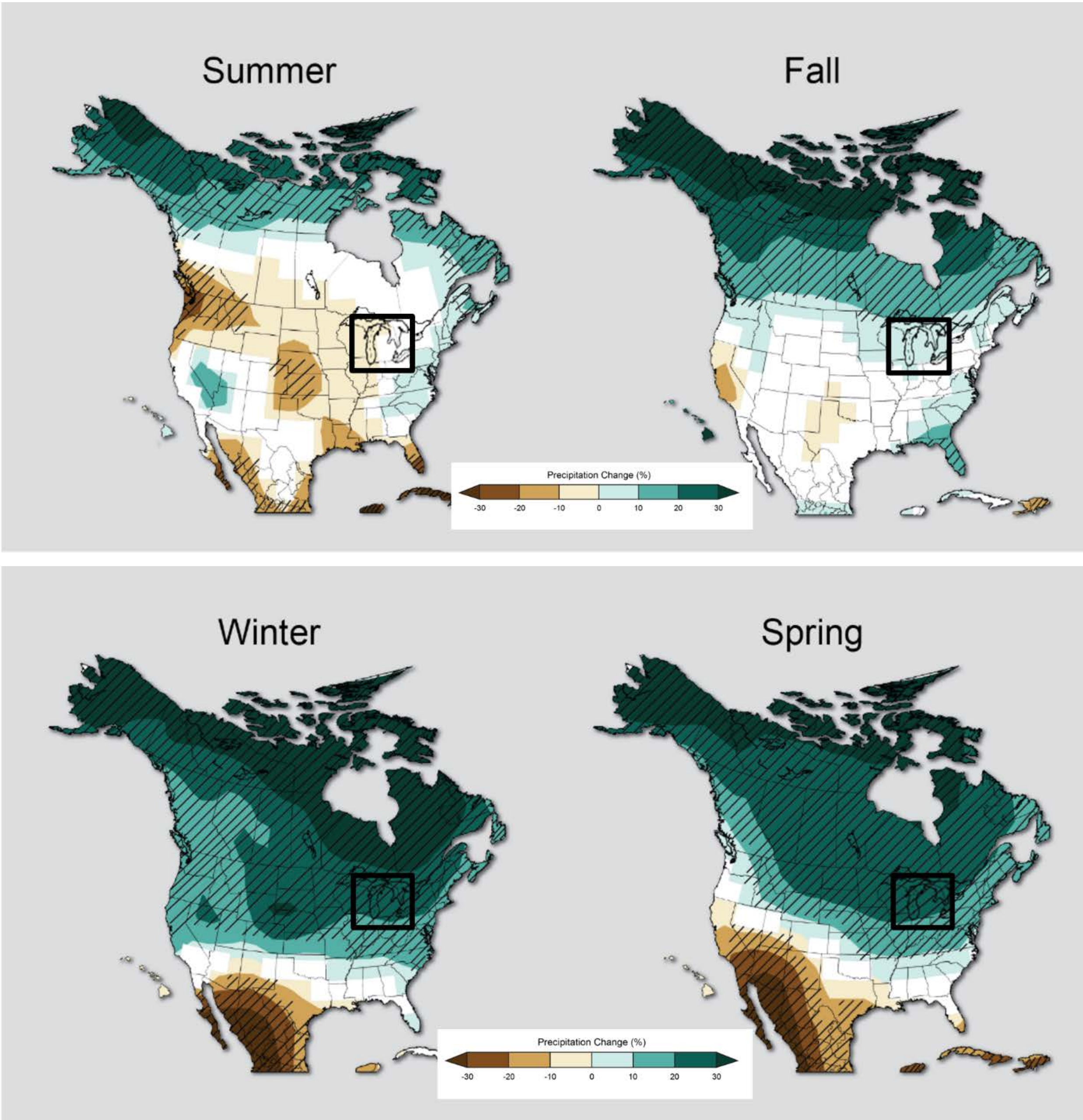

Figure 8.2.14-4: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a High Emissions Scenario

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 make definitive links between severe weather events and climate change. (USGCRP, 2014c)

8.2.14.4. 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 8.2.14-1, climate change impacts as a result of GHG emissions could be significant and require a quantitative analysis if FirstNet's deployment of technology was responsible for increased emissions of 25,000 MT/year or more. The GHG emissions resulting from FirstNet activities fall into two categories: short-term and long-term. Short-term emissions could be associated with deployment activities (vehicles and other motorized construction equipment) and would have no long-term or permanent impact on GHG emissions or climate change. Long-term (both temporary and permanent) emission increases could result from operations, including the use of grid-provided electricity by FirstNet equipment such as transmitters and optical fiber, and from the temporary use of portable or onsite electric generators (a less efficient, more carbon-intensive source of electricity), during emergency situations when the electric grid was down, for example after a hurricane.

A single large cell tower would typically require 20-60kW of power to operate (Balshe, 2011). The CO_2 emissions associated with the operation of the tower would depend on whether it was supplied by a stand-alone power source, such as a generator, or from the grid, and whether it was operating at full power on a continuous basis. A standard 60kW 3-phase diesel generator consumes approximately 5.0 gallons of diesel per hour (Diesel Service & Supply, 2016). Diesel fuel combustion emits 22.38 lbs of CO_2 per gallon (EIA, 2015g). 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, 2015k), 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. Furthermore, the components of the system would not necessarily all be this large, running all the time, or at full power. Some may even run on low/no-emissions renewable energy. Therefore, this scenario is a "worst-case" for GHG emissions. If the system deployment resulted in the operation of more than 50 60 kW towers operating at maximum power in remote locations on diesel generators on a continuous basis, the 25,000 MT/year threshold may be exceeded and a quantitative analysis required. By comparison optical fiber is considerably more energy efficient and consumes considerably less power than transmitters (Vereecken, et al., 2011), and would not impact GHG emissions in such a way as to require a quantitative analysis.

Impact of Climate Change on Proposed Action-Related Resource Effects

Climate change may impact project-related effects by magnifying or otherwise altering impacts in other resources areas. For example climate change may impact air quality, water resource availability, and recreation. These effects would vary from state to state depending on the resources in question and their relationship to climate change. Climate change may expose areas of Michigan to increased intensity and duration of heat waves (USGCRP, 2014c) particularly in large population centers with the significant urban heat islands such as Detroit that could greatly magnify these effects. This could raise morbidity and mortality rates associated with extreme and extended heat waves, particularly for economically or socially distressed populations (USGCRP, 2014a) (Sampson, et al., 2014). Warming temperatures may benefit certain agricultural crops, but may negatively impact key species of trees in Michigan, altering forest composition with cascading effects on other species (USGCRP, 2014a). Climate change is also expected to raise the temperature of the Great Lakes, together with that of rivers and other water bodies, making them more vulnerable to harmful algal blooms and other types of biological contamination, particularly when combined with extreme rainfall events (USEPA, 2015l) (Michigan Department of Health and Human Safety, 2016).

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 8.2.14-1, climate change effects on FirstNet installations and infrastructure would be significant if they negatively affected the operation of these facilities. For areas of Michigan at risk for flooding, climate change is projected to increase the frequency and severity of torrential downpours which in turn may increase the potential for flash floods (USGCRP, 2014c). This could negatively impact FirstNet infrastructure as well as magnify the extent and gravity of flood-related disasters. Extended periods of extreme heat may increase general demand on the electric grid, impede the operation of the grid in the Midwest region (DOE, 2013), and overwhelm the capacity onsite equipment needed to keep microwave and other transmitters cool.

8.2.14.5. 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 Michigan, including deployment and operation activities.

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

Activities Likely to Have No Impacts

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

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: There would be no short-term emissions associated with construction, as construction would not take place. The equipment required to blow or pull fiber through existing conduit would be used temporarily and infrequently, resulting in no perceptible generation of GHG emissions.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up dark fiber would require no construction and have no short-or long-term emissions. This would create no perceptible change in the GHG emissions.
- Satellites and Other Technologies
  - Satellite Enabled Devices and Equipment: The installation of satellite-enabled equipment on existing structures, or the use of portable satellite-enabled devices would not create any perceptible changes in GHG emissions because they would not create any new emissions sources.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. Therefore it is anticipated that there would be no GHG emissions or any climate change effects on the project because of these activities.

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:

- Wireless Projects
  - New Build - Buried Fiber Optic Plant: This activity would include plowing (including vibratory plowing), trenching, and directional boring, and could involve construction of POPs, huts, or other facilities to house outside plant equipment or hand holes to access fiber. These activities could generate GHG emissions.
  - New Build Aerial Fiber Optic Plant: These projects would require construction equipment for installing or replacing new poles and hanging cables as well as excavation and grading for new or modified right-of-ways or easements. It could also include construction of POPs, huts, or other facilities to house outside plant equipment. These activities could generate GHG emissions.
  - Collocation on Existing Aerial Fiber Optic Plant: These Proposed Actions would require equipment for replacement of existing wiring and poles. GHG emissions associated with these Proposed Actions would arise from use of machinery and vehicles to complete these activities.
  - New Build – Submarine Fiber Optic Plant: The deployment of small work boats with engines similar to recreational vehicle engines may be required to transport and lay small wired cable. The emissions from these small marine sources would contribute to GHGs.
  - Installation of Optical Transmission or Centralized Transmission Equipment: The construction of small boxes or huts or other structures would require construction equipment, which could generate GHG emissions.
- Wireless Projects
  - New Wireless Tower Construction: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in short-term, temporary GHG emissions from vehicles and construction equipment. Long-term, permanent or temporary increases in GHG emissions would result from the electricity requirements of the towers (both grid-provided and back-up), and would depend on their size, number, and the frequency and duration of their use.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on existing towers. There would be no short-term GHG emissions associated with construction as construction would not take place. Minor, short-term, temporary GHG emissions may result from any associated equipment used for installation, such as cranes or other equipment. Long-term, permanent or temporary increases in GHG emissions would result from the electricity requirements of the towers (both grid-provided and back-up), and would depend on their size, number, and the frequency and duration of their use.
- Deployable Technologies
  - COWs, COLTs, SOWs: The long-term operations of these mobile systems have the potential to have GHG emission impacts in excess of 25,000 MT if operated in large numbers over the long-term. However this would be highly dependent on their size, number, and the frequency and duration of their use.

- Emissions associated with the deployment and maintenance of a complete network solution of this type may be significant if large numbers of piloted or unmanned aircraft were used for a sustained period of time (i.e., months to years). Emissions would depend on the type of platforms used, their energy consumption, and the duration of the network's operation.

Potential climate change impacts associated with deployment activities as a result of implementation of the Preferred Alternative include increased GHG emissions. GHG emissions would arise from the combustion of fuel used by equipment during construction and changes in land use. Emissions occurring as a result of soil disturbance and loss of vegetation are expected to be less than significant due to the limited and localized nature of deployment activities. 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.

Climate Change Impacts on FirstNet Infrastructure or Operations

Climate change effects on the Preferred Alternative could be potentially significant to less than significant with BMPs and mitigation measures incorporated because climate change may potentially impact FirstNet installations or infrastructure during periods of extreme heat, severe storms, and other weather events. FirstNet installations should be evaluated in the design and planning phase through tiering to this analysis, in the context of their local geography and anticipated climate hazards to ensure they are properly hardened or there is sufficient redundancy to continue operations in a climate-affected environment. Mitigation measures could minimize or reduce the severity or magnitude of a potential impact resulting to the project, including adaptation, which refers to while adaptation refers to anticipating adverse effects of climate change and taking appropriate action to prevent and minimize the damage climate change effects could cause.

Climate change's anticipated impact on extreme weather events such as hurricanes or heat waves may increase the severity of the emergencies to which first responders are responding in vulnerable areas, and thus the extent and duration of their dependence on FirstNet resources. FirstNet would likely prepare to sustain these operations in areas experiencing climate and weather extremes through the design and planning process for individual locations and operations.

8.2.14.6. 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 Proposed Actions discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration.

Deployment Impacts

As explained above, implementation of deployable technologies could involve use of fossil-fuel-powered vehicles, powered generators, and/or aerial platforms. There could be some emissions and soil and vegetation loss as a result of excavation and grading for staging and/or landing areas depending on the type of technology. GHG emissions are expected to be less than significant based on the defined significance criteria, since activities would be temporary and short-term.

Operations Impacts

Implementing land-based deployable technologies (COW, COLT, SOW) could result in emissions from mobile equipment on heavy trucks using internal combustion engines associated with the vehicles and onboard generators. While a single deployable vehicle may have an insignificant impact, multiple vehicles operating for longer periods, in close proximity, may have a cumulative impact, although this impact is expected to be less than significant. Some staging or landing areas (depending on the type of technology) may require excavation, site preparation, and paving. Heavy equipment used for these activities could produce emissions as a result of burning fossil fuels in internal combustion engines. The deployment and operation of aerial technology is anticipated to generate pollutants during all phases of flight, except for balloons. These activities are expected to be less than significant due the limited duration of deployment activities.

Additionally, routine maintenance and inspections of the deployable technologies are anticipated to be less than significant, given that these activities are of low-intensity and short duration.

Climate Change Impacts on FirstNet Deployable Infrastructure or Operations

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. These projects may also consist of deploying aerial vehicles including, but not limited to, drones, balloons, blimps, and piloted aircraft, which could involve fossil fuel combustion. Climate change effects have the most noticeable impacts over a long period. Climate change effects such as temperature, precipitation changes, and extreme weather during operations would be expected but could have little to no impact on the deployed technology due to the temporary nature of deployment. However, if these technologies are deployed continuously (at the required location) for an extended period, climate change effects on deployables could be similar to the Proposed Action, as explained above.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure, or satellites and other technologies. As a result, there would be no impacts to GHG emissions or climate as a result of deployment and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 8.1.14, Climate Change.

8.2.15. Human Health and Safety

8.2.15.1. Introduction

This section describes potential impacts to human health and safety in Michigan associated with deployment 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, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

8.2.15.2. 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 8.2.15-1. As described in Section 8.2, 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 8.2.15-1: Impact Significance Rating Criteria for Human Health and Safety

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Exposure to Worksite Occupational Hazards as a Result of Activities at Existing or New FirstNet Sites	Magnitude or Intensity	Exposure to concentrations of chemicals above occupational regulatory limits and time weighted averages (TWAs). A net increase in the amount of hazardous or toxic materials or wastes generated, handled, stored, used, or disposed of, resulting in unacceptable risk, exceedance of available waste disposal capacity and probable regulatory violations. Exposure to recognized workplace safety hazards (physical and chemical). Violations of various regulations including: OSHA, RCRA, CERCLA, TSCA, EPCRA.	Effect is potentially significant, but with mitigation is less than significant.	No exposure to chemicals above health-protective screening levels. Hazardous or toxic materials or wastes could be safely and adequately managed in accordance with all applicable regulations and policies, with limited exposures or risks. No exposure to unsafe working conditions or other workplace safety hazards.	No exposure to chemicals, unsafe working conditions, or other workplace safety hazards.
	Geographic Extent	Regional impacts observed ("regional" assumed to be at least a county or county-equivalent geographical extent, could extend to state/territory).		Impacts only at a local/neighborhood level.	NA
	Duration or Frequency	Occasional frequency during the life of the 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

8.2.15.3. Description of Environmental Concerns

Worksite Physical Hazards, Hazardous Materials, and Hazardous Waste

The human health and safety concern having the greatest likelihood to occur during FirstNet deployment activities is occupational injury to telecommunication workers. The nature of telecommunication work requires workers to execute job responsibilities that are inherently dangerous. Telecommunication work activities present physical and chemical hazards to workers. The physical hazards have the potential to cause acute injury, long-term disabilities, or in the most extreme incidents, death. Other occupational activities such as handling hazardous materials and hazardous waste often do not result in acute injuries, but may compound over multiple exposures, resulting in increased morbidity. Based on the impact significance criteria presented in Table 8.2.15-1, occupational injury impacts could be potentially significant if the FirstNet deployment locations require performing occupational activities that have the highest relative potential for physical injury and/or chemical exposure. Examples of activities that may present increased risk and higher potential for injury include working from heights (i.e., from towers and roof tops), ground-disturbing activities like trenching and excavating, confined space entry, operating heavy equipment, and the direct handling of hazardous materials and hazardous waste. Predominately, these hazards are limited to occupational workers, but may impact the general public if there are trespassers or if any physical of chemical hazard extends beyond the restricted access of proposed FirstNet work sites. For example, if fuel is spilled from an onsite fuel tank the spilled fuel could migrate down gradient and infiltrate underground drinking water sources. The general public may then be exposed to hazardous chemicals in their drinking water if they utilize the same groundwater aquifer.

To protect occupational workers, the 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, 2016b).

1.) Engineering controls;

2.) Work practice controls;

3.) Administrative controls; and then

4.) Personal protective equipment (PPE).

Engineering controls are often physical barriers that prevent access to a worksite, areas of a worksite, or from idle and operating equipment. Physical barriers take many forms like perimeter fences, trench boxes[144], 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

[144] Trench boxes are 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, 2016b). To the extent practicable, FirstNet partner(s) would likely implement and abide by work practice controls through employee safety training and by developing site-specific health and safety plans (HASP). The HASPs would identify all potential hazardous materials and hazardous wastes, potential physical hazards, and applicable mitigation steps. Other components of a HASP identifying appropriate PPE for each task and the location of nearby medical facilities. Safety Data Sheets (SDS) describing the physical and chemical properties of hazardous materials used during FirstNet deployment and maintenance activities, as well as the physical and health hazards, routes of exposure, and precautions for safe handling and use would be kept and maintained at all FirstNet Proposed Action sites. In addition to HASPs and SDSs, 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, 2016b). Administrative controls may take the form of limiting the number of hours an employee is allowed to work per day, requiring daily safety meetings before starting work, utilizing the buddy system for dangerous tasks, and any other similar activity or process that is designed to identify and mitigate unnecessary exposure to hazards. When engineering controls, work practice controls, and administrative controls are not feasible or do not provide sufficient protection, employers must also provide appropriate PPE to their employees and ensure its proper use. PPE is the common term used to refer to the equipment worn by employees to minimize exposure to chemical and physical hazards. Examples of PPE include gloves, protective footwear, eye protection, protective hearing devices (earplugs, muffs), hard hats, fall protection, respirators, and full body suits. PPE is the last line of defense to prevent occupational injuries and exposure.

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 8.2.15-1, 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 Proposed Action, potential site locations should be screened for known environmental contamination and/or mining activities using federal resources such as the USEPA Cleanups in My Community database and U.S. Department of Interior’s Abandoned Mine Lands inventory, through the MDEP, or through an equivalent commercial resource.

By screening sites for environmental contamination, mining activities, and reported environmental liabilities, the presence of historic contamination and unsafe ground conditions could be evaluated and may influence the site selection process. In general, the lower the density of environmental contamination or mining activities, the more favorable the site will be for FirstNet Proposed Action. If sites containing known environmental contamination (or mine lands) are selected for proposed FirstNet deployment activities it may be necessary to implement additional controls (e.g., engineering, work practice, administrative, and/or PPE) to ensure workers, and the general public, are not unnecessarily exposed to the associated hazards. Additionally, for any proposed FirstNet deployment site, it is possible undocumented environmental contamination is present.

During FirstNet deployment activities, if any soil or groundwater is observed to be stained or emitting an unnatural odor, it may be an indication of environmental contamination. When such instances are encountered, it may be necessary to stop work until the anomaly is further assessed through record reviews or environmental sampling. Proposed FirstNet deployment would attempt to avoid known contaminated sites. However, in the event that FirstNet is unable to avoid a contaminated site, then site analysis and remediation would be required under RCRA, CERCLA, and applicable Michigan 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 NYSDEP 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 8.2.15-1, human health impacts could be significant if FirstNet deployment sites are located in areas that are directly impacted by natural and manmade disasters that could lead to exposure to hazardous wastes, hazardous materials, and occupational hazards. FirstNet's emphasis on public safety-grade communications infrastructure may result in a less than significant beneficial impact, as new infrastructure could be deployed with additional structural hardening, and existing infrastructure may also be hardened as appropriate and feasible, in an effort to reduce the possibility of infrastructure damage or destruction to some degree.

Potential mitigation measures for natural disasters is to be aware of current weather forecasts, forest fire activities, seismic activities, and other news worthy events that may indicate upcoming disaster conditions. Awareness provides time and opportunity to plan evacuation routes, to relocate critical equipment and parts, and to schedule appropriate work activities preceding and after the natural disaster. These mitigation steps reduce the presence of workers and dangerous work activities to reduce the potential for injury or death. Manmade disasters could be more difficult to anticipate due to the unexpected or accidental nature of the disaster. Though some manmade disasters are due to malicious intentions, many manmade disasters result from human error or equipment failure. The incidence of manmade disasters affecting FirstNet deployment sites would be difficult to predict and diminish because the source of such disasters is most likely to originate from sources independent of FirstNet activities. Therefore, FirstNet contractors would develop disaster response plans that outline specific steps employees should take in the event of a natural or manmade disaster.

8.2.15.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

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

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure development 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 could have no impacts on human health and safety because there would be no ground disturbance or heavy equipment used.
- Satellites and Other Technologies
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact human health and safety resources, it is anticipated that this activity would have no impact on those resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to human health and safety as a result of implementation of the Preferred Alternative would encompass a range of impacts that occur as a result of ground disturbance activities, construction activities, equipment upgrade activities, management of hazardous materials and/or hazardous waste, and site selection. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to human health and safety include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber would require the use of heavy equipment and hazardous materials. The additional noise and activity at the site would require workers to demonstrate a high level of situational awareness. Failure to follow OSHA and industry controls could result in injuries. Excavation of soil at proposed sites known to contain environmental contamination has the potential to expose workers to harmful chemicals or releases that could impact the general public in the immediate vicinity. Additionally, some of this work would likely be performed along road ROWs, increasing the potential for vehicle traffic to collide with site workers or equipment. If a proposed deployment activity involves the operation of heavy equipment, managing hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.

- New Build – Aerial Fiber Optic Plant: Installation of new poles and fiber optic lines could require excavation activities, working from heights, use of hazardous materials, and site locations in ROWs. Hazards associated with the site work include injury from heavy equipment, fall hazards, chemical hazards, and the potential for vehicle traffic to collide with site workers or equipment. Excavation of soil at proposed sites known to contain environmental contamination has the potential to expose workers to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.
- Collocation on Existing Aerial Fiber Optic Plant: Installation of overhead fiber optic lines would require work from height. In some instances, new poles would be installed requiring excavation activities with heavy equipment. Hazards associated with the site work include injury from heavy equipment, fall hazards, chemical hazards, and the potential for vehicle traffic to collide with site workers or equipment. Excavation of soil at proposed sites known to contain environmental contamination has the potential to expose workers to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.
- New Build – Submarine Fiber Optic Plant: The installation of fiber optic cables in limited nearshore and inland bodies of water requires workers to operate over aquatic and/or marine environments, which presents opportunities for drowning. When working over water exposure to sun, high or low temperatures, wind, and moisture could impact worker safety. Construction of landings and/or facilities on shore to accept submarine cable would require site preparation, construction, and management of hazardous materials and hazardous waste. Excavation of soils or sediments at proposed sites known to contain environmental contamination may result in workers being exposed to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.
- Installation of Optical Transmission or Centralized Transmission Equipment: Installation of transmission equipment would require site preparation, construction activities, and management of hazardous materials and hazardous waste. Excavation of soils at proposed sites known to contain environmental contamination may result in workers being exposed to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation

lighting, electrical feeds, and concrete foundations and pads) or access roads would require site preparation, construction activities, and management of hazardous materials and hazardous waste. Communication towers would be erected, requiring workers to perform their duties from heights sufficient to result in serious injury or death in the event of falling. Working from heights may also result in additional overhead hazards and falling objects. Excavation of soils at proposed sites known to contain environmental contamination may result in workers being exposed to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.

  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower. This would require workers to perform their duties from heights sufficient to result in serious injury or death in the event of falling not result in impacts to soils. Working from heights may also result in additional overhead hazards and falling objects. Excavation of soils at FirstNet sites known to contain environmental contamination may result in workers being exposed to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.
- Deployable Technologies
  - The use of deployable technologies could result in soil disturbance if land-based deployables are deployed on unpaved areas or if the implementation results in paving of previously unpaved surfaces. The use of heavy machinery presents the possibility for spills and soil and water contamination, and noise emissions could potentially impact human health; and vehicles and heavy equipment present the risk of workplace and road traffic accidents that could result in injury. Set-up of a cellular base station contained in a trailer with a large expandable antenna mast is not expected to result in impacts to human health and safety. However, due to the larger size of the deployable technology, site preparation or trailer stabilization may be required to ensure the self-contained unit is situated safely at the site. Additionally, the presence of a dedicated electrical generator would produce fumes and noise. The possibility of site work and the operation of a dedicated electrical generator have the potential for impacts to human health and safety. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions. Use of aerial vehicles would not involve telecommunication site work. Prior to deployment and when not in use, the aerial vehicles would likely require preventive maintenance. Workers responsible for these activities may handle hazardous materials, not limited to fuel, solvents, and adhesives.
- Satellites and Other Technologies

- Satellite-Enabled Devices and Equipment: The use of portable devices that utilize satellite technology would not impact human health and safety because there is no construction activities or use of hazardous materials. The installation of permanent equipment on existing structures may require workers to operate from heights or in sensitive environments. As a result, the potential for falling, overhead hazards, and falling objects is greater and there is a potential to impact human health and safety.

In general, the abovementioned FirstNet activities could potentially involve site preparation work, construction activities, work in potentially harmful environments (ROWs, work over water and environmental contamination, and mine lands), management of hazardous materials and hazardous waste, and weather exposure. Potential impacts to human health and safety associated with deployment of the Proposed Project could include injury from site preparation and operating heavy equipment, construction activities, falling/overhead hazards/falling objects, and release of hazardous chemicals and hazardous waste. It is anticipated that potential health impacts associated with human exposure to environmental hazardous materials in air, water, or soil, the risk of road traffic, workplace accidents and injuries, noise exposure, and risk of infectious disease transmission would be less than significant due to the small scale of likely FirstNet activities that would be temporary and of short duration. 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, 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. 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.

8.2.15.5. 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. 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 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. 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 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 8.1.15., Human Health and Safety.

MI APPENDIX A – BIOLOGICAL RESOURCES

Table A1. S1 Ranked Terrestrial Communities of Concern in Michigan

Vegetative Community Type	USEPA Ecoregion(s)	Description	Distribution
Alvar	Northern Lakes and Forests	A grass- and sedge-dominated community, with scattered shrubs and sometimes trees. It occurs on broad, flat expanses of calcareous bedrock (limestone and dolostone) covered by a thin veneer of mineral soil.	Alvar is commonly found near the northern Great Lake shorelines in the upper peninsula where flat bedrock pavement is exposed. It is also found along the shoreline of Lake Huron within the Cheboygan Lake Plain.
Cave	Northern Lakes and Forests	All of Michigan's caves occur in karst landscapes, where the dissolution of limestone or dolomite creates an underground drainage system.	There is an extensive karst preserve in Michigan's upper peninsula, which includes a karst drainage system with sinkholes, caves, and streams.
Dry-Mesic Prairie	Eastern Corn Belt Plains and Southern Michigan/Northern Indiana Drift Plains	A native grassland community dominated by big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), and Indian grass (*Sorghastrum nutans*). The community occurs on sandy loam or loamy sand on level to gently sloping sites of glacial outwash, coarse-textured end moraines, and glacial till plain.	Limited to southern Michigan within railroad right-of-ways, which typically border agricultural fields.
Granite Lakeshore Cliff	Northern Lakes and Forests	Consists of vertical or near-vertical exposures of bedrock with sparse coverage of vascular plants, lichens, mosses, and liverworts. The community is characterized by high moisture content due to its proximity to Lake Superior and a stressed and unstable environment because of severe waves, wind, and winter ice.	Occurs in the western Upper Peninsula along Lake Superior.
Hillside Prairie	Northern Lakes and Forests/Eastern Corn Belt Plains and Southern Michigan/Northern Indiana Drift Plains	A grassland or savanna community that occurs on moderate to steep exposed slopes and crests of hills associated with river valleys, streams, or kettle lakes, surrounded by oak forest or oak savanna. This natural community is almost always found on south- to west-facing slopes, where exposure to sunlight is highest.	Found primarily in southern Lower Michigan, where occurrences are concentrated in Kent, Kalamazoo, and Jackson counties. One occurrence is

Vegetative Community Type	USEPA Ecoregion(s)	Description	Distribution
			known in the western Upper Peninsula.
Inland Salt Marsh	Eastern Corn Belt Plains and Southern Michigan/Northern Indiana Drift Plains /Huron and Erie Lake Plains	An herbaceous wetland occurring on mineral soil saturated by sodium- and chloride-laden groundwater from natural brine aquifers. The community is most common along streams or rivers, where glacial drift is thin enough to permit brine from deep saline aquifers to remain concentrated and emerge at discrete points.	The only known, intact salt marshes occur along the Maple River in northern Clinton County. Other occurrences are in Kent, Ionia, Saginaw, Midland, St. Clair, Macomb, Oakland, Wayne, Monroe, and Washtenaw counties.
Lakeplain Oak Openings	Huron and Erie Lake Plains/ Southern Michigan/Northern Indiana Drift Plains	A fire-dependent savanna community, dominated by oaks and characterized by a graminoid-dominated (herbaceous plant) ground layer of species associated with both lakeplain and prairie and forest communities.	Occurs within the southern Lower Peninsula on glacial lakeplains and sand ridges, level sandplains, or adjacent depressions.
Lakeplain Wet Prairie	Huron and Erie Lake Plains/ Southern Michigan/Northern Indiana Drift Plains	A species-rich prairie community that occurs on the seasonally wet ground of glacial lakeplains in the southern Great Lakes region.	Occurs along the shoreline of Lake Huron in Saginaw Bay, within the St. Clair River Delta and near Lake Erie.
Lakeplain Wet-mesic Prairie	Huron and Erie Lake Plains/ Southern Michigan/Northern Indiana Drift Plains	A species-rich, lowland prairie community that occurs on moist, level, seasonally inundated glacial lakeplains of the Great Lakes.	The community is most commonly associated with inland portions of lakeplains, but is also found along low beach ridges near the Saginaw Bay shoreline.
Limestone Lakeshore Cliff	Northern Lakes and Forests	Vertical or near-vertical exposures of bedrock, which typically support less than 25% vascular plant coverage, although some rock surfaces can be covered with lichens, mosses, and liverworts.	Occurs in the Upper Peninsula along the shorelines of Lake Michigan and Lake Huron. Also extends west to the Door Peninsula of Wisconsin and farther east to the

Vegetative Community Type	USEPA Ecoregion(s)	Description	Distribution
			Bruce Peninsula of northern Lake Huron and Georgian Bay and on into northern Lake Ontario.
Mesic Prairie	Southern Michigan/Northern Indiana Drift Plains	Native grassland community dominated by big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), and Indian grass (*Sorghastrum nutans*). The community occurs on sandy loam or loamy sand on level to gently sloping sites of glacial outwash.	Occurs almost exclusively on glacial outwash on nearly level to slightly undulating sites. Today, the community is restricted to railroad right-of-ways, cemeteries, and other small remnants that typically border agricultural fields.
Mesic Sand Prairie	Southern Michigan and Northern Indiana Drift Plains/ Huron and Erie Lake Plains/Northern Lakes and Forests/Eastern Corn Belt Plains	A native grassland community occurring on sandy loam, loamy sand, or sand soils on nearly level glacial outwash plains and lakeplains in both the northern and southern Lower Peninsula. Sites experience fluctuating water tables, with relatively high water tables occurring in the spring followed by drought conditions in the late summer and fall.	Occurs in shallow depressions within glacial plains and lakeplains that are located in western and southeastern Michigan.
Northern Bald	Northern Lakes and Forests	A low shrub and herbaceous community with scattered flagged trees and trees distorted into a krummholz growth form by branch breakage due to heavy snow, thick ice, and extreme winds off Lake Superior.	The community occurs on Isle Royale and extends to the northeastern tip of the Keweenaw Peninsula to the southwest into Houghton, Ontonagon, and Gogebic counties.
Oak Barrens	Southern Michigan and Northern Indiana Drift Plains/ Huron and Erie Lake Plains/ Eastern Corn Belt Plains	A fire-dependent savanna natural community dominated by oaks having between 5 and 60% canopy, with or without a shrub layer. Black oak (*Quercus velutina*) and white oak (*Quercus alba*) typically dominate the scattered overstory.	Found on droughty soils that occur on nearly level to slightly undulating glacial outwash in southern Lower Michigan.
Oak Openings	Southern Michigan and Northern Indiana Drift	A fire-dependent savanna dominated by oaks, having between 10 and 60% canopy, with or without a shrub layer. They historically	This natural community has been nearly

Vegetative Community Type	USEPA Ecoregion(s)	Description	Distribution
	Plains/ Northern Lakes and Forests/Eastern Corn Belt Plains	occurred in the southern Lower Peninsula primarily on level to rolling topography of glacial outwash plains and coarse-textured end moraines and occasionally on steep slopes of with ice-contact features.	extirpated from Michigan; only one small example remains.
Volcanic Lakeshore Cliff	Northern Lakes and Forests	This community consists of vertical or near-vertical exposures of bedrock, which support less than 25% vascular plant coverage, although lichens, mosses, and liverworts are abundant on some rock surfaces.	Occurs on Lake Superior along the Keweenaw Bay shoreline of the Keweenaw Peninsula and along the northern shoreline of Isle Royale.
Wet Prairie	Southern Michigan and Northern Indiana Drift Plains/ Eastern Corn Belt Plains/Huron/Erie Lake Plains	Wet prairie is a native lowland grassland. It occurs on level, saturated and seasonally inundated stream and river floodplains, lake margins, and isolated depressions in southern Lower Michigan. It is typically found on outwash plains and channels near moraines.	Occurs in southern Michigan.
Wet-mesic Prairie	Southern Michigan and Northern Indiana Drift Plains/ Eastern Corn Belt Plains/Huron/Erie Lake Plains	A native lowland grassland prairie that occurs on outwash plains and channels, typically near coarse-textured moraines, within stream or river floodplains, isolated depressions, and along lake margins.	Occurs in inundated stream and river floodplains, lake margins, and isolated depressions in southern Lower Michigan.

Sources: (Kost et al. 2010).

Note: Natural community descriptions for “Lake – Deep, Soft, Drainage” and “Lake – Meromictic” were not available.

% = percent, in. = inches, ft. = feet

ACRONYMS

Acronym	Definition
AACS	Annual Admin Code Supplement
AAR	Alpena-Amberley Ridge
AARC	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
APCO	Association of Public Safety Communications Officials
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
ATSDR	Agency For Toxic Substances and Disease Registry
BGEPA	Bald and Golden Eagle Protection Act
BLS	Bureau of Labor Statistics
CAA	Clean Air Act
CCR	Consumer Confidence Reports
CEQ	Council On Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFOI	Census of Fatal Occupational Injuries
CGP	Construction General Permit
CH4	Methane
CIMC	Cleanups In My Community
CIO	Chief Information Officer
CO2	Carbon Dioxide
COLT	Cell on Light Truck
COW	Cell on Wheels
CRS	Community Rating System
CWA	Clean Water Act
DEH	Division of Environmental Health
DEQ	Department of Environmental Quality
DET	Detroit Metropolitan Airport
DHHS	Department of Health and Human Services
DNR	Department of Natural Resources
DNREC	Department of Natural Resources and Environmental Control
DOE	Department of Energy
DRECP	Desert Renewable Energy Conservation Plan
DTW	Detroit Metropolitan Wayne County Airport
EFH	Essential Fish Habitat
EIA	Energy Information Agency
EJSCREEN	Environmental Justice Screening and Mapping Tool
EMS	Emergency Medical Services
EO	Executive Order
EPCRA	Emergency Planning and Community Right to Know Act
ESA	Endangered Species Act
FAA	Federal Aviation Administration

Acronym	Definition
FAQ	Frequently Asked Questions
FAR	Federal Aviation Regulations
FCC	Federal Communication Commission
FDMA	Frequency-Division Multiple Access
FEA	Final Environmental Assessment
FEMA	Federal Emergency Management Agency
FGDC	Federal Geographic Data Committee
FHA	Federal Housing Administration
FHWA	Federal Highway Administration
FIPS	Federal Information Processing Standard
FL	Flight Level
FLM	Federal Land Manager
FR	Federal Register
FRA	Federal Railroad Administration
FSDO	Flight Standards District Offices
FSS	Flight Service Station
FTA	Federal Transit Authority
GADNR	Georgia Department of Natural Resources
GAO	Government Accountability Office
GAP	Gap Analysis Program
GHG	Greenhouse Gas
GNIS	Geographic Names Information System
GRR	Gerald R. Ford International Airport
HAP	Hazardous Air Pollutants
HASP	Health and Safety Plans
HAZMAT	Hazardous Material
HHRA	Human Health Risk Assessment
IBA	International Birding Area
ICIS	Integrated Compliance Information System
IEEE	Institute of Electrical and Electronics Engineers
IFR	Instrument Flight Rules
IPCC	Intergovernmental Panel On Climate Change
ITU	International Telecommunication Union
ITU-T	International Telecommunication Union Standardization Sector
LBS	Locations-Based Services
LCCS	Land Cover Classification System
LID	Low Impact Development
LMR	Land Mobile Radio
LRR	Land Resource Region
LTE	Long Term Evolution
MBTA	Migratory Bird Treaty Act
MCL	Michigan Compiled Laws
MCSWA	Michigan Committee on Severe Weather Awareness
MDARD	Michigan Department of Agriculture & Rural Development
MDEP	Michigan Department of Environmental Protection
MDEQ	Michigan Department of Environmental Quality
MDNR	Michigan Department of Natural Resources
MDOT	Michigan Department of Transportation
MHI	Median Household Income
MI	Michigan
MIHHS	Michigan Department of Health & Human Services
MILARA	Michigan Department of Licensing and Regulatory Affairs

Acronym	Definition
MIOSHA	Michigan Occupational Safety and Health Administration
MIPC	Michigan Invasive Plant Council
MLRA	Major Land Resource Areas
MMPA	Marine Mammal Protection Act
MMT	Million Metric Tons
MNFI	Michigan Natural Features Inventory
MOA	Memorandum of Agreement
MPSC	Michigan Public Service Commission
MPSCS	Michigan Public Safety Communications System
MPUC	Michigan Public Utility Commission
MR2	Michigan Register
MRBIS	Michigan Recreation Boating Information System
MSFCMA	Magnuson Stevens Fishery Conservation and Management Act
MSL	Mean Sea Level
MSUE	Michigan State University Extension
MYA	Million Years Ago
N2O	Nitrous Oxide
NA	Not Applicable
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NAICS	North American Industry Classification System
NAS	National Airspace System
NAS	National Audubon Society
NASAO	National Association of State Aviation Officials
NCED	National Conservation Easement Database
NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program
NHA	National Heritage Area
NHL	National Historic Landmarks
NHPA	National Historic Preservation Act
NIST	National Institute of Standards and Technology
NM	Nautical Miles
NNL	National Natural Landmarks
NO2	Nitrogen Dioxide
NOAA	National Oceanic and Atmospheric Administration
NOC	Notice of Coverage
NOTAM	Notices To Airmen
NOX	Oxides of Nitrogen
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NPS	National Park Service
NPSBN	Nationwide Public Safety Broadband Network
NRC	National Response Center
NRCS	Natural Resources Conservation Service
NREPA	Natural Resources and Environmental Protection Act
NRHP	National Register of Historic Places
NSA	National Security Areas
NSF	National Science Foundation
NTFI	National Task Force On Interoperability
NTIA	National Telecommunications and Information Administration
NWHC	National Wildlife Health Center
NWI	National Wetlands Inventory

Acronym	Definition
NWR	National Wildlife Refuges
NWS	National Weather Service
NWSR	National Wild and Scenic Rivers
OBS	Office of Biological Services
OE/AAA	Obstruction Evaluation and Airport Airspace Analysis
OSH	Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
OSMRE	Office of Surface Mining Reclamation and Enforcement
OTR	Ozone Transport Region
OWMRP	Office of Waste Management and Radiological Protection
PAB	Palustrine Aquatic Bed
PBC	Polychlorinated Biphenyl
PCS	Permit Compliance System
PEIS	Programmatic Environmental Impact Statement
PEM	Palustrine Emergent Wetland
PFO	Palustrine Forested Wetland
PGA	Peak Ground Acceleration
PM	Atmospheric Particulate Matter
PNAS	Proceedings of the National Academy of Science
POP	Points of Presence
PPE	Personal Protective Equipment
PSAP	Public Safety Answering Points
PSC	Public Safety Communications
PSCR	Public Safety Communications Research
PSD	Prevention of Significant Deterioration
PSS	Palustrine Scrub-Shrub Wetland
PUB	Palustrine Unconsolidated Bottom
R&D	Research and Development
RCRA	Resource Conservation and Recovery Act
RF	Radio Frequency
RMP	Resource Management Plan
ROV	Remotely Operated Vehicles
ROW	Right-of-Way
SAA	Sense and Avoid
SAIPE	Small Area Income and Poverty Estimates
SASP	State Aviation System Plan
SCEC	State Climate Extremes Committee
SDS	Safety Data Sheets
SDWA	Safe Drinking Water Act
SESC	Soil Erosion and Sedimentation Control
SF6	Sulfur Hexafluoride
SGCN	Species of Greatest Conservation Need
SHPO	State Historic Preservation Office
SIP	State Implementation Plan
SLTC	Salt Lake Technical Center
SO2	Sulfur Dioxide
SOC	Standard Occupational Classification
SOP	Standard Operating Procedures
SOW	System On Wheels
SOX	Oxides of Sulfur
SPL	Sound Pressure Level
STATSGO2	Digital General Soil Map of the United States

Acronym	Definition
SUA	Special Use Airspace
SWPPP	Stormwater Pollution Prevention Plan
SWS	Solid Waste Services
TDMA	Time Division Multiple Access
TEP	Threatened, Endangered, and Proposed
TFR	Temporary Flight Restriction
THPO	Tribal Historic Preservation Officers
TMDL	Total Maximum Daily Load
TOXMAP	TRI Map Data
TPY	Tons Per Year
TRI	Toxics Release Inventory
TSCA	Toxic Substances Control Act
TWA	Time Weighted Average
UA	Unmanned Aircraft
UACE	Urban Area Census Code
UAS	Unmanned Aircraft Systems
UHF	Ultra High Frequency
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USDOI	U.S. Department of Interior
USDOT	U.S. Department of Transportation
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGCRP	U.S. Global Change Research Program
USGS	U.S. Geological Survey
USS	U.S. Ship
UVA	University of Virginia
VFR	Visual Flight Rules
VHF	Very High Frequency
VOC	Volatile Organic Compounds
WAP	Wildlife Action Plan
WBD	Watershed Boundary Dataset
WCS	Wetlands Classification Standard
WLD	Wildlife Division
WNS	White-Nose Syndrome
WONDER	Wide-Ranging Online Data For Epidemiologic Research
WWI	World War I
WWII	World War II
XSIC	Xerces Society for Invertebrate Conservation

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The citations in this Draft PEIS reflect the most recent information on the referenced site at the time the document was written. If the site was updated after that point, the more recent information will be incorporated into the final document, as feasible.

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